


Transforming the Future of Furniture Woodworking Instruction Through VR-Enhanced Distance Teaching During the COVID-19 Pandemic

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ABSTRACT

During the COVID-19 pandemic, distance teaching became the main solution, including for the furniture woodworking course at National Taipei University of Technology in Taipei, Taiwan, which relied on video and online software. However, this posed challenges for maintaining teaching quality and achieving objectives in technical practice courses. To address this, this study introduced remote technical guidance using VR in technical practice courses. This method combined distance-teaching and live dual-teacher broadcasts, allowing students to participate in real-time online discussions. During these broadcasts, instructors used VR to demonstrate operations on a virtual platform, explaining as they went along. Students could observe from the operator's perspective, gaining insights into furniture production processes. They also engaged in group interactions, assuming roles like technical operators, thereby mastering key furniture production concepts. This innovative teaching approach offered a solution that combined remote technical guidance with VR. It provided immediate teaching enhancements and problem-solving solutions in the post-COVID-19 era.

KEYWORDS

COVID-19, Digital Twin, Distance Teaching, Dual-Teacher Live Broadcast, Remote Technical Guidance, Tele-Education, Virtual Learning Environments, Virtual Reality

INTRODUCTION

When the COVID-19 pandemic hit, Taipei Tech faced disruptions in its practical courses, such as furniture woodworking and overseas internships. To mitigate this issue, many schools shifted to distance education methods (Iyer et al., 2020; Mishra, 2021; Tekiner et al., 2020; X. Wang et al., 2020). Taipei Tech, primarily focusing on furniture woodworking, responded to the pandemic by

DOI: 10.4018/IJOPCD.334593

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introducing remote teaching, resulting in the suspension or conversion of numerous practical courses into slide-based remote instruction.

Practical courses in furniture technology heavily depend on specific operational settings, including well-equipped woodworking studios, specialized tools, and access to essential materials such as wood, machinery, and finishing products. These conditions are crucial in facilitating students' acquisition of hands-on skills and practical experience in furniture technology, as the course content could not be adequately conveyed through presentation slides alone.

Furthermore, under the distance-learning mode, students find it challenging to understand the real-time operation of machine production from a first-person operator's perspective. This difficulty emerges due to the lack of direct opportunities for hands-on experience. This situation results in students having to piece together their understanding of overall furniture production and processing knowledge through fragmented and fragmentary slide pictures, leading to suboptimal learning outcomes.

Therefore, this study combines remote technical guidance with VR technology in online teaching; adopting a dual-teacher, live broadcast approach to provide a comprehensive perspective. Teachers conduct online teaching like game broadcasters, aligning with students' preferences to enhance engagement. Guided by teachers, students can observe the processing procedures from the teachers' perspective, engage in real-time interaction, and raise questions. Teachers can also provide direct feedback to students through the live-streaming interface.

Students actively participate through role-playing and assignments, assuming specific tasks and addressing questions related to technical operators, quality controllers, and more. Teachers use VR to illustrate concepts, complementing traditional lecture methods and fostering interactive teaching.

This innovative approach successfully overcomes pandemic-related field limitations in furniture technology courses, enabling remote participation through live broadcasts. Students gain real-time access to educators, deepening their understanding of furniture manufacturing and machine operation. The integration of VR technology adds a realistic dimension to the learning experience, fostering student participation and interaction through dual-teacher live broadcasts and group role-playing, facilitating a deeper understanding of furniture manufacturing.

Contrasting This Study With Prior Research

This study distinguishes itself from previous research by creatively integrating industry-standard remote technical guidance with VR instructional operations, while employing a unique dual-teacher instructional approach. It specifically focuses on furniture production, requiring operational demonstrations and equipment explanations. This is in contrast to past studies that primarily emphasized theoretical courses with slide presentations for remote teaching. Additionally, unlike earlier remote teaching methods that targeted single machines or tasks, this study comprehensively covers the entire concept of furniture production and its processing procedures. The innovative approach of combining lecture and technical teachers for remote live teaching, especially during the COVID-19 pandemic, represents a significant breakthrough. The application of such technology in traditional furniture production courses is exceptionally rare, setting this research apart from related studies.

LITERATURE REVIEW

The application of remote technical guidance and VR technology has become widespread in vocational training and business applications. The utilization of remote technical guidance with a digital twin has been widely implemented globally, with notable applications in product design, vocational training, maintenance, assembly, and other manufacturing operations (Buñ et al., 2021; Tan et al., 2021; P. Wang et al., 2020, 2021). For instance, these technologies have been effectively employed in professional skills development, including remote education and training, remote machine repair training, and

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