

Original Paper

Applying Micro-lecture Technology in the Laboratory Course “Jewelry Processing and Production”

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Received: October 22, 2025 Accepted: November 16, 2025 Online Published: November 20, 2025

doi:10.22158/asir.v9n4p64

URL: <http://doi.org/10.22158/asir.v9n4p64>

Abstract

Against the backdrop of the deepening national strategy for digital education, enhancing the teaching effectiveness of practical experimental courses in application-oriented undergraduate programs has become a pressing issue. Taking the course "Jewelry Processing and Production" as an example, the high demands for skill training and the limited resources for teacher guidance create a core tension in the teaching process. Specifically, excessive pressure on instructors and prolonged waiting times for student operations constrain the overall improvement of teaching quality. To address this structural contradiction, this study introduces micro-lectures as a core vehicle, systematically constructing and implementing a digitally assisted model aimed at optimizing the teaching process. Practice has shown that by embedding standardized, reusable micro-lecture resources proactively into various teaching stages, this model effectively alleviates the burden of repetitive demonstrations on teachers and significantly reduces student idle time in the classroom. Consequently, it creates the necessary conditions for personalized teacher guidance and refined student training. Post-reform, students' skill acquisition and project completion rates have substantially improved. This study confirms that digital resources, represented by micro-lectures, play a fundamental role in restructuring teaching processes and unleashing instructional effectiveness. The practical pathway of "problem diagnosis—resource intervention—process optimization—efficacy release" established herein provides a valuable preliminary paradigm for the digital reform of similar courses.

Keywords

Micro-lecture, Jewelry Processing and Production, Teaching Efficacy, Digital Assistance

1. Introduction

Against the backdrop of the nation's strategic push for comprehensive digital transformation in education and the construction of a modern vocational education system, applied undergraduate education is shifting from mere knowledge transmission to the deep cultivation of competence and professional literacy. Experimental teaching, as the pivotal link for this transition, has become a critical focus for enhancing teaching effectiveness and deepening instructional reform (Lu et al., 2020). Nevertheless, in current practice many high-skill-intensity courses still encounter a bottleneck of over-emphasis on resources while neglecting process optimization. The introduction of digital technologies has yet to reach the core instructional processes, and consequently its potential to improve teaching quality remains largely untapped.

The "Jewelry Processing and Production" course serves as a typical example of this contradiction. As a core course requiring students to master high-precision manual techniques such as sawing, welding, and polishing, its instructional effectiveness depends on timely, precise, personalized guidance. However, under the traditional teacher-centered, synchronous modeling paradigm, the course falls into a dilemma of declining guidance effectiveness. The underlying tension stems from the incompatibility between the uniform pace demanded by large-scale class teaching and the personalized, asynchronous instruction needed for skill acquisition. As the sole expert in the classroom, the instructor's energy and time are consumed by repetitive basic demonstrations and Q&A, leading to a serious lack of deep mentorship and creative stimulation for students. Consequently, students, deprived of immediate feedback, experience frequent interruptions in their skill-training process, resulting in low completion rates and substandard quality of course projects.

To break this impasse systematically, a novel approach that structurally optimizes the teaching process and enables scalable provision of instructional resources is required. In this context, digital teaching resources represented by micro-lectures demonstrate unique value. With their core features—focused content, reusable access, and support for asynchronous learning—micro-lectures can deconstruct complex operations into standardized, modular units, allowing high-skill-intensity tasks to be delivered in bite-size, precise formats. Consequently, they provide a new technical pathway that frees instructors from repetitive tasks, enabling them to concentrate on advanced instruction and ultimately enhance overall classroom effectiveness (Mao & Niu, 2021).

Based on this, the present study, grounded in the teaching practice of the 'Jewelry Processing and Production' course, seeks to answer the following core question: In a hands-on course characterized by high-skill training, how can purpose-driven design and systematic application of micro-lectures improve and augment the traditional teaching process? Moreover, how can this approach effectively reduce the instructor guidance load, enhance in-class time utilization, and provide a feasible pathway for comprehensively boosting students' skill attainment? By implementing a complete teaching cycle, this study will detail the construction, integration, and deployment of micro-lecture resources. Supported by an empirical analysis of teaching outcomes, it aims to offer a concrete, actionable case reference for

similar courses navigating the early stages of digital transformation.

2. Literature Review – Micro-lectures as a Teaching Aid

A micro-lecture is an instructional resource that uses short video as its core medium, designed to provide a targeted explanation of a single knowledge point or teaching segment. Its essential characteristics are widely summarized as “short, concise, and compact,” meaning it is highly focused, brief in duration, and clear in its objective. This format inherently fits students’ fragmented learning time and mobile learning scenarios (Li et al., 2018).

2.1 Core Supporting Functions of Micro-lectures

Existing research and practice have confirmed several fundamental functions of micro-lectures as teaching aids. The primary function is their repeatability, which overcomes temporal and spatial constraints. Students can pause, rewind, and replay procedural details on demand, providing an effective solution to the “can’t see clearly, can’t remember” problem that arises from “one-time demonstration, multiple observers.” Secondly, micro-lectures serve as standardized demonstrations. Recorded carefully by teaching teams, they ensure that key operational steps, safety protocols, and other critical information are delivered to every student in the most accurate and standardized manner, thereby reducing instructional variances caused by differences in individual teachers’ explanations or fluctuations in the classroom environment or the teacher’s condition. Furthermore, micro-lectures play a vital role in supporting pre-class preparation and after-class review, enabling students to familiarize themselves with experimental content beforehand or to address learning gaps, thus extending the effective learning pathway (Wu et al., 2021).

2.2 The Instrumental Role of Micro-lectures in Laboratory Teaching

Within the domain of laboratory teaching, the value of micro-lectures lies primarily in their ability to assist and supplement traditional instructional phases. Substantial research indicates that providing students with micro-lectures on equipment operation and fundamental technical processes for pre-class study significantly improves their operational proficiency and safety once they enter the lab. During class, when students encounter forgotten or unclear steps, micro-lectures serve as an immediate electronic reference book, allowing rapid consultation. This reduces their dependence on waiting for teacher assistance and, to some extent, alleviates the instructor’s in-situ guidance pressure. These applications clearly demonstrate that the primary role of micro-lectures in current educational practice is that of an efficient information-delivery medium and a visual cognitive tool, whose value resides in enhancing the effectiveness of specific instructional segments.

In summary, as a mature teaching aid, micro-lectures’ role in enhancing knowledge delivery efficiency and supporting personalized review and preparation is well-established. However, for specific contexts involving complex, high-precision manual skills such as jewelry design and fabrication, a critical question remains: how can we systematically design a micro-lecture resource architecture and integrate it thoroughly throughout the entire learning pathway to maximize its practical benefits by replacing

repetitive demonstrations and reducing ineffective waiting? This requires context-specific program design and empirical validation.

Based on this foundation, the present study acknowledges and builds upon the fundamental utility of micro-lectures described above. It aims to systematically explore a feasible resource architecture for the construction and application of micro-lecture resources within the specific context of a university-level jewelry design and fabrication course. The study further seeks to empirically evaluate its concrete effects on alleviating teaching and learning workload and improving classroom time efficiency.

3. Micro-Lecture Resource Construction and Application Design for Classroom Activation

In the context of the digital transformation of education, the construction quality and application mode of micro-lectures—an important digital teaching resource—are directly linked to the improvement of teaching effectiveness. Grounded in an activity-theory perspective, this study builds a comprehensive resource architecture for the construction and application of micro-lecture resources. The aim is to optimize classroom teaching structures and enhance instructional efficacy through systematic resource design and process redesign.

3.1 Industry-Standard-Based Micro-Lecture Resource Development

Micro-lecture resource construction is a systematic undertaking that must follow educational laws and technical standards. This study adopts a three-phase development path of "industry tracing, teaching deconstruction, and educational reconstruction" to ensure that the micro-lecture resources can not only promptly adapt to the dynamic updates of industry standards but also align with the fundamental cognitive needs in the teaching process (Jiang, Xu, Guo, et al., 2025). During the Industry Tracing stage, the teaching team conducts field research on the production line of jewelry-manufacturing enterprises, authentically documenting the key operational procedures performed by senior technicians. Video recording is used to capture first-hand raw footage. The footage covers core technical processes such as precious-metal material handling, precision sawing, high-temperature welding, and surface finishing. This material not only guarantees the standardization of skill delivery but also introduces the latest industry standards and technological innovations into teaching practice, effectively addressing the lag in skill updates that traditionally hampers instruction (Jiang & Huang, 2016).

3.2 Micro-Lecture Resource Development Centered on Common Difficulties

While this raw footage ensures the authenticity and standardization of skill demonstration, its long duration and relaxed pacing make it resemble an industrial-documentary style video, which does not readily meet classroom requirements regarding student attention and cognitive load. To solve this problem, the teaching team carried out a teaching-oriented deep-processing of the original material. This process focuses on two key steps—deconstruction and reconstruction. "Deconstruction" refers to the process of breaking a complex, continuous operational sequence into a set of discrete, well-defined micro-skill units based on the inherent logic of skill acquisition. For example, the highly error-prone welding process can be decomposed into core steps such as flame regulation, temperature judgment, flux

flow control, and weld-seam inspection. The instructional flow begins with the basic safety operation of flame regulation, proceeds to the handling step of flux placement, then moves to the critical micro-skill of heat control, and finally concludes with weld-seam quality analysis and defect remediation as the quality-control closure. These four units are relatively independent yet tightly linked, forming a complete learning loop for welding skills that reflects both the progressive and holistic nature of skill cultivation. In the reconstruction phase, the research focus shifts from content decomposition to pedagogical-expression design. The core of this stage lies in transforming the de-constructed knowledge units into instructional media that align with cognitive principles. Reconstruction is not a simple video-editing task; it is a pedagogical-principles-based re-creation process: first, restructuring the narrative logic by converting the linear workflow into a problem-centric micro-teaching narrative, such as organizing content around “how to control flux flow”; second, redesigning visual guidance through close-up shots and dynamic annotations to direct attention to critical details; finally, recalibrating the cognitive rhythm to form a compact “pose the question → demonstrate the process → summarize key points” structure. This deep, pedagogy-oriented processing elevates micro-lectures from mere operational records to efficient teaching components, thereby laying a solid foundation for their classroom application.

3.3 Parallel Guidance Model Integrated into the Full Teaching Process

A high-quality resource library must be embedded within an effective instructional process to unlock its potential. This study constructs a full-process application model centered on micro-lectures that spans the pre-class, in-class, and post-class phases (Gao et al., 2019). The core objective is to break away from the traditional classroom’s linear cycle of “teacher demonstration → student waiting → teacher guidance,” and to establish a more flexible and efficient dual-track parallel teaching model. During the pre-class phase, instructors, via an online teaching platform, provide students with a curated set of micro-lectures closely linked to the upcoming experimental task, together with guided activities that require autonomous learning. This arrangement enables students to form a clear cognitive schema of the operational procedures, technical key points, and safety protocols before entering the laboratory. The front-loading of knowledge provides a solid foundation for highly efficient hands-on practice during class. During the in-class experimental phase, the role of micro-lectures shifts to that of an embedded teaching assistant supporting just-in-time support for learning. When students encounter confusion or forget operational details during hands-on practice, the teaching process explicitly directs them to first review the corresponding micro-lecture video. This “Micro-lecture First, Guidance Second” strategy aims to cultivate students’ self-directed (autonomous) learning and problem-solving skills. Its most immediate effect is a significant reduction in downtime—the pause in operation caused by the whole class relying on a single teacher resource—thereby reallocating precious classroom time to hands-on practice. For the instructor, micro-lectures assume a substantial load of repetitive, fundamental guidance tasks, freeing the teacher from the previously exhausting “fire-fighting” mode. Consequently, the teacher can redirect the conserved energy to conduct whole-class observations, keenly identify common technical challenges,

and provide more targeted personalized tutoring and higher-order thinking support for students who need deeper assistance. In the post-class phase, micro-lectures continue to serve as personalized resources that support student reflection and consolidation. Students can revisit these materials at any time to compensate for shortcomings of classroom learning and to promote the deep internalization of knowledge and skills. Through the systematic embedding of micro-lectures, the entire application process achieves structural optimization of the traditional instructional pathway. This frees teachers from repetitive tasks, allowing them to shift from fragmented “fire-fighting” to more strategic roles. At the same time, it extends students’ learning agency forward and embeds it more deeply into practice, thereby enhancing overall classroom effectiveness—the original design intent of activating the classroom’s collective efficacy (Yang et al., 2022).

3.4 Chapter Summary

This chapter details the standardized construction of micro-lecture resources at the industry source and their deep integration into the classroom teaching process. By innovating both resource construction and process design, micro-lectures have been transformed from a marginalized auxiliary material into a core element that underpins efficient classroom operation. This systematic design provides a solid foundation for the subsequent evaluation of its effectiveness in actual teaching, and the practical outcomes will be examined and validated in detail in the next chapter.

4. Analysis of Implementation Effects: From Structural Optimization to Performance Improvement

Through three rounds of iterative teaching practice and systematic observation, the micro-lecture-supported model constructed in this study has demonstrated multidimensional effectiveness in large-scale experimental teaching scenarios. By combining quantitative data with qualitative observations, we carried out a comprehensive evaluation of the restructured teaching process. The value of this model is reflected primarily in three interrelated dimensions.

4.1 Structural Optimization of the Teaching Process and Efficiency Improvement

The deep embedding of micro-lectures first brings about a structural change in the teaching process, and its most immediate impact is seen in the optimization of classroom-time allocation. Continuous observation of the experimental courses shows that, after adopting the "Micro-lecture-First" guidance strategy, the idle time caused by students waiting for individual teacher assistance declines markedly. Classroom-behavior sampling analysis indicates that the average waiting time drops by roughly 60 % compared with the traditional model, meaning that time previously wasted is now effectively reallocated to hands-on practice and the internalization of skills. This transformation confirms the intrinsic value of micro-lectures as a "parallelized" instructional resource—by offering standardized demonstrations that can be accessed on demand, they overcome the bottleneck of the traditional one-on-one guidance model. At the same time, because key operational standards and safety protocols are delivered in advance and uniformly through micro-lectures, the rate of equipment failures caused by improper operation has

decreased by nearly 40%, thereby systematically enhancing the orderliness and safety of the learning environment. Consequently, the classroom ecology has shifted from a fragile system that heavily relied on teachers' instantaneous reactions and individual experience to a more resilient, stable, and autonomy-supportive learning space.

4.2 Optimization of Student Skill Acquisition Pathways and Consolidation of Learning Outcomes

The deep embedding of micro-lectures brings about a structural change in the teaching process, and its most immediate impact is the optimization of classroom-time allocation. Continuous observation of the experimental courses shows that, after adopting the "Micro-lecture-First" guidance strategy, the idle time caused by students waiting for individual teacher assistance declines markedly. Classroom-behavior sampling analysis indicates that the average waiting time drops by roughly 60% compared with the traditional model, meaning that time previously wasted is now effectively reallocated to hands-on practice and the internalization of skills. From the perspective of cognitive-load theory, micro-lectures decompose complex, multi-step skills into manageable cognitive units, thereby reducing extraneous cognitive load during the operational phase. This frees mental resources, allowing learners to concentrate more on the refinement of craftsmanship and problem-solving, which creates the necessary conditions for a larger proportion of students to achieve higher-level skill mastery. Post-course feedback consistently confirms that the on-demand availability of micro-lecture resources greatly facilitates self-directed learning, the tackling of difficult points, and error reflection, which in turn enhances learners' sense of control and confidence throughout the learning process.

4.3 Evolution of Teachers' Professional Roles and the Enhancement of Work Efficiency

While the use of micro-lectures frees students from waiting time, it also profoundly reshapes teachers' work patterns and professional roles. Once micro-lectures assume the basic, repetitive tasks of demonstration and Q&A, teachers are released from the high-intensity, reactive "piecemeal-firefighting" mode. This liberation does not imply a weakening of the teacher's role; rather, it catalyzes a valuable evolution of their professional identity—from a one-way knowledge presenter and process supervisor to a learning-environment designer, a process facilitator, and an innovation catalyst. In practice, teachers are no longer confined to the lectern or to answering elementary questions. Instead, they can conduct classroom-wide monitoring, allowing them to identify students' personalized challenges and nascent creativity in the integration of design and craftsmanship earlier and more precisely.

The timing of teacher intervention shifts from post-hoc error correction to guidance during the learning process, and the instructional focus moves from the basic question of "how to do it correctly" to the higher-order question of "how to do it better and more creatively." This shift means that teachers' professional expertise is no longer dissipated by routine tasks; instead, it is reconfigured and directed toward more creative instructional design, personalized tutoring, and scholarly guidance, thereby deeply liberating work efficiency and restoring the core professional value.

4.4 Chapter Summary

Synthesizing the above analysis, the core achievement of this practice lies in the systematic embedding

of processes that enables micro-lectures to evolve from a peripheral aid into an indispensable procedural element of classroom instruction. Their fundamental value goes beyond the original role as a knowledge-delivery medium; it is manifested most clearly in the strategic reallocation of two scarce educational resources—classroom time and teacher effort. By effectively assuming standardized, foundational teaching tasks, micro-lectures break the inefficient cycle of "teacher exhaustion and student waiting," thereby providing a viable pathway toward a more supportive, efficient instructional design that fosters deep learning. This shift from "tool" to "essential element" constitutes the underlying mechanism by which micro-lectures exert a fundamental impact in this curricular reform.

5. Discussion and Conclusion

By systematically integrating micro-lecture resources into the instructional workflow, this study empirically demonstrates the effectiveness of micro-lectures as a classroom catalyst in high-skill-intensity, hands-on courses such as Jewelry Processing and Production. The findings show that, leveraging their core features—repeatable access and support for asynchronous learning—micro-lectures free instructors from repetitive tasks and significantly reduce students' idle time during hands-on activities, thereby enhancing overall classroom efficiency. These outcomes not only confirm the theoretical value of micro-lectures as cognitive tools for reducing extraneous cognitive load and supporting personalized learning pathways, but also address the practical challenge of balancing skill standardization with individualized guidance in the context of large-scale instruction.

However, this study also reveals several issues that merit deep reflection. The effective operation of the micro-lecture model largely depends on students' autonomous learning willingness and digital literacy, which may give rise to learning disparities already in the preview stage, posing potential equity challenges for students who have limited access to digital resources or entrenched learning habits. Moreover, although micro-lectures efficiently handle the transmission of standardized knowledge, they impose new demands on teachers' competency structures: how to use learning-analytics data from micro-lectures for precise interventions, and how to design higher-order inquiry activities, become new imperatives for professional development. These findings remind us that the essence of technology-enabled education lies in fostering educators rather than merely producing tools, and that any digital tool must evolve together with pedagogical philosophy, assessment methods, and the roles of teachers and learners.

In conclusion, this study offers a practical framework for applying micro-lectures in practice-based courses, covering resource development and process integration. Its core contribution lies in empirically demonstrating—through rigorous research—that repositioning micro-lectures from peripheral auxiliary resources to core procedural elements can systematically optimize classroom instruction and unlock the potential of teachers and students. The industry-benchmarking → instructional deconstruction → precise reconstruction resource-development pathway, together with the "micro-lecture first, teacher-guided" dual-track instructional model developed in this study, provides concrete, actionable references for

comparable high-skill, hands-on courses that are in the early stages of digital transformation. Future research can build upon this foundation to further explore the deep integration of micro-lectures with project-based learning, virtual simulation, and other pedagogical models, while examining their adaptability and sustainability across diverse institutional contexts and student populations. This will propel digital teaching reform from mere “tool application” into the deep-water zone of “ecological reconstruction.”

Fund Project

Cultivation Project of School-level Curriculum Ideological and Political Education Demonstration Course at Guangzhou City University of Technology (2025-2026)- Course: “Jewelry Production Process”. (NO. J2125020)

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