

# Accelerating Training with Immersive Technologies

Applying Immersive Instructions Through Spatial Computing in Technical Training: A Case Study

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In an era of digital transformation, the demand for skilled workers outpaces the effectiveness of traditional training methods. The skilled trades industry faces a critical challenge: traditional training methods cannot meet the rising demand for qualified workers due to high costs, employee turnover, and limitations in time, safety, and physical resources. This research study, conducted in partnership with BILT Incorporated and Warshauer Trade, explores the application of spatial computing on Apple Vision Pro to deliver immersive instructional content through the lens of an electrical training case study.

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The following study tracked students through a 12-week electrical certification program, with projects supplemented by BILT Immersive Instructions on Apple Vision Pro. Performance metrics revealed students completed the curricula 23.85% faster than historical baselines, with improvements in error reduction and knowledge retention. Quantitative data from log files and surveys demonstrated enhanced student confidence and comprehension, while qualitative insights from instructors highlighted improved critical thinking and reduced reteaching time.

The findings suggest that integrating immersive learning materials with spatial computing into technical training creates more efficient, engaging, and effective learning environments that better prepare students for real-world applications. Additional research is recommended to establish definitive conclusions and best practices for implementation across diverse training environments.

# Methodology

The following study supplemented the Warshauer Trade electrical certification curriculum in Lakewood, New Jersey with BILT Immersive Instructions developed for Apple Vision Pro. Data collected tracked performance metrics from students' hands-on training sessions, along with log files and post-intervention surveys assessing student sentiment of material comprehension and engagement. Qualitative insights were gathered through semi-structured interviews with students and instructors. Quantitative data from log files and surveys were analyzed using descriptive statistics, while interview responses underwent inductive thematic analysis to identify recurring patterns in perception and adoption.

## 2.1 Participants

Nineteen participants were enrolled in the 12-week Electrical Contracting Certification Program with BILT for Apple Vision Pro. The class demographics consisted of male students between the ages of 17-35 ( $M = 21.53$ ,  $SD = 5.17$ ). Two participants were omitted from the study due to vision incompatibilities and scheduling conflicts after the screening process.

## 2.2 Course Structure

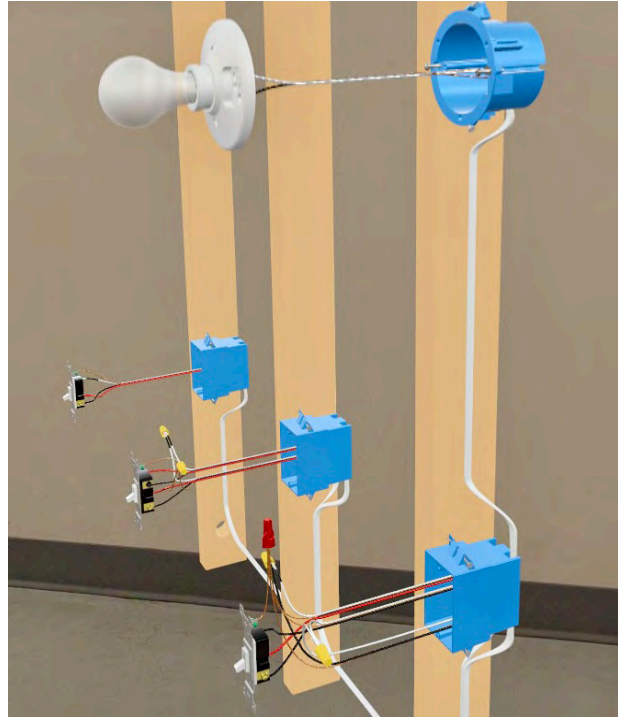
The course is organized into classroom lectures and hands-on workshops for 96 hours of electrical training content. The first two weeks include background lessons for field requirements and equipment use. Hands-on work begins on the third week alongside classroom lectures. Each session begins with a lecture on project objectives, followed by hands-on work in the shop. Participants viewed lessons supplemented with BILT Immersive Instructions on Apple Vision Pro before entering the shop environment.

After the first module lecture, students advanced through hands-on projects at their own pace, at which they could return to the classroom to review BILT Immersive Instructions, codebooks, and class notes. Instructors conducted frequent reviews, demonstrations, and comprehension questionnaires throughout the certification program.

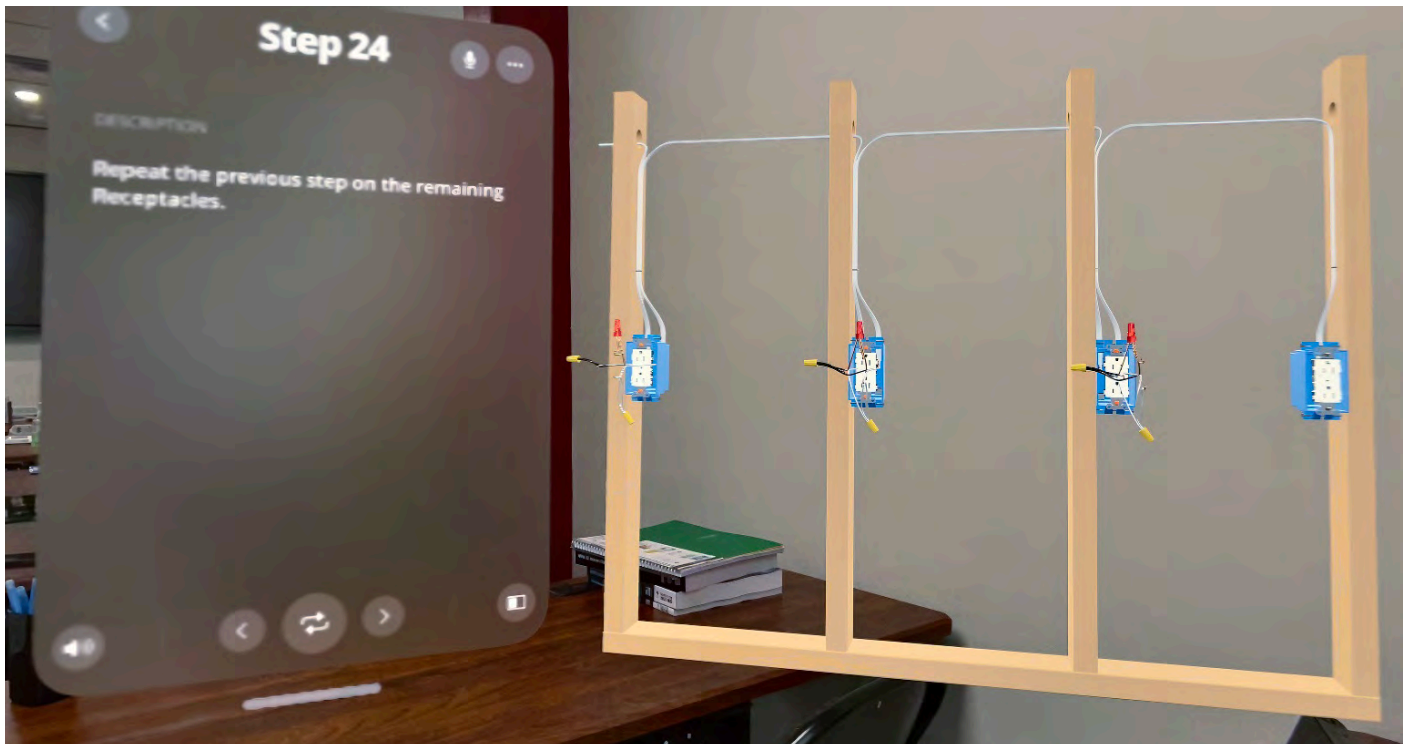


### 2.3 Immersive Content

Projects 1, 9, and 10 were supplemented with BILT Immersive Instructions on Apple Vision Pro in accordance with guidelines provided by the instructors. Lesson 1 introduced electrical concepts, serving as a foundation for subsequent projects; Lesson 9 was selected for being one of the most time-intensive; and Lesson 10, a shorter project, was utilized by instructors to assess the students' critical thinking skills.



Project 9: *Dead-End 3-Way System*, student screen capture of learning model at a reduced scale.



Project 1: *Four Receptacles Wired in Parallel*, student screen capture with instructions panel. Note, Apple Vision Pro uses gaze tracking to render high-fidelity visuals within the viewers direct line of sight, peripheral content is blurred until the viewer's gaze shifts.

### 2.4 Learning Environment

The certification employed traditional lectures in the classroom alongside hands-on projects in a workshop environment. BILT Immersive Instructions on Apple Vision Pro was introduced in the classroom setting to supplement lecture material for hands-on projects 1, 9, and 10 before entering the workshop environment. While BILT Intelligent Instructions are accessible on other devices, participants were limited to immersive experiences through BILT Immersive Instructions on Apple Vision Pro throughout this study.



Student interacting with BILT Immersive content on Apple Vision Pro before entering the workshop.



Students gathered in the workshop receiving direction from instructor before beginning independent projects.

## 2.5 Data Collection Methods

This study employed a mixed-methods approach to evaluate the impact of BILT Immersive Instructions through spatial computing on proficiency and learning outcomes. Quantitative data captured by log files and field notes were used to track start and completion times for projects 1-10. Instructor scoring documents and student ratings were utilized to gauge confidence levels, quality of work, understanding of project objectives and code requirements. Specific project tasks and errors were tracked from instructor guided metrics with Projects 1, 9, and 10 supplemented by BILT Immersive Instructions on Apple Vision Pro. Data collected were compared to baseline estimates provided by instructors.

Students participated in four surveys throughout the course of the study. The background survey gathered information on participants' electrical skill levels, familiarity with immersive technology, general technology proficiency, and their sentiment toward Apple devices and the electrical certification program. For Projects 1–8, students were surveyed on their confidence in understanding the material, the frequency of instructor intervention, how often they asked questions or referred back to instructions, and their overall engagement and confidence levels. Similarly, the survey for Projects 9 and 10 captured perceived confidence in material comprehension, frequency of instructor intervention, frequency of questions asked, reference back to instructions, and sentiment toward engagement and confidence. The final survey evaluated overall comprehension, confidence in applying the material in real-world scenarios, course satisfaction, and the factors students considered most important for immersive technologies to effectively promote learning.

## Evaluation Metrics

### Time to completion:

- Time spent for projects 1-10 per student. Includes time spent in both workshop and classroom setting until students reach proficiency, measured by instructor evaluation of specific project learning objectives.
- Time spent on BILT Immersive Instructions on Apple Vision Pro per student.

### Instructor scoring:

- National Electrical Code (NEC) compliance
- Quality of work
- Box mounting height and depth
- Non-metallic (NM) cable installation and project neatness
- Splices and terminations
- Tool use and material selection
- Safety
- Operational check

### Student ratings:

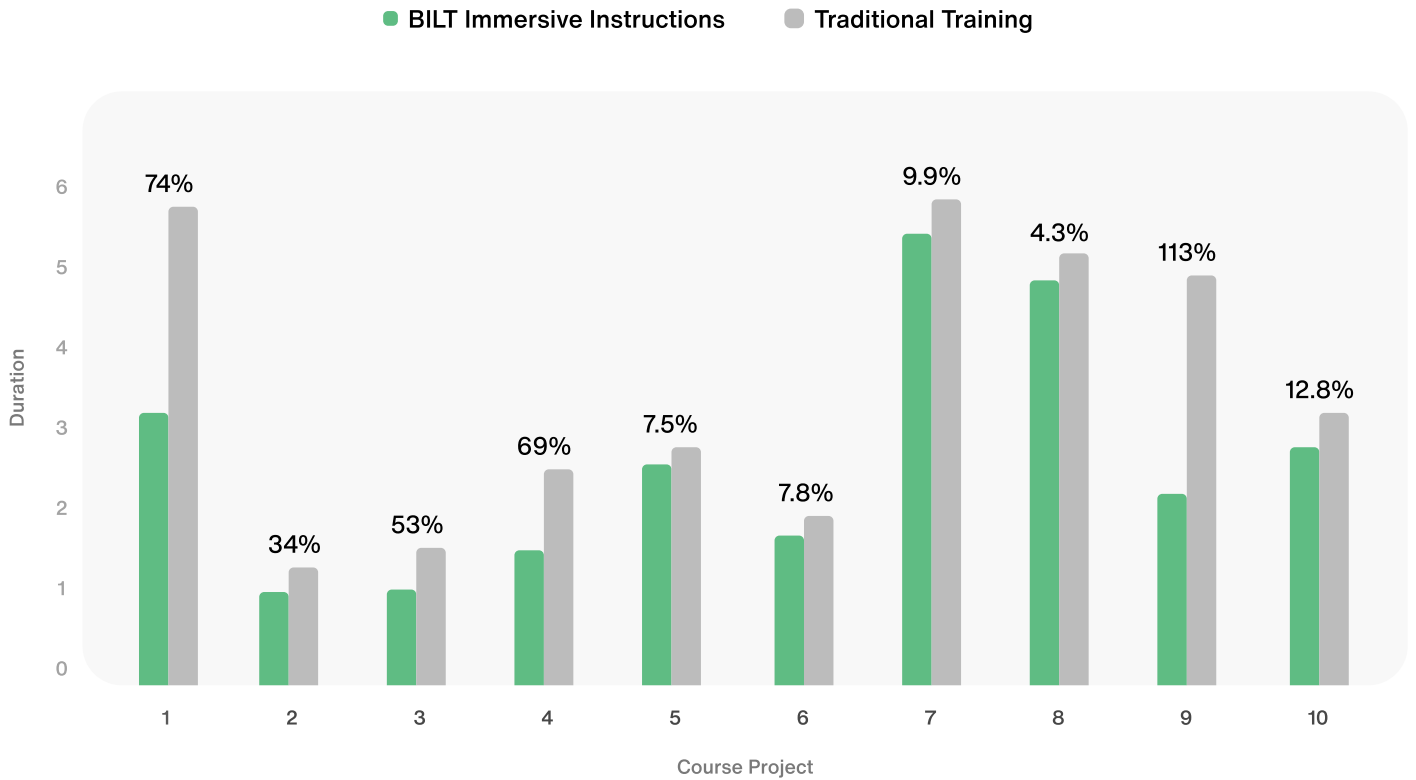
- Confidence in project functionality
- Comprehension of project objectives
- Comprehension of NEC code

# Results

Performance metrics revealed that students completed tasks 23.85% faster than historical baselines, with improvements in error reduction and knowledge retention. Data from log files and surveys demonstrated enhanced student confidence and comprehension, while qualitative insights from instructors highlighted improved critical thinking and reduced reteaching time.

### 3.1 Time Completion Files

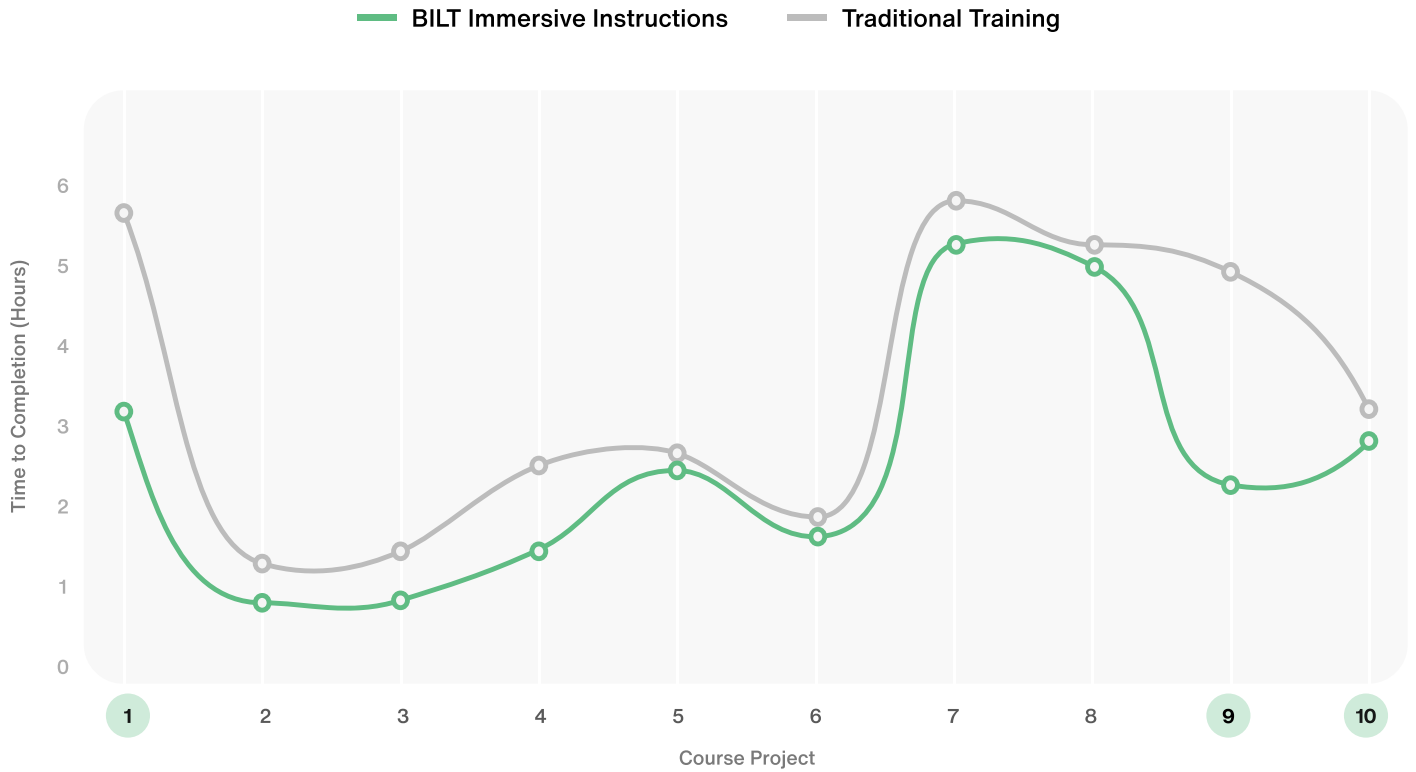
## Project Percentage Improvement



**23.85%**  
faster than cohorts

Performance metrics indicate that on average, participants using BILT Immersive Instruction on Apple Vision Pro completed the course 23.85% faster than cohorts.

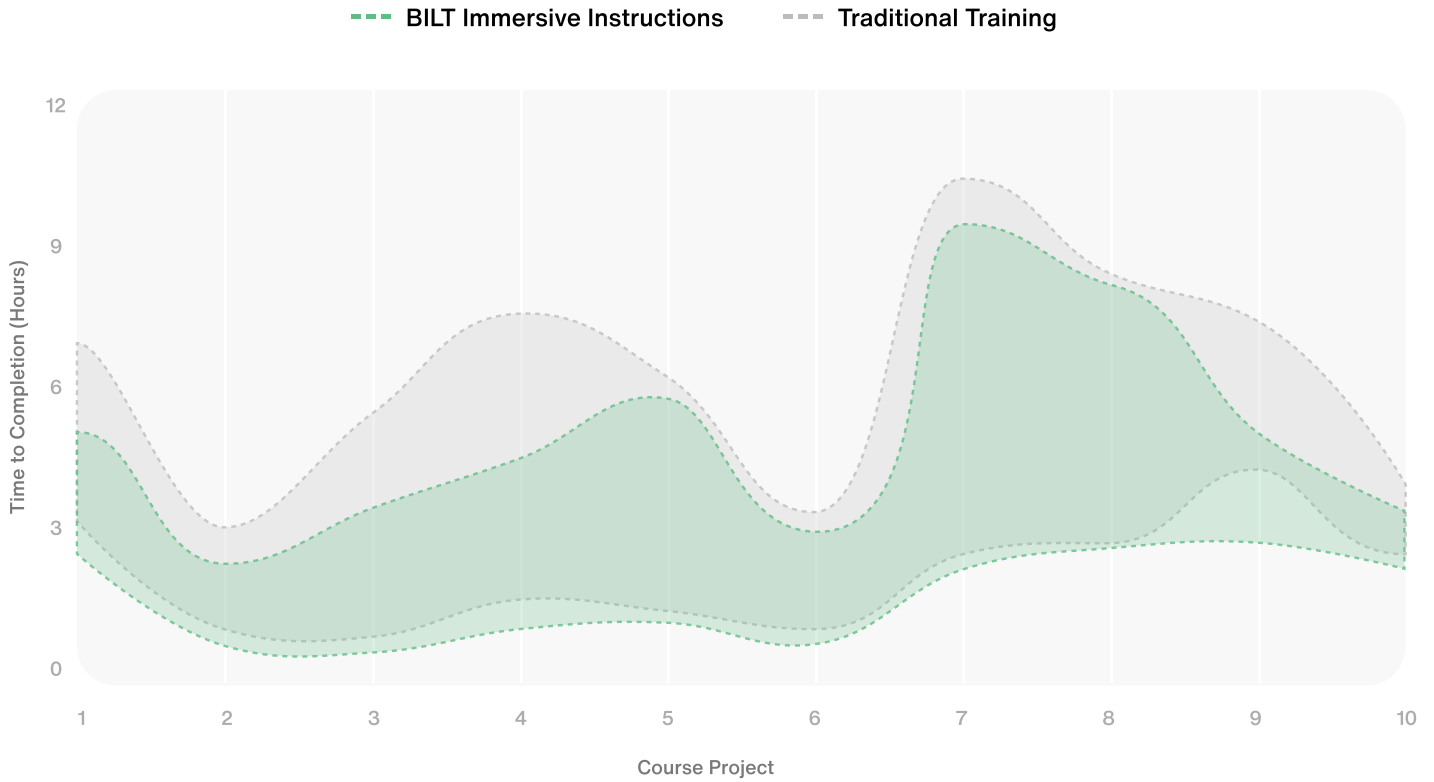
## Project Time to Completion Average



**76%**  
tracked ahead  
of baseline

BILT Immersive Instructions were integrated into three key projects via Apple Vision Pro: Project 1 (introductory electrical concepts), Lesson 9 (among the most time-intensive), and Lesson 10 (a shorter project used to challenge critical thinking). Results indicated that lessons enhanced by the spatial curriculum in this cohort were completed, on average, nearly 67% faster than historical benchmarks, with Projects 1 and 9 showing improvements of 74% and 113%, respectively. Throughout the duration of the study, 76% participants tracked ahead of the historic baseline whilst 88% were 2.5 weeks ahead.

## Project Time to Completion Variance



**28%**  
decrease in variability

Results indicate variability in time to completion of tasks decreased by 28%, with the performance gap between the fastest and slowest student seeing an average reduction of variability by 42 minutes. Student survey results and instructor observations indicated increased engagement and autonomy in problem-solving, aligning with broader implications for the integration of immersive technologies in technical training and applied education.

### 3.2 Task Performance Metrics

Key performance improvements were observed in specific tasks, with students completing electrical box mounting 73% faster than those trained using traditional methods. The average completion time was 11 minutes, with only one notable error—stripping wire before feeding it through electrical boxes—which was corrected within 5 minutes. In contrast, the conventional process typically takes 40 minutes, often requiring multiple corrections and consuming the remaining shop time.

The efficiency gains resulted in instructors reclaiming 2.5 hours of class time on the first project alone. By week 7, the proportion of students proficient in “Dead-end 4-ways” increased from the typical 40% to 90%, whilst those progressing at the slowest rate reduced their completion times by nearly 20%.

“ Project one has so many fundamentals. Students seeing BILT on the Apple Vision Pro set the fundamentals up correctly from the beginning. If they mount their boxes right the first time, they’re going to mount right the second time. If they put their sheathing in the first time, it’s not going to take them until the third time. And that’s what we saw in projects 1-10. ”

**Kristian Desjardin**  
Electrical Instructor

### 3.3 Error Types

Specific errors were analyzed according to instructor directional data for areas most impacted within their training environment. Whilst the reductions of other errors may have been present, only the following were monitored throughout the scope of this study.

**Eliminated reverse polarity errors**  
(historical rate: 18%)

**Eliminated sheathing errors**  
(historical rate: 20%)

**Reduced the error of connecting traveler wires to a 4-way by 90%**  
(50% to 5%)

**No instances of incorrect interpretation for pigtail wiring or misinterpretation of left-handed instruction reported**

### 3.4 Knowledge Retention

Preliminary analysis suggests that observed retention of course material directly supplemented with spatial learning improved from 30%, including vocabulary and terminology retention, to 90% compared to cohorts. Measurable reductions in project completion times, higher confidence and course material comprehension ratings, as well as reductions in specific tasks provided insights into the capabilities for spatial technologies with immersive instructions to impact kinesthetic learning practices.



Student advances to Project 9 through BILT on Apple Vision Pro, ahead of the scheduled lesson.

### 3.5 Field Readiness and Application

Survey results identified a deeper understanding of key concepts with 93% of participants reporting feeling ready to apply what they learned in class to the field and 27% reporting a strong ability to comprehend and easily explain key concepts at the end of the course.

In open-ended feedback from learning surveys, 67% of participants referred to the interactive digital twins replicated with BILT Immersive Instructions on Apple Vision Pro as playing a role in linking abstract concepts to real-world application. Among surveyed students, 81% described the ability to clearly see their physical environment alongside embedded digital models—and to interact with those models using hand gestures—as the key factor that made immersive technologies like Apple Vision Pro with BILT Immersive Instructions particularly effective for technical training.



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**93%**

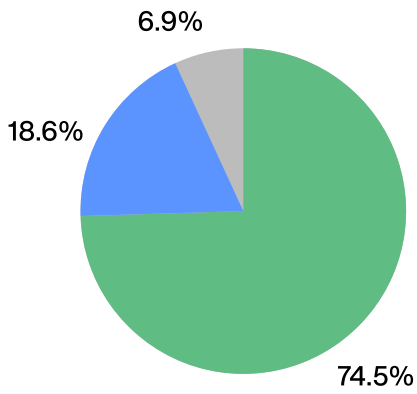
**Felt ready to apply what they learned in class to the field**

# Project Time to Completion Variance

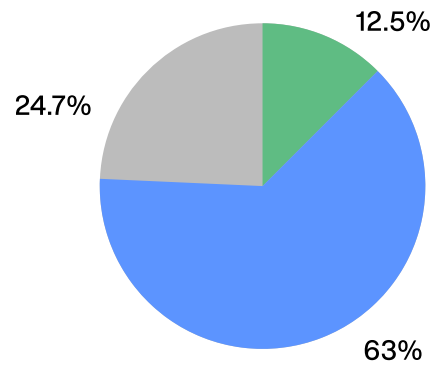
Participant results by alignment rating within the following statement groups:



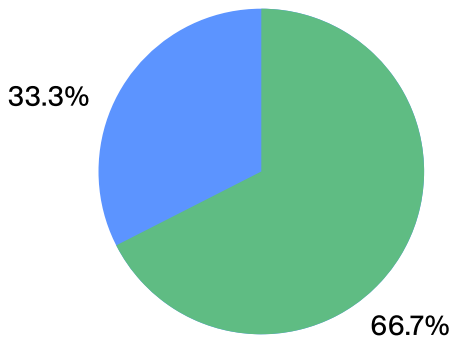
Feeling engaged with the course content:



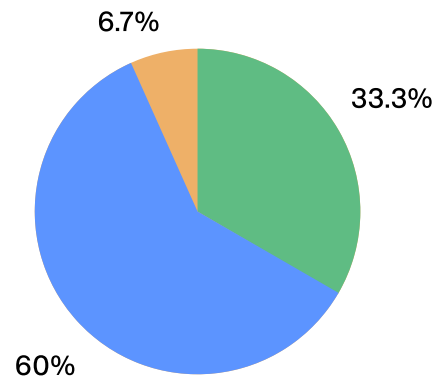
Confidence in problem-solving abilities in the face of challenges:



Ease of staying focused in the classroom environment:



Ease of staying focused in the shop environment:



# Additional Insights

Beyond the primary results, the study identified several promising advantages of integrating immersive instructions with spatial computing into training programs that merit additional investigation.

### 4.1 Equipment Access & Hands-On Practice

Participants demonstrated faster proficiency progression for Project 9 compared to previous cohorts. By week 6, 53% of students had reached proficiency; this increased to 71% by week 7, and by week 8, all students achieved proficiency.

With 76% of participants tracking three weeks ahead of the typical schedule, instructors were able to allocate this time for additional commercial project training. Typically, students receive only one week of commercial training by the end of the course.

Reductions in time to completion observed in projects 1-10 supplemented with the spatial curricula allowed for expanded hands-on experience with commercial projects, providing students with safe, unrestricted equipment access and the ability to review materials without physical constraints.

**“ The top 10% percent of the class are rock stars. The bottom 10% struggle and we always have that bottom 10% who are going to struggle, but that 80% in the middle got there faster. They got there faster, and it helped every one of those students. We had more students all at Project 9 at the same time and faster than any other class. ”**

**Brian Hahner**  
Electrical Instructor

### 4.2 Critical Thinking

Participants displayed enhanced engagement while simultaneously reaching proficiency benchmarks more rapidly and with fewer errors than comparable cohorts. This study's findings suggest that the incorporation of spatial computing with immersive digital content may have impacted independent problem-solving capabilities by establishing a learning environment where students had access to resources that fostered deeper understanding of the curriculum compared to conventional instructional approaches.

Figure 1a illustrates how frequently students requested instructor assistance for projects in the spatial curricula. For projects that received foundational training through BILT Immersive

Instructions on Apple Vision Pro for Project 1, but were not directly supplemented with immersive instructions for projects 2-8, 64% of students reported needing instructor intervention 1-5 times. By comparison, when spatial computing with immersive instructions directly supplemented projects, 73% of participants reported fewer than 5 instances of assistance, and 13% reported completing their work independently without any instructor intervention.

The reduction in errors observed during training suggests that tools present in BILT Intelligent Instructions® with Apple Vision Pro helped students grasp complex concepts more intuitively, reducing reliance on direct instructor intervention.

Frequency of Instructor Support Requests After Immersive Instruction Through Spatial Computing

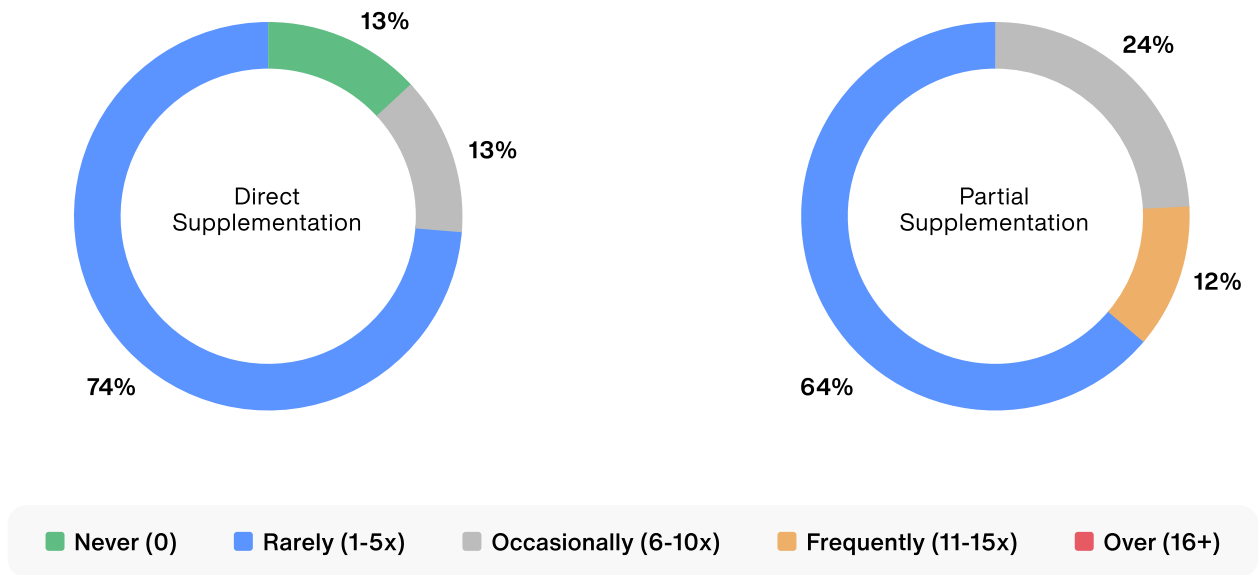


Figure 1a

### 4.3 Reduced Time Spent Reteaching Material

Performance metrics highlight the promising potential for reducing the need to reteach lessons. Instructors noted improvements in lesson retention when BILT Immersive Instructions on Apple Vision Pro were incorporated into instruction. As one instructor shared, “With immersive instructions, I found that the lesson went smoother, and I found the retention was better. When I came back the next night, I didn’t have to reteach it. They knew it.”

Figure 1b illustrates how often participants consulted instructions during the study. For projects that received foundational training through BILT Immersive Instructions on Apple Vision Pro for Project 1, but were not directly supplemented with immersive instructions for projects 2-8, 47% of students reported to have reviewed instructions 6-10 times. In comparison, when projects incorporated BILT Immersive Instructions directly, 60% of students consulted learning materials fewer than 5 times over the course of their work.

Reported Frequency of Revisiting Learning Materials Post Immersive Instruction Through Spatial Computing

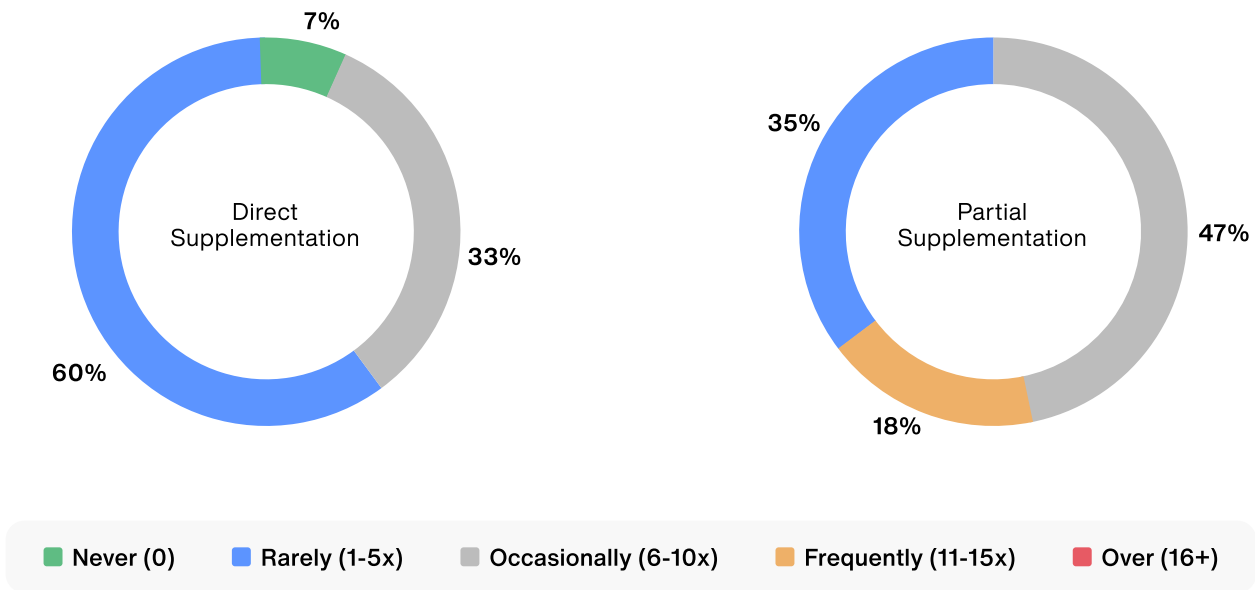


Figure 1b

#### 4.4 Enabling Independent Access to Current Procedural Knowledge

A potential stand-out for utilizing immersive instructions through immersive technologies for training is the ability for students to revisit the most “up to date” procedural demonstrations for content on their own, enabling them to engage with the material more deeply and resolve questions without relying on the instructor for immediate answers.

In environments where code requirements undergo frequent updates and where physical constraints limit guided hands-on instruction, a learning solution that enables individuals to seamlessly engage with technical materials while maintaining awareness of their physical surroundings becomes essential. Such environments create opportunities for learners to reference current standards and procedures in real time without disconnecting from the practical context in which these skills must ultimately be applied.

“ They found the answers themselves by going back into the material. Having the availability to go back again and again, that’s the critical thinking and problem solving, and they’re doing it on their own without referencing us for the input. A lot more people got answers to questions that they weren’t going to ask us. ”

– Kristian Desjardin

### 4.5 Learning Accommodations

An important area of exploration, extending beyond the scope of this study, is the impact of spatial technologies with immersive learning content in improving accessibility to applied technical trades for individuals with learning challenges. Instructors noted difficulties in providing adequate resources for students with attention deficits and other learning accommodations, particularly those struggling with reading or processing text.

Technologies that blend physical and digital environments with intuitive gestures and hands-free interactions through auditory commands and eye-controlled selection could provide opportunities for hands-on learning that might cater to different cognitive styles, bridging the gap between resources for training professionals with learning accommodations.



## 4.5 Implementation

### Initial Resistance is Natural and Expected

The integration of immersive instructions through spatial computing into the curriculum was initially met with skepticism. Brian Hahner, one of the lead electrical instructors at Warshauer Trade, explained, “When I first sat down with this, I was like, I don’t want technology in the classroom because to me, it’s not hands-on.” This resistance stemmed from concerns that technology might be implemented as a replacement for hands-on instruction.

### Direct Experience Transforms Perceptions

As instructors engaged with the technology, perceptions began to shift: “Once I experienced it firsthand, I realized there’s a definite, documentable advantage for students using these tools,” said Hahner. Hands-on experience with immersive learning content through spatial computing was crucial in reevaluating its educational value. Successfully incorporating innovative teaching resources into traditional technical education requires providing instructors with time to familiarize themselves with the immersive technology. Once instructors understand the technology’s capabilities, they can identify which areas of their curricula are best suited for immersive content and plan the most effective way to integrate it into their unique learning environments.

### Learning with Immersive Technologies

Once these initial challenges were addressed, the role for immersive instructions with spatial technology within the classroom became clearer. Rather than functioning as a standalone replacement for traditional methods, it served as a tool for reinforcing instruction and improving student engagement. Kristian Desjardin, Warshauer Trade’s co-lead electrical instructor, shared “When used correctly, the benefits are astronomical. Students are immersed in an environment with fewer distractions, and they get that one-on-one instruction. They can also rewind lessons and absorb content at their own pace.” This insight suggests that the effectiveness of immersive technologies depends not only on its technical capabilities but also on how it is integrated into various frameworks.

## CONCLUSION

This study evaluated how immersive technologies can accelerate skill acquisition by reducing errors and performance variability, using an electrical training case study to derive insights applicable across the skilled trades. The data collected from this specific implementation with BILT Immersive Instructions on Apple Vision Pro indicated that students completed tasks faster than historical baselines, with a measured reduction of 23.85% in average completion time across all projects. Projects supplemented with spatial technology showed the most notable differences, with Project 1 and Project 9 demonstrating 74% and 113% improvements respectively when compared to historical benchmarks.

The observed learning progression allowed a majority of students (76%) to advance approximately three weeks ahead of traditional schedules within this implementation. This additional time was allocated toward commercial applications that extended beyond the standard curriculum. Of particular interest was the observation that students engaged differently with the learning material, formulating more specific technical questions while demonstrating greater autonomy in problem-solving.

These observations should be considered within their context-specific limitations. Future exploration should examine whether similar patterns emerge across diverse educational environments, trade disciplines, and populations. Additional research is needed to assess long-term retention, skills transferability to workplace settings, and comparative effectiveness against other innovative teaching methodologies.

Understanding how various technologies might serve individuals with diverse learning needs represents a critical direction for developing inclusive educational approaches. As the landscape of technical education evolves alongside technological advancement, industry-specific solutions must be developed that meets new generations of technical workers where they are—integrating technology as one resource within a broader ecosystem of complementary tools. The findings from this single-site case study offer one perspective for considering how digital and physical learning environments might complement each other in pursuit of solutions towards the broader conversation addressing workforce development challenges.

## **Author**

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## **Warshauer Trade Instructors**

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