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AI-Assisted Video Scaffolding in Construction Management Education: A Multi-Course Study

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Sharon is an Associate Professor in the Sweeney Program of Construction Management at Wentworth Institute of Technology in Boston. Her research focuses on construction management education, with particular emphasis on innovative pedagogical approaches that enhance student learning outcomes in undergraduate programs. Her current scholarly work investigates AI-assisted video-based instructional scaffolding and its effectiveness in problem-based learning environments. This multi-course investigation examines how AI-generated instructional videos can support students across construction management courses, with strategic attention to modules where students have historically demonstrated the greatest difficulty. Sharon's pedagogical approach emphasizes data-driven instructional design, using historical performance data to identify topics where targeted video support can have the greatest impact. Her commitment to accessible instructional content reflects her attention to student engagement and evidence-based teaching practices.

AI-Assisted Video Scaffolding in Construction Management Education:

A Multi-Course Study

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Abstract

The construction industry needs graduates who can apply what they learn to real problems. As construction management (CM) programs adopt problem-based learning (PBL), students often struggle with technical concepts that require both procedural skill and professional judgment. This study examined AI-assisted video scaffolding across three undergraduate CM courses at Wentworth Institute of Technology: Advanced Estimating (n = 58), Project Management (n = 88), and Building Construction (n = 37). The production workflow used ChatGPT for script development and HeyGen for video generation with a custom instructor avatar. Each video took about 2–3 hours to produce.

The study used a quasi-experimental mixed-methods design. Results show that video scaffolding was associated with strong student performance. In Advanced Estimating & Bid Analysis, students scored 89.6% on the quiz and 91.0% on the assignment. In Construction Project Management, students who watched the optional videos scored higher than those who did not (48.0% vs. 39.6%) on an ungraded practice quiz. They also exceeded the three-year historical mean of 44.0%, which ranged from 38.9% to 50.0%. This comparison drew on three years of prior cohort data from the same course using the same ungraded practice quiz format. This comparison matters because students who chose to watch tended to be those who had struggled earlier. In Building Construction, students scored 81.7% on a case study with no prior comparison data.

Survey data (n = 64) showed strong acceptance. Between 91% and 100% of upper-division students said the materials were easy to follow. Only 43% correctly guessed that the videos were AI-generated when asked directly. The custom avatar appears to have kept a sense of instructor presence. Students valued the ability to pause, rewind, and review content at their own pace. That fits with the idea that videos work best as scaffolding in a blended approach. Class level mattered. Juniors showed more confidence and stronger preferences for video resources than first-year students. For construction educators, AI-assisted video production offers a practical, low-barrier option for adding technology to PBL without extensive production skills.

Keywords: construction management education, video-based learning, problem-based learning, instructional scaffolding, artificial intelligence

I. Introduction

There is a clear mismatch between what construction employers expect graduates to do and what students can actually do upon graduating. Ahmed et al. [1] surveyed construction professionals and found the most valued skills were knowledge of health and safety regulations, understanding contract documents, attention to detail, familiarity with building codes, and time management. Ahn et al. [2] reached similar conclusions after surveying recruiters from over 100 companies. Ethics, problem-solving, and people skills ranked highest. Both studies point to the same issue. Industry values judgment, communication, and professional skills that go beyond technical knowledge alone.

Construction Management (CM) programs must build student skills across cost estimation, project scheduling, contract administration, and building systems. Each area requires both procedural accuracy and contextual judgment. Traditional lectures often fall short in developing these applied skills. Many programs have turned to problem-based learning (PBL) to engage students in real-world scenarios.

PBL presents distinct challenges in construction education. Construction problems require mastery of specialized software, industry standards, and math procedures. Students need this foundation before they can engage meaningfully with open-ended projects. This creates a teaching problem. Students need sufficient foundational knowledge to work on complex tasks, but many do not acquire it through lectures alone. Backgrounds differ. Learning speeds differ.

Video scaffolding offers one way to address this challenge. Students can pick up foundational knowledge on their own time. That frees class time for collaborative activities that develop the skills industry values. Research shows that instructional videos help students understand complex concepts and are widely used as supplementary learning tools in engineering education [3], [4]. The COVID-19 pandemic sped up video adoption across higher education [4]. But the systematic study of video effectiveness in CM remains limited.

A few studies have looked at video-based learning in construction contexts. Zaneldin et al. [5] found that 94% of CM students considered videos supportive. E-learning approaches yielded better outcomes than face-to-face lecturing alone. These studies are notable exceptions that address video learning in construction education.

Recent advances in artificial intelligence (AI) have expanded video production options while reducing practical barriers. Weerakoon et al. [6] developed workflows using generative AI for course video production. Research shows that AI-generated videos can achieve learning outcomes comparable to traditional videos, though they may have limitations in social presence [7], [8].

This study started from an iterative instructional development process. Initial work in Advanced Estimating (Summer 2025) tackled the estimate reconciliation procedures that students had struggled with for years. Outcomes were encouraging. Survey feedback showed students were on board. Over 90% of respondents said the materials were easy to follow. One student described it as "a great way to learn; I feel as if I learned the same amount of information as in-person class." These outcomes led to expanded use in Fall 2025. Project Management used an optional video design. This allowed direct comparisons between users and non-users, as well as comparisons with historical data. Building Construction required videos for visually intensive introductory content across all sections.

Three research questions guided this study:

RQ1: How does video-based instructional scaffolding affect student performance on technical assessments in CM courses?

RQ2: What differences exist in learning outcomes between students who access optional video resources and those who do not?

RQ3: How do student perceptions of video-based learning resources differ between first-year students and upperclassmen?

Previous studies of video-based learning in construction education usually focused on a single course, relied on conventional video production, or lacked historical comparison data. This study examines AI-assisted video scaffolding across multiple CM courses and compares current results with three prior cohorts. It also explores whether a custom instructor avatar leads students to experience AI-generated videos as if the instructor were personally present.

II. Literature Review

A. Video-Based Learning in Engineering Education

The effectiveness of video in engineering education has received considerable research attention, particularly after the widespread adoption of online and hybrid instruction. Systematic reviews confirm that videos can enhance learning outcomes in higher education [4].

Akhavan-Safar et al. [3] studied video learning among mechanical engineering students. They found that 96% used video resources as supplementary tools. Students said videos helped them understand difficult concepts (89%), let them review content as needed (84%), and offered flexible access (78%). Students strongly preferred demonstration and tutorial formats (49%) over lecture-style recordings (12%). Most (84%) preferred watching videos after class for review.

Here is what stood out: 75% of students said instructor-led teaching remains essential for meaningful learning. Only 25% thought video could replace in-person teaching. This fits with broader research showing that videos work best as supplements to human instruction, not replacements [9].

B. AI-Generated Instructional Videos

Artificial intelligence has opened new approaches to video production. Weerakoon et al. [6] developed a workflow using ChatGPT-4 and DALL-E 2 to generate course introduction videos. Instructors noted potential to reduce production workload but raised concerns about content accuracy and the need for thorough human review.

Arkun-Kocadere and Ozhan [7] found that video lectures featuring AI-generated instructors produced lower reported engagement but comparable learning outcomes to videos featuring human instructors. Xu et al. [8] reported similar learning performance but differences in learning experience between recorded and AI-generated videos.

Recent research in construction education provides direct evidence about AI-generated content. Kallamadugu and Burgett [11] compared AI-narrated and human-narrated presentations in a drone certification course. They found no significant difference in exam performance (85.2% vs. 86.6%, $p = 0.526$). Their workflow involved extracting transcripts from existing lectures, processing them with ChatGPT, generating audio with ElevenLabs text-to-speech, and syncing with presentation software. In a companion study [12], students rated the quality of AI-generated material at 4.3 out of 5. Students in the AI-narrated course reported feeling more encouraged to ask questions ($p < .001$). AI-generated content may create a more receptive learning environment.

Pellas [10] found significant improvements in self-efficacy ($d = 0.96$) with AI-generated videos in a PBL context. These findings suggest AI-generated videos offer efficiency gains while maintaining learning effectiveness.

C. Scaffolding and Problem-Based Learning

Problem-based learning requires students to engage with problems that mirror professional practice. In CM, PBL activities may include developing cost estimates, creating schedules with realistic constraints, or analyzing case studies of project outcomes. Such activities develop critical thinking but require foundational knowledge to support productive engagement.

Scaffolding provides temporary instructional support that enables learners to accomplish tasks beyond their current level of independent capability [13]. Barnes et al. [14] developed guidelines for supplemental instructional videos in CM. They emphasized that videos should support, not substitute for, other learning methods. Antwi et al. [15] found that PBL enhanced students' understanding of AI applications in construction contexts.

D. Industry Competency Requirements

Ahmed et al. [1] found that personal attributes and managerial skills ranked highest among industry priorities. Technical skills ranked sixth. Ahn et al. [2] reported that affective competencies (leadership, collaboration) and cognitive competencies (problem-solving, ethics) tied at 4.28 out of 5. Technical competency scored 3.80. These findings suggest programs must develop problem-solving and collaboration skills alongside technical knowledge. Video scaffolding within PBL can help by reallocating class time to collaborative activities.

III. Theoretical Framework

Two theoretical perspectives inform the rationale for using video-based scaffolding.

Cognitive load theory holds that learning improves when instruction accounts for the limitations of working memory [17]. Video can reduce extraneous load through clear demonstrations, appropriate distribution of information across visual and auditory channels, and learner-controlled pacing. The video design in this study also drew on Mayer's cognitive theory of multimedia learning [18]. Key principles included segmentation (keeping videos under ten minutes), signaling (using organizational cues to highlight key concepts), and the modality effect (pairing narration with visual demonstrations rather than relying on on-screen text).

Social cognitive theory also informed the design. Videos provide expert demonstrations that learners can observe and replicate. Custom AI avatars representing the instructor may preserve the social presence benefits typically associated with instructor-led instruction.

IV. Course Contexts

The study used both required and optional video designs across courses. Advanced Estimating and Building Construction required video viewing. This ensured all students received the content. Project Management used optional videos for two reasons. First, it allowed direct comparison between students who chose to watch and those who did not. Second, it tested whether students would use the resource without a grade incentive. This mixed approach lets the study examine video effectiveness from multiple angles: overall performance with required viewing, and differences between self-selected users and non-users.

A. Advanced Estimating

Advanced Estimating is an upper-division course for juniors. It covers detailed cost estimates, quantity takeoffs, and preconstruction planning. For this study, a required video explained the estimate reconciliation procedures. This topic has caused trouble for years. Students consistently score poorly on the reconciliation quiz.

Estimate reconciliation has no single correct answer. Variances between estimates can come from scope differences, pricing errors, coding problems, or design changes. Students need to learn how to investigate discrepancies and use professional judgment. That is hard to teach in a lecture. The video showed the instructor's thought process: how to spot when numbers don't match, what questions to ask, and how to dig into ambiguity. Students could pause, try the reasoning themselves, and rewatch when they got stuck.

The assessment had two parts: an auto-graded quiz worth 24 points and an assignment worth 100 points. Fifty-eight students completed both. The mean quiz score was 89.6%. The mean assignment score was 91.0%.

B. Project Management

Construction Project Management is a junior-level course covering project delivery, contracts, and cost control. The Guaranteed Maximum Price (GMP) Cost Report assessment was an ungraded practice quiz used to gauge student understanding before the graded assignment. The same format was used across all four years, with only numerical values changed to prevent answer sharing. This quiz had a history of low scores. Over the previous three years, the mean was 44.0%. Individual years ranged from 38.9% to 50.0%. Students struggled with this topic year after year. The material almost always needs reteaching. What makes it tricky is that students think they understand it. Then the quiz shows they do not. That pattern made GMP a good candidate for video scaffolding.

Why does the GMP Cost Report trip students up? A Guaranteed Maximum Price sounds like a fixed number. It is not. It is a tool for splitting risk. Students have to distinguish between allowances (known scope, unknown cost), contingency (construction risk), and change orders (owner decisions). All three involve money moving, but for different reasons. Students often memorize definitions rather than understand who owns the risk. That explains why in-class exercises and homework did not fix the confusion in past semesters. The video lets the instructor explain the thinking behind each category.

This course used optional videos, not required ones. This design choice allowed direct comparisons between students who watched and those who did not. It also allowed comparisons with historical data. One hundred fifteen students across four sections took part in Fall 2025. Learning management system analytics tracked video access: 25 video users and 63 non-users.

Because viewing was optional, self-selection played a role. Students who watched the videos tended to be those who had struggled with earlier material. A smaller group of high performers also watched, since they used every available resource.

C. Building Construction

Building Construction is an introductory course for first-semester students. It covers construction materials, methods, and systems. In past semesters, this content was delivered in in-person lectures with no formal assessment. This semester, students watched AI-generated videos on their own and then completed a case study assessment on a campus building project.

Building Construction was picked for a different reason than the other two courses. Advanced Estimating and Project Management were chosen because students had struggled with specific content for years. Building Construction was included to examine whether class level affected students' feelings toward the videos. As a first-semester course, it served as a comparison group for the junior-level courses. This allowed addressing Research Question 3 by comparing first-year students and juniors.

This first-year course had different goals than the junior courses. Juniors needed to develop complex judgment. First-year students needed foundational knowledge about building systems and construction sequencing. The video used real construction footage, photos, and schedules from a campus building project. First-semester students got a concrete reference for how buildings actually go together.

The study included two sections. The author taught one. An adjunct instructor taught the other. All students in both sections watched the same AI-generated videos and completed the same assessment. This setup allowed examination of whether AI-generated videos could work consistently across different instructors. Thirty-seven students completed the assessment. The mean score was 81.7%.

V. Methods

A. Study Design

The study used a quasi-experimental mixed-methods design. Performance data allowed quantitative comparison across conditions. Survey responses provided qualitative insight into student perceptions. The design could not achieve random assignments. Students self-selected into courses through normal registration, and video access in Project Management was optional by design.

B. AI-Assisted Video Development

Each video followed a procedural walkthrough format. The instructor built all slides in PowerPoint, showing step-by-step calculations, annotations, and decision points relevant to each topic. The instructor wrote the script using ChatGPT [20] as a drafting aid, then rendered the final video using HeyGen [21] with a custom instructor avatar for narration and on-screen presence. AI was not used to generate images or visual content. Students saw the instructor avatar working through each procedure in sequence, with narration explaining the reasoning behind each step. More dynamic formats such as whiteboard demonstrations or live software walkthroughs were not implemented in this phase and represent a direction for future development.

Draft scripts were developed using ChatGPT-4 [20] through an iterative process. The instructor provided context before generating any content: what had been covered in lecture, what materials students would have open, and whether the video was meant to reinforce a concept, walk through a process, or show a worked example. Technical content varied by course. Advanced Estimating focused on comparing two estimates line by line and addressing assumptions. Construction Project Management covered carrying allowances, change orders, and CM contingency. Building Construction followed step-by-step sequencing. Input to ChatGPT ranged from rough notes to partially solved problems.

The instructor added clarifying notes to the Notes section of existing PowerPoint slides, then exported the presentation as a PDF in Notes format. That PDF was uploaded to ChatGPT, which converted the input into spoken teaching language with clean sentences, logical flow, and clear transitions. HeyGen break tags controlled pacing: short pauses after definitions, longer pauses before key steps. The instructor reviewed each draft, adjusting tone, tightening language, cutting filler, and clarifying steps to match how content was delivered in class. The final script was pasted directly into HeyGen for video generation.

Videos went out at different times depending on the purpose. Sometimes before class. Sometimes after the lecture. Sometimes as optional review. But never as a replacement for class. They supported direct instruction. They did not substitute for it.

Table I: Production Method Comparison

Factor	Traditional	AI-Assisted
Production time	6–9 hours	2–3 hours
Verbal fillers	Frequent; requires retakes	Eliminated in script
Audio consistency	Variable	Consistent (digital)
On-camera presence	Requires practice	Avatar maintains eye contact
Error correction	Record new takes	Edit script text

Note. Production time estimates for traditional method based on instructor experience with Panopto screen recording. AI-assisted time based on ChatGPT script development and HeyGen video generation.

C. Data Collection and Analysis

Performance data came from the Brightspace learning management system for all three courses.

Advanced Estimating. Students watched a required video module on estimate reconciliation. Then they took a 24-point auto-graded quiz and completed a 100-point assignment. This was a new approach for this module. Prior semesters used traditional lectures. All scores came from Brightspace.

Project Management. Students could choose whether to watch supplementary videos on the GMP Cost Report. Learning management system analytics tracked who watched. This allowed comparison between users (n = 25) and non-users (n = 63). Quiz scores were retrieved from Brightspace and compared with three years of historical data. The quiz was identical across all years.

Building Construction. Students watched the required videos on construction sequences. Then they completed a 41-point case study assessment. Two sections took part, one taught by the author and one by an adjunct. All students in both sections watched the same videos and took the same assessment. This allowed examination of whether results stayed consistent across different instructors. This content was previously delivered through in-person lectures with no formal assessment, so there is no historical comparison.

Survey Administration. Perception surveys were sent via Brightspace after students finished each module. The survey was developed by the instructor for this study and was not a standardized instrument. All three courses used similar questions to enable comparison. Items included 5-point Likert-scale questions on satisfaction, perceived learning, and confidence; a True/False question asking whether students thought the videos were made with AI; and open-ended questions about what could be improved.

VI. Results

A. Video Impact on Performance

Here is what the data show. Table II summarizes performance across all three courses. For Advanced Estimating, scores reflect the 58 students who completed both assessments. For Project Management, results compare video users against non-users and against the three-year historical mean. Building Construction had no prior assessment to compare against.

Table II: Performance Results Summary

Course / Condition	n	Mean Score
Advanced Estimating (Junior), Quiz	58	89.6%
Advanced Estimating (Junior), Assignment	58	91.0%
Project Management (Junior), Video Users	25	48.0%
Project Management (Junior), Non-Users	63	39.6%
Project Management Historical (3-year)	n/a	44.0%
Building Construction (First-Year)	37	81.7%

Note. Construction Project Management scores reflect an ungraded practice quiz. Historical range: 38.9% to 50.0% (2022–2024). Same quiz format used across all four years.

B. Video Users vs. Non-Users

Table III compares GMP quiz performance across four academic years. The three-year historical mean (2022–2024) was 44.0%, with individual years ranging from 38.9% to 50.0%. In 2025–2026, students who accessed the optional videos scored 48.0%, while non-users scored 39.6%.

Table III: Historical Performance Comparison

Academic Year / Condition	GMP Quiz Mean
2022–2023 (No video)	38.9%
2023–2024 (No video)	50.0%
2024–2025 (No video)	43.0%
2025–2026 Non-users (Video available, not accessed)	39.6%
2025–2026 Users (Video accessed)	48.0%

Video users (48.0%) scored higher than non-users (39.6%) and above the three-year historical mean (44.0%). The difference between video users and non-users was 8.4 percentage points. Inferential statistics (t-test) were not performed for three reasons: the small sample of video viewers ($n = 25$) limits statistical power, self-selection into viewing conditions confounds group comparisons, and the quasi-experimental design precludes causal interpretation regardless of significance. Descriptive comparison with historical data provides context, but future research with larger samples and random assignment would permit formal hypothesis testing.

C. Student Perceptions

Sixty-four students completed the perception survey (30.5% response rate), which falls within the range reported as acceptable for online surveys in educational research [16]. Across all respondents, 43% correctly identified the videos as AI-generated. The custom avatar appears to have maintained instructor presence. Students valued the ability to pause, rewind, and review content. They appreciated step-by-step procedural guidance.

Students responded well to the video format, but asynchronous delivery limits real-time interaction. Research in construction measurement education shows that students prefer blended approaches. They want to ask questions and get immediate answers during face-to-face sessions. Video alone cannot provide this [19]. Videos work as scaffolding to support direct instruction, not replace it.

VII. Discussion

A. Effectiveness of AI-Assisted Video Scaffolding

The videos served different purposes depending on the course level. For juniors, videos modeled professional judgment: how to investigate ambiguity, how to treat concepts as thinking tools rather than definitions. For first-year students, videos provided visual documentation of actual construction and helped build foundational knowledge. This difference may help explain why class level mattered in students' feelings toward the videos (RQ3).

These results line up with recent research on AI-generated instructional videos. Pellas [10] studied AI-generated video tutorials in science education. Students improved from pre-test to post-test. Learning gains held up over time. Students could transfer what they learned to new situations. Like this study, Pellas found that videos supported learning without needing fancy preview features or interactive add-ons. The videos themselves did the job.

B. Production Efficiency Gains

Traditional screen recording with voiceover using Panopto presented several challenges for non-professional presenters. Verbal hesitations required multiple retakes. Audio quality varied depending on the speaker's head position and distance from the microphone. Turning to look at the screen or shifting in a chair could change the sound. Maintaining eye contact with the camera while reading notes proved difficult. Each error required recording a new take.

The AI-assisted approach directly addressed these challenges. HeyGen generates audio digitally from the script text. There is no microphone, and there is no variation based on physical position. Audio quality remains consistent throughout. The avatar maintains natural eye contact automatically. Errors are corrected by editing the script and regenerating, not by re-recording.

C. Maintaining Instructor Presence

Most students did not realize the videos were generated by AI. This matches what other researchers have found. Kallamadugu and Burgett [11], [12] saw no real difference between AI and human narration in their studies.

D. Class Level as Moderator

Junior-level students reported higher rates of accessibility (98% vs. 61%) and stronger preferences for more asynchronous modules (77% vs. 61%). These differences likely reflect developmental factors in self-regulated learning capabilities. First-year students may benefit more from structured guidance and synchronous instructor support.

E. Video as Scaffolding, Not Replacement

This study does not claim that video is superior to other instructional approaches. The findings position videos as effective scaffolding within blended PBL approaches. Videos worked as scaffolding in several ways. Students could control pacing, pause to try procedures themselves, rewind when confused, and revisit content while completing assignments. Lecture moves at a fixed pace and cannot be replayed. Video lets students iterate: watch, try, get stuck, rewatch, try again. For complex topics like reconciliation and GMP, this back-and-forth process may have helped students develop professional judgment rather than just memorizing steps.

The goal of video scaffolding is not to reduce time with the instructor. It is to improve problem-based learning. Videos may help students learn procedural knowledge on their own time. This frees up class time for collaborative activities, case analysis, and applied projects. Students who skip optional video resources still receive direct instruction in class, but they miss the benefits of self-paced review. Non-users in Project Management scored below the historical average (39.6% vs. 44.0%). This pattern suggests that optional videos may widen the gap between students who seek extra help and those who do not. Required video viewing, as used in Advanced Estimating and Building Construction, ensures all students get the same support. Beyond immediate performance, video scaffolding develops self-directed learning habits that carry into professional practice, where on-demand training through platforms like YouTube, Procore, and software vendor libraries has become the industry standard for continuing education.

F. Other Factors

Several things beyond video access could have affected results. Students may have performed differently because they knew their learning was being studied. No other curricular changes were made in these courses during the study period. The assessments, rubrics, and grading procedures stayed the same as in prior years. Instructor delivery of in-class content followed established patterns. The main instructional difference was the availability of supplementary video resources.

G. Alignment with Industry Requirements

Video-based professional learning has become standard practice in the construction industry. Manufacturers distribute installation tutorials via YouTube. Software vendors such as Procore, Bluebeam, and various estimating platforms provide on-demand training modules. Continuing education providers offer video-based content for professional development. Students who learn through video scaffolding in academic contexts become familiar with the learning modes they will encounter throughout their careers.

H. Limitations

Single University. All data comes from one university. Most courses were taught by a single instructor. The Building Construction course had two sections, one taught by the author and one by an adjunct. All students in both sections used the same AI-generated videos and took the same assessment. That provides some evidence that the approach works across different instructors, but it remains unknown whether the findings would hold at other schools.

Sample Size. The video users' group in Project Management (n = 25) was relatively small. This limits statistical power and constrains the conclusions that can be drawn about the size of performance differences. Larger samples would be needed to detect small effects and to conduct meaningful subgroup analyses.

Limited Outcomes. Assessments focused on knowledge and procedural skills. Higher-order outcomes such as transfer to novel problems, retention over time, and application in later courses remain unexamined.

Survey Response Rates. Response rates varied by course and engagement level. In Project Management, 88% of video users completed the survey, while no non-users responded. This means perception data reflects only engaged students. Non-user attitudes toward video resources remain unknown. Interpretations of student perceptions should be cautious.

Self-Selection. Video viewing was optional in Construction Project Management. Students who chose to watch may differ from those who did not in motivation, prior knowledge, or study habits. Without random assignments, performance differences cannot be attributed to video viewing. LMS data suggested a non-linear pattern in optional video use. High-performing students and students who had struggled earlier in the semester were most likely to access the video. Mid-tier students were least likely to engage, despite being well positioned to benefit from additional review. This pattern suggests that optional scaffolding may not reach the students who would benefit most, because adequate performance reduces the perceived need for supplementary resources. Required video viewing, as used in Advanced Estimating and Building Construction, eliminates this gap by ensuring all students receive the same support regardless of their perceived need. The LMS platform did not provide granular analytics on pause, rewind, or segment-level engagement. Video access was tracked by completion only. Future research should incorporate platforms with embedded interaction analytics to identify which content segments students revisit most frequently.

VIII. Conclusion and Future Research

AI-assisted video-based instructional scaffolding may support student learning in CM education. The workflow described here offers a practical, replicable approach for instructors without specialized video production skills. Results across three courses show positive associations between video scaffolding and student performance, though self-selection and other limitations preclude causal conclusions.

For construction educators, the main contribution of this work is showing that an AI-assisted workflow can fit into routine teaching without disrupting existing course structures. Class level matters. Junior students showed greater comfort with asynchronous resources than first-year students. Scaffolding approaches may need adjustment based on where students are in their development.

Future research could address these gaps in several ways. A pre-/post-design would measure how much students learned. Students would take an assessment before watching the video and again after. Pellas [10] used this approach. A randomized design would tackle self-selection bias. Students would be randomly assigned to either the video or the non-video condition. Those without videos could watch them after the assessment. To check long-term outcomes, researchers could survey capstone instructors. Do students show stronger skills in areas covered by the videos? Tracking student performance in later courses that build on higher-order thinking and analysis, like estimate reconciliation and GMP development, would also help.

Future research could also examine whether engagement and performance effects fade over time as students get used to the AI-generated video format. Replication at community colleges and large research universities would help test whether findings generalize beyond a private northeastern institutional context. Studies at other types of schools or programs outside the northeastern United States would strengthen external validity.

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