

Article

AI-Assisted Interactive Storytelling for Education: A Healthy Building Case

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Abstract

Higher education increasingly addresses topics that are complex, interdisciplinary, and context-dependent, creating challenges for traditional lecture-based instruction. This study explores the potential of AI-assisted interactive storytelling as a pedagogical approach for such learning contexts, using healthy buildings as an instructional case relevant to architecture, engineering, and construction (AEC) education. Grounded in constructivist learning theory, a set of interactive stories was developed using generative AI and implemented in Twine to create a decision-based learning experience. The intervention was tested in a class using a pretest–posttest design along with a student perception survey. The results showed a significant improvement in knowledge following the intervention. Student feedback was also positive across all measured dimensions, including perceived learning, cognitive engagement, emotional engagement, motivation to learn, and comparison with traditional lectures. These findings suggest that interactive storytelling can support both learning and engagement when teaching complex, multidimensional topics. This study further indicates that generative AI can serve as a practical development partner by reducing the time and technical effort required to create interactive educational materials. Overall, this paper contributes to higher education research by positioning and demonstrating AI-assisted interactive storytelling as a promising instructional approach for complex learning areas.

Keywords: constructivist learning; interactive storytelling; artificial intelligence; higher education; AEC; healthy buildings



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1. Introduction

Higher education increasingly demands that students develop not just familiarity with disciplinary content but the capacity to reason across domains, apply knowledge in context, and navigate complex, value-laden problems. Traditional lecture-based instruction, while efficient for content delivery, is widely recognized as limited in supporting these deeper learning outcomes. Research consistently shows that active, constructivist approaches—in which learners engage with authentic problems, make meaningful decisions, and construct understanding through participation—produce stronger motivation, deeper learning, and more transferable knowledge than passive content transmission (Deslauriers et al., 2019; Freeman et al., 2014; Rovai, 2004). Among the pedagogical modes that operationalize these principles, interactive storytelling has attracted growing interest for its capacity to place learners inside realistic, branching scenarios where knowledge must be applied, choices

carry consequences, and meaning is built through experience rather than observation alone (Bagley et al., 2025; Wu & Chen, 2020).

Translating this potential into practice has historically been constrained by the time and technical expertise required to develop pedagogically coherent interactive narratives. Platforms such as Twine, a widely used tool for nonlinear, branching storytelling, demand familiarity with passage logic, conditional structures, and markup conventions that many educators lack or cannot easily afford to develop. The emergence of large language models such as ChatGPT and Claude offers a meaningful response to this barrier, enabling educators to generate narrative content and platform-compatible code with a substantially reduced development burden while retaining full responsibility for pedagogical alignment, accuracy, and design intent (Korzynski et al., 2023; Sommer et al., 2024).

This paper reports on the design, implementation, and evaluation of an AI-assisted interactive storytelling experience developed for a higher education course using healthy buildings in architectural studies as a case study using the framework developed by Shafique (2026). ChatGPT was used to generate both the narrative content and the Twine-compatible code, which was then directly deployed as a classroom learning activity. A pre- and post-test design assessed knowledge gains, and a perception-based survey captured students' experiences of this mode of learning. Together, these instruments address not only whether students learned more but also how they experienced the learning, a distinction central to understanding the broader promise of AI-assisted interactive storytelling as a constructivist pedagogical tool in higher education.

2. Literature Review

2.1. Limitations of Traditional Classroom Learning

Traditional classroom learning in higher education has long been dominated by lectures, content transmission, and individual recall. While this model can efficiently deliver large volumes of information, research consistently shows it falls short when learning demands active reasoning, practical application, and conceptual integration. A large-scale meta-analysis in STEM higher education found that active learning produced better examination performance and lower failure rates than traditional lecturing, prompting its authors to question whether lecture-only instruction should remain the default mode of teaching. Complementary research has shown that students in active learning environments often acquire more knowledge even when they feel they are learning less, suggesting that conventional lecture formats can privilege familiarity and surface fluency over deeper knowledge construction. Together, these findings indicate that one-way content delivery is fundamentally limited when the educational goal extends beyond information exposure to meaningful understanding and transferable skill (Deslauriers et al., 2019; Freeman et al., 2014).

These limitations become especially pronounced when higher education addresses topics that are interdisciplinary, value-laden, and context-dependent. Sustainability and wellbeing exemplify this challenge, as they require students to reason not within a single discipline but across technical, environmental, social, ethical, and human-centered dimensions simultaneously. Research in architecture and engineering education has shown that students frequently struggle to develop integrated understandings of sustainability when instruction remains fragmented or narrowly discipline-bound, with similar concerns raised about the capacity of conventional teaching to cultivate integrative thinking and values-oriented reasoning (Boarin et al., 2020; Gutierrez-Bucheli et al., 2022; Shafique et al., 2024). A comparable challenge arises in teaching health and wellbeing in the built environment, where students must understand how design decisions shape physical, mental, and social outcomes across multiple scales and perspectives (Patil et al., 2026). In such contexts, traditional classroom instruction may succeed in introducing concepts, but it frequently fails to

help students connect those concepts to real situations, navigate ambiguity, or appreciate the interdependencies among competing priorities.

2.2. Constructivism in Education

Constructivism has its roots in Jean Piaget's (1896–1980) theory of cognitive development and views learning as an active process in which students build understanding by connecting new knowledge to prior experience, engaging with authentic problems, reflecting on meaning, and interacting with others (Piaget, 1972). Rather than treating learners as passive recipients of information, this perspective shifts attention toward the design of learning environments that support inquiry, collaboration, reflection, and application. Within this framework, the teacher's role shifts accordingly from dispenser of fixed knowledge to facilitator who structures tasks, dialog, and feedback so that learners can actively make sense of ideas within meaningful contexts (Rovai, 2004; Vespone, 2023).

This reorientation has several important implications for higher education practice. Rather than centering lectures, recall, and one-way delivery, constructivist teaching emphasizes student engagement with problems, peers, and real or realistic tasks (Rovai, 2004). Empirical research has linked constructivist learning environments in higher education with stronger motivation, improved learning strategies, and deeper approaches to learning. For instance, a constructivist redesign of a higher education project management course was associated with gains in both intrinsic and extrinsic motivation alongside improved learning strategies (Do et al., 2023), while research on co-constructed learning in undergraduate settings found benefits for engagement, skill development, meaning-making, and students' sense of purpose (Vespone, 2023). Earlier scholarship on online college learning similarly argued that effective constructivist design depends on reflection, interaction, authentic activities, and timely, varied assessment rather than content delivery alone (Rovai, 2004). Related work has further connected constructivist environments with deeper approaches to learning and stronger alignment between learning processes and assessment outcomes (Gijbels et al., 2005).

Constructivist principles are most visibly realized through the pedagogical modes they inform. Problem-based learning is among the clearest examples, requiring students to draw on prior knowledge, engage with authentic problems, collaborate with peers, and learn through guided inquiry (Hendry et al., 1999). Project-based and workshop-based models similarly reflect these principles by placing active responsibility for investigation and solution development in students' hands (Do et al., 2023). Digital and online learning environments can also be constructivist in character when designed around interaction, reflection, and authentic tasks rather than passive content consumption (Rovai, 2004). Within this broader family of approaches, storytelling and digital storytelling have been connected to constructivist and social constructivist thinking because they support meaning-making, help learners connect academic content with lived experience, and encourage more active engagement with knowledge (Abderrahim & Gutiérrez-Colón Plana, 2021). Research on digital storytelling has further associated it with stronger engagement, motivation, skill development, higher-order thinking, and more authentic connections between students' experiences and course content (Karantalis & Koukopoulos, 2022), suggesting that interactive storytelling may represent a particularly promising extension of constructivist pedagogy in higher education.

2.3. Interactive Storytelling in Education

Interactive storytelling is a form of narrative-based learning in which learners do not passively follow a fixed story but actively shape its direction, progression, or outcome through choices and decisions. Unlike linear storytelling, it places learners inside unfold-

ing scenarios, enabling them to explore consequences, apply knowledge, and construct meaning through participation rather than observation alone. In higher education, this makes interactive storytelling particularly well suited to topics that demand judgment, contextual reasoning, and the application of ideas in evolving situations rather than the simple recall of facts (Bagley et al., 2025).

Its effectiveness appears to stem from the way it integrates several characteristics associated with student-centered learning: narrative coherence, immersion, reflection, application, and learner agency. Baldwin and Ching (2017) argue that interactive storytelling offers meaningful opportunities for online course design precisely because it enables learners to engage actively with content through decision-making, exploration, and narrative progression rather than passive reception. A systematic review of educational digital storytelling found benefits spanning cognitive, affective, conceptual, social, and academic domains, suggesting that narrative-based digital learning can simultaneously support engagement and deeper learning processes (Wu & Chen, 2020). More recent work in higher education and professional contexts has reinforced this picture, indicating that interactive storytelling helps learners apply knowledge, skills, and behaviors in realistic settings while also supporting meaning-making and a stronger sense of connection to the learning experience (Bagley et al., 2025).

Several tools are available to educators for developing interactive stories. Among these, Twine stands out as a widely used open-source platform for creating nonlinear, branching narratives. Its appeal for educational use lies in its relative accessibility: built on an HTML-based structure, Twine allows educators to construct branching, node-based narratives with conditional logic and multimedia elements without requiring advanced programming experience. Its application across fields including literature, ethics, history, health sciences, and forensic science suggests that it can effectively support decision-making, reflective learning, and scenario-based exploration in a range of educational settings (Morningstar-Kywi & Kim, 2021; Terry & Dusenberry, 2018; Thompson, 2020).

Despite these advantages, developing narratives that are pedagogically coherent and translating them into Twine-compatible structures remains a demanding and time-intensive process for educators. This is where generative AI becomes particularly relevant. Large language models such as ChatGPT and Claude are already used to generate narratives (Sommer et al., 2024) and structured code (Korzynski et al., 2023), and they can assist with drafting Twine-compatible passage text, branching options, variable logic, conditional structures, and even twee-style scaffolds. Crucially, generative AI in this context does not replace instructional design; rather, it reduces the time and technical burden involved in prototyping interactive stories. Educators retain full responsibility for the accuracy, coherence, and pedagogical alignment of the final learning experience.

Shafique (2026) developed a framework to create twine-based interactive stories for education using generative AI tools such as ChatGPT. This framework guides educators through a five-stage process. Educators begin by crafting structured prompts that direct an LLM to generate story content—dialog, settings, and decisions—formatted as Twine-ready code. That code is then imported into Twine to build a branching narrative, either passage by passage or as a complete .twee file. Educators can further refine the story to meet specific learning goals before students engage with the final product in a nonlinear, immersive environment where their choices shape the experience. This study expands on this framework by creating research-based prompts for ChatGPT to develop an interactive story-based lecture and test it empirically in a classroom.

3. Materials and Methods

The objectives of this study were twofold: (i) to create an interactive story (or set of narratives) for higher education focused on healthy buildings and (ii) to test these narratives with a class of undergraduate students to evaluate their effectiveness in promoting knowledge gain, motivation, and engagement. The following subsections describe in detail the methods used to achieve these objectives.

3.1. Study Context and Participants

This study was designed for a “Fundamentals of Environmental Design” class offered in spring of 2026 at a large midwestern public university. Total class enrollment was 125, and all students were freshmen with architecture or interior design majors. First-year students constitute a meaningful population for this study as they are early in their design education and represent a baseline before disciplinary habits are formed. The researchers decided to create a lecture on the topic of healthy buildings in the interactive story mode, as the researchers found this topic to be interesting, complex and new to the students.

3.2. Development of Interactive Stories

The development of the interactive stories involved three interconnected phases: defining the pedagogical content scope, designing the narrative structure, and using ChatGPT version 5.5 to generate both the story content and the technical implementation in Twine 2.10.0. Each phase required deliberate human judgment and iterative refinement, with generative AI functioning as a production tool rather than a design authority.

3.2.1. Content Scope and Learning Objectives

The content scope was organized around the ten core concept areas that define the healthy building framework ([International WELL Building Institute, 2020](#)): Air, Water, Nourishment, Light, Movement, Thermal Comfort, Sound, Materials, Mind, and Community. Each concept area was assigned a set of three learning objectives, designed to be appropriate for first-year architecture students with no prior specialized knowledge of building health. Across all ten concepts, the objectives followed a consistent structure: first, explaining why the concept matters for occupant health and wellbeing; second, identifying the key factors, sources, or conditions involved; and third, describing basic strategies that buildings and designers can employ in response. For example, the objectives for Air asked students to explain why indoor air quality affects health and performance, identify common indoor air pollutants and their sources, and describe strategies such as ventilation, filtration, and source control. This structure ensured that each story was anchored to specific, verifiable learning outcomes rather than general familiarity with a topic. The complete list of learning objectives is provided in [Appendix A](#).

3.2.2. Narrative Structure and Design Logic

Each WELL concept area was developed as a self-contained micro-story, resulting in a set of ten stories compiled within a single Twine project titled Healthy Buildings: 10 Micro-Stories. Students accessed the content through a central hub passage that allowed them to select any concept story in any order. This hub-and-spoke architecture provided learners with autonomy over sequence while preserving the expectation that all ten concepts would be completed by the end of the activity.

All micro-stories followed a shared internal structure to ensure consistency of cognitive load and navigational clarity. Each story opened with a brief scenario situated in a familiar architectural setting appropriate for first-year students. Scenarios were intentionally grounded in plausible campus or workplace contexts to support transfer from narrative

decisions to real-world building conditions. The ten settings included an architecture studio with laser-cutting residue and limited ventilation (Air), a clinic where a hydration station produced metallic-tasting water (Water), a campus café redesigned to encourage healthier choices (Nourishment), a library associated with glare, headaches, and drowsy zones (Light), a tall building where elevators were routinely used for short trips (Movement), a lecture hall with persistent hot/cold zones (Thermal Comfort), a makerspace combining loud tools with concentration-heavy tasks (Sound), a freshly renovated office associated with odor and irritation complaints (Materials), a bright and crowded campus service lobby described as disorienting (Mind), and a shared commons perceived by some students as unwelcoming or confusing (Community).

Following the introductory scenario, each micro-story presented three sequential decision points. At each decision point, students selected from two or three response options representing building-relevant actions (design, operations, or occupant behavior). Each choice immediately led to a short consequence passage that explained the outcome in accessible terms and then advanced the learner to the next decision. The third decision led to one of two outcomes: a “healthy building outcome” reflecting effective conceptual reasoning, or an “unintended consequence outcome” reflecting less-informed choices and a deteriorating situation. Students who reached an unintended outcome were offered a “try again” option, allowing them to reattempt the story and explore alternative pathways. Every story concluded with a debrief passage (“What you should remember”) that summarized the core principle(s), strategies, and key takeaways, functioning as explicit consolidation of the learning objectives embedded in the narrative.

This consequence-bearing branching logic was central to the instructional design. Rather than presenting information as static exposition, the stories were structured to make decision quality visible: more appropriate choices produced improved outcomes, while weaker choices generated plausible negative consequences that illustrated why each concept matters in practice. The debrief passage then bridged experiential learning and conceptual understanding by making the underlying principle explicit and reinforcing what should transfer to future design and building-operations decisions.

3.2.3. AI-Assisted Content Generation Using ChatGPT

After finalizing the pedagogical and narrative framework for the ten micro-stories, the authors used ChatGPT to generate the complete interactive story content and Twine-ready code in a single step. The prompt positioned the model as an instructor in an AEC program and required the generation of multi-level interactive stories aligned with the ten WELL v2 concept areas (Air, Water, Nourishment, Light, Movement, Thermal Comfort, Sound, Materials, Mind, Community), targeted to undergraduate freshmen in an “Introduction to healthy buildings” module. The prompt used is pasted in Appendix B.

To ensure pedagogical alignment and consistency across all concept stories, the prompt explicitly specified (a) concept-specific learning objectives, (b) 3–4 decision points per story, (c) consequence-based feedback and at least two endings (healthy outcome and unintended consequence), (d) a “try again” loop after unintended outcomes, (e) a short “What you should remember” debrief, and (f) simple state tracking with at least two variables whose values changed based on learner choices. The prompt also constrained tone (engaging, realistic, beginner-friendly), required one setting per concept story, and avoided region-specific code compliance and medical/legal advice.

This “direct-to-code” prompting approach was intentionally selected to maximize reproducibility and usability for educators: instead of requiring manual reformatting or separate scripting, the model was instructed to output complete Twine (Harlowe) code

for each passage, ready to paste into Twine with clear and unique passage names. The prompts used for generation are provided in Appendix A to support replication.

3.2.4. Code Generation and Twine Implementation

All ChatGPT-generated outputs, including both the narrative text and the Twine-compatible code, were reviewed by a healthy buildings expert to ensure factual accuracy, conceptual appropriateness, and alignment with the intended learning objectives. The review process evaluated: (1) factual appropriateness at an introductory level; (2) whether decision options were meaningfully differentiated and plausible within the scenario context; (3) whether consequence passages clearly communicated the underlying concept; (4) whether the debrief aligned with the stated learning objectives; and (5) whether Twine link structure and variable updates produced the intended branching behavior.

Following review, the generated Harlowe code was inserted into Twine with minimal manual adjustment. Minor edits were limited to correcting occasional link errors, aligning passage naming conventions, and resolving formatting inconsistencies. The final deliverable comprised a hub-and-spoke Twine structure containing ten self-contained concept stories within one Twine file, allowing students to select concept stories in any order while maintaining full coverage across the module. The stories developed were hosted via the free hosting website borogove.io. They can be accessed via the following link: <https://jfkfsnzp.play.borogove.io/> (accessed on 10 May 2026).

3.3. Evaluation Study Design

This study employed a single-group pre- and post-test design combined with a perception-based survey, conducted within a real classroom setting. This research aimed to address two complementary questions: first, whether engagement with AI-assisted interactive storytelling produced a measurable gain in student knowledge of healthy building concepts, and second, how first-year architecture students experienced and perceived this mode of learning.

3.3.1. Intervention

The intervention consisted of a single in-class session in which students engaged independently with the Twine-based interactive storytelling experience. Students accessed the stories through a web browser, navigating the ten micro-stories at their own pace within the allocated class time. No supplementary lecture, reading, or instructional framing was provided before the activity beyond the instructions embedded in the Start passage of the Twine file itself, which oriented students to the decision-based format and submission expectations. Students were not required to complete all ten stories in a fixed order; the hub structure of the Twine file allowed them to choose their own sequence. However, completion of all ten stories was expected by the end of the session.

3.3.2. Tool Development

Knowledge gain was assessed using a pre- and post-test consisting of ten multiple-choice questions, with one question aligned with each WELL concept. Each item included four response options, of which only one was correct (please refer to Appendix D). To evaluate student perceptions of the interactive story as an instructional modality, we developed a feedback survey instrument informed by the prior literature (Yang & Wu, 2012; Sadik, 2008; Li et al., 2024) and organized around five dimensions: perceived learning, cognitive engagement, emotional engagement, motivation to learn, and comparison with a standard lecture format. A Likert scale-based instrument used three items for each dimension, making a total of 15 items. The Likert scale options included -2 = Strongly Disagree, -1 = Disagree, 0 = Neutral, 1 = Agree, and 2 = Strongly Agree (refer to Appendix E).

3.3.3. Ethical Considerations

This study was approved by the Institutional Review Board of the University of Missouri (Project No. 2133314; approved on 3 February 2026). Participation was voluntary, and only students aged 18 years or older were eligible to participate. Before data collection, students were provided with an informed consent statement describing the purpose of the study, the procedures involved, the approximate time required, the voluntary nature of participation, and contact information for both the research team and the Institutional Review Board. No personal identifiers were collected, and all responses were anonymous. Participation or non-participation had no effect on students' course standing, and students could discontinue participation at any time without penalty. Data were analyzed only in aggregate form.

3.3.4. Data Analysis

Data analysis was conducted using IBM SPSS Statistics version 31.0. For the pre- and post-test data, descriptive statistics and paired-samples *t*-tests were used to examine changes in students' knowledge. For the feedback survey, one-sample *t*-tests were conducted using a test value of 0.

4. Results

4.1. Participant Overview

The total number of enrolled students for the class was 125. On the day of data collection, 110 students attended the class. A total of 90 students filled out the pretest survey. However, since participation was voluntary, only 37 of those students put in the effort to complete the process and fill out the post-test + feedback surveys, making $n = 37$ and a response rate of 33.6%.

4.2. Knowledge Gain

The pre- and post-test results are summarized in Table 1. The results show a significant increase in knowledge for all questions asked.

Table 1. Pre- and post-test results.

Question	Pretest		Post-Test		Test Statistic	<i>p</i> -Value
	Mean	Standard Deviation	Mean	Standard Deviation		
1	0.65	0.484	0.92	0.277	−3.651	<0.001 **
2	0.73	0.450	0.90	0.280	−2.220	0.033 *
3	0.70	0.463	0.95	0.299	−2.991	0.005 **
4	0.71	0.440	0.95	0.229	−2.700	0.010 *
5	0.70	0.460	0.97	0.164	−3.651	<0.001 **
6	0.70	0.463	0.95	0.229	−2.991	0.005 **
7	0.68	0.475	0.94	0.212	−2.935	0.006 **
8	0.73	0.450	0.97	0.164	−2.991	0.005 **
9	0.62	0.492	0.95	0.229	−3.723	<0.001 **
10	0.76	0.435	0.95	0.229	−2.492	0.017 *

** Pre- and post-story differences are significant at a 99% confidence interval. * Pre- and post-story differences are significant at a 95% confidence interval.

4.3. Student Perception of Learning Experience

Since three items were used to define each of the five dimensions or constructs, a reliability check was done using Cronbach's Alpha. All values were above 0.80, which indicated good internal consistency. The results of the reliability test are shown in Table 2.

Table 2. Reliability test results.

Dimension	No. of Items	Cronbach's Alpha
Perceived learning	3	0.886
Cognitive engagement	3	0.824
Emotional engagement	3	0.859
Motivation to learn	3	0.865
Comparison to traditional lecture	3	0.897
Overall scale	15	0.963

The student feedback survey results are summarized in Table 3. As there were three items for each dimension, we took a mean to represent the dimension. The test value was taken as “0”.

Table 3. Feedback survey results.

Dimension	Mean	Standard Deviation	Test Statistic	p-Value
Perceived Learning	1.00	0.899	6.764	<0.001 **
Cognitive Engagement	0.89	0.805	6.737	<0.001 **
Emotional Engagement	1.03	0.944	6.617	<0.001 **
Motivation to Learn	1.00	0.793	7.666	<0.001 **
Comparison to Lecture	1.00	0.892	6.817	<0.001 **

** Difference from test value is significant at a 99% confidence interval.

5. Discussion

The findings of this study suggest that AI-assisted interactive storytelling can function as a meaningful instructional approach in higher education, particularly when learning requires more than the transmission of information. The pretest–post-test gains indicate that students were able to improve their conceptual understanding within a relatively brief instructional intervention, while the perception results show that students responded positively across all measured dimensions rather than merely neutrally. In practical terms, this means the intervention was not only statistically effective but also educationally viable: students learned from it and regarded it as more engaging and useful than conventional lectures. This matters for higher education because many instructional innovations are either enjoyable without strong learning value or effective without being positively experienced by students. The present findings suggest that AI-assisted interactive storytelling may offer both, making it a potentially valuable design option for educators teaching complex, interdisciplinary, and applied topics.

These outcomes align with prior work showing that interactive and narrative-based learning environments can promote meaning-making, application, and stronger engagement than more transmission-oriented models (Bagley et al., 2025; Baldwin & Ching, 2017; Wu & Chen, 2020). Viewed through a constructivist lens, the results suggest that students benefited not only from receiving content but also from encountering it in a form that required participation, interpretation, and contextual reasoning. This distinction matters because constructivism does not merely argue that active learning is more enjoyable; it argues that knowledge is fundamentally built through experience rather than absorbed through exposure (Vygotsky, 1978). The present results lend empirical support to that theoretical position in the specific context of AEC higher education.

The present study also differs from earlier research in several important ways. Prior scholarship on constructivist learning has established the value of active, contextual, and reflective learning environments, but it has not generally focused on AI-assisted interactive narrative formats. Research on digital storytelling has often emphasized linear storytelling

or student-produced stories, while studies on interactive storytelling have more often highlighted pedagogical potential than tested classroom outcomes empirically. In contrast, the current study combines constructivist pedagogy, AI-assisted development, interactive storytelling, and classroom-based evaluation within a higher education setting. It also applies this combination to healthy buildings, a topic characterized by intertwined technical, environmental, and human-centered dimensions. In this respect, this study extends earlier research by moving from theoretical promise to an applied and empirically assessed instructional case.

5.1. Implications for AEC Education

One important implication of these findings concerns AEC education more broadly. Many topics in AEC and related built-environment disciplines are complex because they require students to integrate design, technical systems, environmental conditions, and human experience rather than treat them as isolated domains. Previous studies on interdisciplinary and multidisciplinary AEC education have similarly emphasized that effective learning in these fields depends on students' ability to move across disciplinary boundaries and engage with integrated project realities (Ali, 2019; Badawi & Abdullah, 2021; Oliveira et al., 2022; Wang et al., 2025). The present findings suggest that interactive storytelling may be particularly well suited to this kind of educational challenge because it can place students in situations where knowledge is not merely described but must be interpreted and applied.

This argument connects to a broader critique of traditional lecture-based instruction in professional and technical education. Researchers have argued that didactic, information-transfer models can produce inert knowledge—information that students can recall in isolation but fail to apply in novel or complex situations (Renkl et al., 1996). AEC contexts are especially prone to this risk because professional practice routinely demands the simultaneous consideration of structural, environmental, regulatory, aesthetic, and social factors. Interactive storytelling mitigates the risk of inert knowledge by embedding content within decision-making scenarios, compelling students to exercise judgment rather than passively receive information. In that sense, the significance of this study lies not only in the positive results for one intervention but also in what those results imply for AEC education as a field increasingly defined by multidimensional learning demands.

5.2. Healthy Buildings as a Test Case

The results also help explain why interactive storytelling may be especially useful for complicated topics such as healthy buildings. Unlike traditional lectures, interactive storytelling situates knowledge within a sequence of choices, contexts, and consequences. This is especially valuable for topics that are interdisciplinary, value-laden, and context-dependent because students must do more than remember terminology; they must understand how multiple factors interact in practice. Healthy buildings provided a strong instructional case for this study because the topic inherently combines technical and human-centered considerations, including air, light, thermal comfort, sound, materials, movement, mind, and community (Kokatnur et al., 2025). At the same time, recent scholarship in architectural education has argued that health and wellbeing should be treated as central concerns because design decisions increasingly affect physical, mental, and social outcomes for building users and communities (Patil et al., 2026).

What makes healthy buildings particularly compelling as instructional content is that the field lacks a single authoritative solution to most design problems. Instead, it requires students to weigh competing priorities—energy efficiency against ventilation rates, cost constraints against material health, occupant preferences against environmental standards—in ways that resist algorithmic answers. This kind of wicked problem structure

(Rittel & Webber, 1973) is precisely where narrative and scenario-based instruction can add value because stories are one of the primary cognitive tools humans use to reason about uncertain, value-laden situations (Bruner, 1990; Schank & Abelson, 1995). By embedding healthy building content within an interactive story, this intervention created conditions where students had to reason like practitioners rather than test-takers. The positive outcomes observed here therefore suggest that healthy buildings were not only suitable content for the intervention but also a compelling test case for demonstrating the educational value of interactive storytelling in complex learning domains.

5.3. *The Role of AI as a Development Partner*

Another important contribution of this study concerns the role of AI as a development partner. In this work, generative AI did not function as an autonomous teacher or substitute for pedagogy. Rather, its contribution was in supporting the creation of the interactive learning environment itself. Recent work on generative AI and code generation suggests that such tools can reduce technical barriers, accelerate prototyping, and help nonexpert programmers produce structured digital artifacts more efficiently while still requiring human review for accuracy and quality (Jiang et al., 2026; Peng et al., 2023; Wills et al., 2024). This is particularly relevant for Twine-based educational design. Twine is an open-source platform for creating interactive, nonlinear stories, but developing coherent branching narratives and compatible logic structures can still be demanding for educators (Quail et al., 2023; Twine, n.d.). In this context, AI can help draft passage text, branching options, and logic structures, making interactive storytelling more feasible as an instructional method.

This framing—AI as development partner rather than autonomous agent—is worth elaborating because it aligns with emerging scholarship on human–AI collaboration in educational design. Researchers have cautioned against models in which AI is expected to replace teacher judgment, arguing instead that the most productive role for AI tools in education is augmentative: amplifying educator capacity without displacing pedagogical expertise (Zawacki-Richter et al., 2019; Luckin et al., 2016). The present study illustrates what this augmentative role looks like in practice. The instructional designer retained authorial control over learning objectives, narrative arc, and disciplinary accuracy, while AI assistance reduced the technical labor required to translate that design vision into a functional, branching digital experience. This division of responsibility reflects a broader principle: that the quality of AI-assisted instruction depends less on the sophistication of the AI than on the clarity and expertise of the human directing it. The findings of this study therefore suggest that AI’s pedagogical value lies not in replacing instructional design but in enabling educators to build richer learning experiences with greater efficiency.

5.4. *Engagement, Motivation, and the Affective Dimension*

An aspect of the findings that warrants particular attention is the consistently positive pattern across both cognitive and emotional engagement. Prior research on educational technology has often revealed a tension between what students find motivating and what actually produces learning gains, with some engaging formats yielding high enjoyment but modest knowledge acquisition (Clark, 1994; Mayer, 2019). The present study found that positive affect and measurable learning coexisted, which is theoretically significant. Self-determination theory provides one framework for interpreting this result: when learners experience a sense of autonomy, competence, and relatedness within an instructional environment, intrinsic motivation increases, and intrinsic motivation is more reliably associated with deep processing and durable knowledge than extrinsic pressure (Deci & Ryan, 2000; Ryan & Deci, 2017). The branching, choice-driven structure of interactive storytelling

may produce precisely these conditions—students navigate their own path through the content, encounter consequences of their decisions, and are positioned as agents rather than recipients. Future research should explore whether these affective gains translate into longer-term retention and transfer, questions that the present study's single-session design cannot fully address.

5.5. Limitations and Future Directions

The study has several limitations. The intervention was delivered in a single session with a single cohort, which restricts claims about generalizability across contexts, student populations, and content areas. The absence of a randomized control group means that alternative explanations for learning gains—including novelty effects or demand characteristics—cannot be entirely ruled out. Novelty effects, in particular, are a persistent concern in educational technology research; students may respond positively to any novel format simply because it breaks routine rather than because the format has specific pedagogical advantages (Dillon & Gabbard, 1998). Longitudinal follow-up data would help distinguish durable learning from short-term engagement.

Future work can build on this by testing interactive storytelling in other complex domains, comparing it directly with traditional lecture-based approaches using controlled designs, and examining how narrative complexity, branching structure, and degree of AI assistance influence both immediate and longer-term learning outcomes. Research might also investigate how individual differences—including prior domain knowledge, digital literacy, and learning style preferences—moderate student responses to interactive narrative environments. Finally, as AI tools continue to mature, future studies could examine how iterative, AI-assisted refinement of branching narratives affects instructional coherence and ultimately student achievement, opening a productive line of inquiry into the optimization of human–AI collaboration in educational design.

6. Conclusions

This study examined the potential of AI-assisted interactive storytelling as a pedagogical approach in higher education, using healthy buildings as a case of complex and multidimensional learning. The results showed significant improvement in student knowledge from pretest to post-test, while student feedback was positive across all measured dimensions, including perceived learning, cognitive engagement, emotional engagement, motivation to learn, and comparison with traditional lectures. Together, these findings suggest that interactive storytelling can support both meaningful learning and a more engaging educational experience, particularly for topics that require students to connect technical knowledge with context, consequences, and human experience.

This study also highlights the broader instructional value of combining constructivist pedagogy with AI-supported development. For complex topics, interactive storytelling offers a way to move beyond transmission-based teaching by placing students in realistic, decision-based learning contexts. At the same time, generative AI can help reduce the practical barriers involved in developing such learning materials, making this approach more feasible for educators. Overall, the findings suggest that AI-assisted interactive storytelling is a promising direction for higher education and warrants further study across other disciplines, topics, and learning settings.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in this study using the language presented in Appendix C.

Data Availability Statement: The dataset is available on request from the authors.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Healthy Building Concepts: Learning Objectives

Air

Explain why indoor air quality matters for health, comfort, and performance.

Identify common indoor air pollutants and their typical sources (e.g., particles, VOCs, combustion byproducts).

Describe basic strategies to improve air quality (ventilation, filtration, source control, maintenance).

Water

Explain why water quality affects health in buildings.

Identify basic water quality concerns (microbial risk, chemicals/metals, taste/odor) at a high level.

Describe common points where water quality can degrade in a building (storage, stagnation, fixtures).

Nourishment

Explain how food environments influence choices and long-term health.

Identify factors that shape eating behavior in buildings (availability, placement, pricing, time).

Describe basic strategies to encourage healthier choices without being overly prescriptive.

Light

Explain how light affects vision, comfort, mood, and daily rhythms.

Distinguish between daylight and electric light, and list pros/cons of each.

Identify common lighting quality issues (glare, flicker, uneven lighting, poor color rendering) conceptually.

Movement

Explain why buildings can either support or discourage physical activity.

Identify everyday “movement opportunities” in buildings (stairs, walking routes, active workstations).

Describe basic design/operational strategies that nudge more movement (layout, prompts, amenities).

Thermal Comfort

Explain what thermal comfort is and why it varies among people.

Identify key factors that affect comfort (air temperature, humidity, air movement, radiant heat, clothing, activity).

Describe typical thermal comfort problems in buildings (hot/cold spots, drafts, seasonal swings).

Sound

Explain how noise impacts stress, concentration, privacy, and learning.

Distinguish between sound level, sound quality, and speech privacy (conceptually).

Identify common indoor noise sources (mechanical systems, people, equipment, traffic).

Materials

Explain why material choices matter for health (exposure pathways and long-term contact).

Identify broad categories of material-related concerns (emissions, dust, moisture/mold risk, cleaning chemistry).

Describe basic strategies to reduce exposure (low-emitting products, safer finishes, good installation and maintenance).

Mind

Explain how buildings can influence mental wellbeing and stress.

Identify environmental stressors and supports (crowding, privacy, daylight/views, nature, comfort, control).

Describe basic approaches to support restoration and calm (quiet zones, biophilic elements, clear layouts).

Community

Explain how building environments and policies affect inclusion, safety, and social connection.

Identify basic elements of a supportive community environment (equity, accessibility, respect, communication).

Recognize how wayfinding, amenities, and shared spaces can foster belonging.

Appendix B. Prompt Used to Create the Twine Codes

You are an instructor in an Architecture school

TASK

Create a multi-level interactive stories in Twine to teach the healthy buildings based on WELL v2 concepts: Air, Water, Nourishment, Light, Movement, Thermal Comfort, Sound, Materials, Mind, and Community.

The stories must teach a basic understanding of the concept for beginner undergraduate learners.

CONTEXT (audience + setting)

- Learner level: Undergraduate freshmen
- Course/module: "Introduction to healthy buildings"
- Time-on-task: 30 min
- Tone: engaging and realistic. Add human emotions where possible.
- Setting: Variety of settings (e.g., office retrofit, clinic, school). But one setting per story or concept.
- Region/codes: keep general

LEARNING DESIGN REQUIREMENTS

- Use the following learning objectives for each concept:

Air

- i. Explain why indoor air quality matters for health, comfort, and performance.
- ii. Identify common indoor air pollutants and their typical sources (e.g., particles, VOCs, combustion byproducts).
- iii. Describe basic strategies to improve air quality (ventilation, filtration, source control, maintenance).

Water

- i. Explain why water quality affects health in buildings.
- ii. Identify basic water quality concerns (microbial risk, chemicals/metals, taste/odor) at a high level.
- iii. Describe common points where water quality can degrade in a building (storage, stagnation, fixtures).

Nourishment

- i. Explain how food environments influence choices and long-term health.
- ii. Identify factors that shape eating behavior in buildings (availability, placement, pricing, time).
- iii. Describe basic strategies to encourage healthier choices without being overly prescriptive.

Light

- i. Explain how light affects vision, comfort, mood, and daily rhythms.
- ii. Distinguish between daylight and electric light, and list pros/cons of each.
- iii. Identify common lighting quality issues (glare, flicker, uneven lighting, poor color rendering) conceptually.

Movement

- i. Explain why buildings can either support or discourage physical activity.
- ii. Identify everyday “movement opportunities” in buildings (stairs, walking routes, active workstations).
- iii. Describe basic design/operational strategies that nudge more movement (layout, prompts, amenities).

Thermal Comfort

- i. Explain what thermal comfort is and why it varies among people.
- ii. Identify key factors that affect comfort (air temperature, humidity, air movement, radiant heat, clothing, activity).
- iii. Describe typical thermal comfort problems in buildings (hot/cold spots, drafts, seasonal swings).

Sound

- i. Explain how noise impacts stress, concentration, privacy, and learning.
- ii. Distinguish between sound level, sound quality, and speech privacy (conceptually).
- iii. Identify common indoor noise sources (mechanical systems, people, equipment, traffic).

Materials

- i. Explain why material choices matter for health (exposure pathways and long-term contact).
- ii. Identify broad categories of material-related concerns (emissions, dust, moisture/mold risk, cleaning chemistry).
- iii. Describe basic strategies to reduce exposure (low-emitting products, safer finishes, good installation and maintenance).

Mind

- i. Explain how buildings can influence mental wellbeing and stress.
- ii. Identify environmental stressors and supports (crowding, privacy, daylight/views, nature, comfort, control).
- iii. Describe basic approaches to support restoration and calm (quiet zones, biophilic elements, clear layouts).

Community

- i. Explain how building environments and policies affect inclusion, safety, and social connection.
- ii. Identify basic elements of a supportive community environment (equity, accessibility, respect, communication).

- iii. Recognize how wayfinding, amenities, and shared spaces can foster belonging.
 - Include a short debrief passage for each story: “What you should remember” (3–5 bullet points).

STORY/GAMEPLAY REQUIREMENTS

- Structure: 3–4 decision points.
- Include at least 2 endings: one “healthy building outcome” and one “unintended consequence outcome.”
- Use simple game state:
- Track at least 2 variables for each story.
- Choices must change variables and lead to different consequences.
- Add a “Try again” loop after the unintended outcome ending.
- Use a different background color for each page of the story.
- Avoid medical or legal advice; keep it educational.

OUTPUT

Provide the complete Twine code using Harlowe for each passage, ready to paste. Use clear, unique passage names.

QUALITY BAR

- Use concise passages to be covered within the time allocated.
- Make choices realistic for building decisions (design, operations, occupant behavior).
- Ensure every learning objective is actually assessed by at least one choice or question.
- Do not cite or quote the WELL standard text; explain in your own words.

Appendix C. Language of the Written Consent

Project Title: Interactive Storytelling for Education

Principal Investigator/Researcher: Faizan Shafique

IRB Reference Number: 2133314 MU

You are being invited to take part in a research project. You must be 18 years of age or older. Your participation is voluntary, and you may stop being in this study at any time. The purpose of this research project is to understand the effectiveness of interactive storytelling as a medium of education. You are being asked to go through 10 interactive narratives on healthy buildings and fill two forms, one before and one after. Your participation should last up to 50 min. There are no identifiers being collected and your feedback will be completely anonymous.

If you have questions about this study, you can contact the University of Missouri researcher at: faizanshafique@missouri.edu. If you have questions about your rights as a research participant, please contact the University of Missouri Institutional Review Board (IRB) at 573-882-3181 or muresearchirb@missouri.edu. The IRB is a group of people who review research studies to make sure the rights and welfare of participants are protected.

You can ask the researcher to provide you with a copy of this consent for your records, or you can save a copy of this consent if it has already been provided to you. We appreciate your consideration to participate in this study.

Appendix D. Test Used Before and After Intervention (Pre and Post)

The following ten questions (one for each concept) were asked to assess the current and changed state of knowledge. Each question had four options with one being correct.

1. During critique week, students report: “The studio feels heavy, I get headaches, and the smell is strong near model making.” Outdoors, the air smells smoky due to nearby traffic. What is the best first response?

2. A clinic hydration station tastes “metallic” mostly Monday mornings and improves by midday. Which explanation is most consistent with building-side causes?
3. The campus café wants to promote healthier choices but avoid backlash. Which combined approach is most likely to work and preserve autonomy?
4. Students complain of headaches in a late-night library. You notice bright downlights reflected on laptop screens and glossy tables. The team proposes “just dim everything.” What’s the best critique of that fix?
5. A building team wants more stair use. Which intervention is most effective and inclusive?
6. In one lecture hall, students near windows complain of being cold, while the center seats feel warm. Which diagnosis is most plausible?
7. A makerspace is not extremely loud overall, but students still complain: “Everyone can hear my conversation.” Which statement best explains this?
8. After a renovation, people complain of eye irritation and strong odor. A manager proposes stronger cleaners and air fresheners “to make it smell clean.” What is the most accurate concern?
9. A student services lobby is crowded and confusing; conflicts happen at the queue. Which change best targets stress reduction in a realistic way?
10. In a shared common, some students say: “I don’t know where I’m allowed to be.” Which intervention best supports belonging and inclusion?

Appendix E. Student Experience Survey Items

The students responded to the items listed below using the Likert scale: −2 = Strongly Disagree, −1 = Disagree, 0 = Neutral, 1 = Agree, 2 = Strongly Agree.

Perceived Learning

- i. The stories improved my understanding of how buildings affect health and wellbeing.
- ii. The stories helped me connect concepts to real building decisions
- iii. I can explain at least three WELL-related concepts more clearly now than before.

Cognitive Engagement

- i. The stories made me think through decisions instead of memorizing terms.
- ii. The information blocks helped me reason through choices
- iii. I had to compare options and consider tradeoffs

Emotional Engagement

- i. I felt emotionally engaged by at least some situations.
- ii. The scenarios felt realistic and relatable.
- iii. The stories held my attention better than a typical lecture would.

Motivation to Learn

- i. The story format made me more motivated to learn the topic.
- ii. I want more activities like this in other architecture topics.
- iii. I was curious to see “what happens next” after decisions.

Comparison to Standard Lecture

- i. Compared with a standard lecture, this method was more engaging.
- ii. Compared with a standard lecture, this method helped me remember key ideas.
- iii. Compared with a standard lecture, I feel more able to apply concepts to real situations.

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