Exploring Pathways for Digital Empowerment in Vocational Undergraduate Teaching Models: A Case Study of the Precision Measurement Technology Course

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Abstract: Vocational undergraduate education focuses on the cultivation of high-level technical and skilled talents. As one of the core courses of Mechanical Manufacturing and Automation, Precision Measurement Technology has extremely high requirements for students' practical ability and digital application ability. Based on this, this paper focuses on the challenges in precision measurement technology course teaching at the vocational undergraduate level, and explores the construction path of digital empowerment teaching model. It aims to break teaching barriers through digitalization, improve students' core competence in precision measurement, and provide practical reference for the reform of integrated theory and practice courses in vocational undergraduate education.

Keywords: Vocational undergraduate education; Digital; Precision measurement technology; Teaching model; Pathway exploration

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1.Introduction

With the implementation of the "Digital China" strategy, Digital technology has brought new opportunities for curriculum teaching reform. Based on this, this paper takes Precision Measurement Technology as the research object, and deeply explores the specific implementation path of the Digital empowerment teaching model. The goal is to realize the deep integration of "theoretical teaching—digital simulation—practical application", so as to cultivate high-level technical talents to meet industrial needs.

2.Current Teaching Situation of Precision Measurement Technology

At present, CMM is expensive and difficult to maintain, so it is difficult for most universities to realize the "one student one machine" training allocation, which limits students' practical operation and leads to poor teaching effect. In addition, some complex and industry-specific measuring parts cannot be trained physically, making it difficult for students to contact real and complex work tasks, resulting in inconsistent understanding of actual post requirements. In terms of teaching content and methods, the course often has the problem of disconnection between theory and practice.

Under the background of digital empowerment, the teaching model of precision measurement technology course should take "technical skills combined with digital literacy" as the core. It is necessary to ensure that students master the core professional competence of precision measurement, and at the same time cultivate the comprehensive literacy to meet the digital needs of the industry, and finally achieve the talent training goal of seamless connection with posts.

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3.Digital Empowerment Paths of Vocational Undergraduate Teaching Model

3.1 Application of Precision Measurement Virtual Simulation Training System

The application of precision measurement virtual simulation training system is an important way to break through the limitations of traditional training hardware and improve students' practical ability. It is necessary to build a high-simulation and high-interaction virtual training environment around curriculum core knowledge points and typical post tasks.The holographic simulation system covers the whole process of precision measurement, including equipment operation, parameter setting, measurement programming, data collection and error analysis. Using 3D modeling technology to restore the appearance, operation interface and working principle of Hexagon measuring equipment, students can complete a full set of operations from equipment calibration to part measurement in the virtual environment. For high-cost, high-risk and difficult-to-implement training scenarios in this course, such as precision measurement of large parts and size detection of complex components, the application of this system has significant advantages. By restoring real working conditions in the virtual simulation system, students can be familiar with the key operation points and precautions of various measurement scenarios through repeated practice and exploration.

In addition, the system has a real-time feedback function, which automatically prompts the cause of errors and correction methods when students make mistakes. After training, the system automatically generates videos recording operation steps, measurement data and error results, which helps students review and optimize, and facilitates teachers' evaluation and guidance. In the "Engine Cylinder Body and Shaft Parts Programming Measurement" module of Precision Measurement Technology, students can use the virtual system to repeatedly practice probe replacement, coordinate system establishment, measurement point planning and other operations of CMM, effectively master the detection methods of typical parts, lay a foundation for subsequent physical training, and effectively solve the problems of insufficient equipment and limited practice opportunities in traditional training.

3.2 Construction of Course Digital Twin Teaching Scenarios

Constructing digital twin teaching scenarios is a "virtual-real integration" teaching method and the key to improving the connection between courses and posts. Taking real industrial measurement projects as the blueprint, digital twin technology is used to build a virtual teaching environment to realize synchronous mapping with the physical world. Scene construction needs to integrate enterprise actual part models, production process data, measurement standards and other information, restore the enterprise precision measurement workflow in the virtual environment, and let students learn in the simulated post scene.

Digital twin teaching scenarios need to have "virtual-real interaction". When students formulate measurement schemes and carry out measurement operations in the virtual environment, the system can compare and analyze virtual measurement data and physical measurement data, intuitively show the differences between virtual and actual operations, and help students understand the source of measurement errors. At the same time, the scenario can be dynamically adjusted to simulate the changes of various working conditions, such as the influence of part material changes and ambient temperature fluctuations on measurement results, guide students to analyze variable factors, and promote the solution of complex measurement problems.

In the "Production Line Parts Batch Testing" module of Precision Measurement Technology, students can simulate the industrial production line measurement process in the digital twin environment, formulate measurement plans according to the conveying rhythm of virtual production line parts, and carry out synchronous comparison of virtual and physical measurement data, so as to prepare for the working methods and efficiency requirements of industrial posts in advance.

3.3 Design of "Digital Task-Driven" Teaching Modules

Designing digital task-driven teaching modules is an important way to break the barrier between theory and practice and deepen students' knowledge application ability. Centering on curriculum content, designing progressive digital learning activities based on real industrial measurement tasks enables students to acquire knowledge and improve abilities in the process of completing tasks. Task design should follow the logic of "basic—advanced—comprehensive".Basic tasks focus on simple measurement structures and single measurement parameters, such as "diameter" and "distance" dimension measurement; advanced tasks emphasize the integration of multiple knowledge points, such as "dimension" and "geometric tolerance" measurement; comprehensive tasks simulate complex industrial real projects, such as "oil pan size automatic measurement program writing and testing course design". Each task module is supported by digital tools and resources such as teaching videos, digital measurement templates and online collaborative documents to guide students to complete tasks through independent exploration or group cooperation.

In addition, the module sets up a digital submission and display link of task results. Students upload measurement data and analysis reports to the digital platform. Excellent works fed back by teachers online can be included in the course case library for other students to reference. In the "Flat Parts Precision Measurement" teaching of Precision Measurement Technology, teachers can develop a "digital task-driven" teaching module. Students take groups to plan measurement paths, simulate measurement processes with digital measurement software, and finally generate digital reports including measurement data, error analysis and optimization suggestions, so as to deepen their understanding of precision measurement principles and methods of flat parts.

3.4 Construction of Precision Measurement Digital Resources

Building a precision measurement digital resource library is an important support to realize students' personalized learning and enrich teaching content. Centering on curriculum needs, systematically integrating diverse resources to form a multi-level system covering "theoretical learning, training guidance and career development".The resource library includes theoretical resources such as measurement principle animation explanation, key and difficult knowledge video analysis and electronic textbooks; training resources such as equipment operation demonstration videos, training task work orders and virtual operation manuals; post development resources such as enterprise measurement cases, industrial technical standards and the latest measurement technology trends. The resource library has the functions of classified retrieval, personalized recommendation and dynamic update. Students can quickly find resources according to their learning progress and needs, and the system can push targeted learning content according to students' learning data.

At the same time, the resource library needs to cooperate with industrial enterprises to update real cases and technical standards regularly to ensure timeliness and post relevance. In the study of Precision Measurement Technology, students can use the digital resource library to watch CMM operation demonstration videos and measurement cases of various parts at any time. After class, they can use the virtual training materials in the resource library to consolidate practical skills and independently explore cutting-edge measurement technology to meet personalized learning needs.

4.Conclusion

In short, the digital education model provides an important breakthrough for the teaching reform of precision measurement technology courses in vocational undergraduate education. Its core idea is to use digital technology to reconstruct the teaching environment and optimize the teaching process, rather than simple technical superposition. Through the in-depth application of virtual simulation , it not only breaks through the practical limitations of traditional teaching, but also cultivates students' digital measurement thinking and application ability.

In the future, it is necessary to continue to deepen the integration of digital and curriculum, and iteratively update teaching content and models combined with industrial technology, so that vocational undergraduate education can truly resonate with industrial needs and lay a solid foundation for the cultivation of high-level digital technical and skilled talents.

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