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Digital Course Practice of Mechanical Innovation Design Based on Outcome-Based Education (OBE) and the Thousands of Faces Concept

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Abstract. The advancement of educational technology has facilitated the implementation of outcome-based education (OBE) and personalized talent development models in higher education. This study concentrates on the innovative design of mechanical engineering digital curricula, integrating OBE principles with personalized learning approaches to enhance students' creative and practical skills. The research identifies issues such as unclear curriculum objectives and monotonous content, and proposes well-defined, specific, and quantifiable curriculum goals, along with a personalized curriculum content design. It suggests incorporating diverse teaching methods and flexible assessment techniques to boost student engagement and enthusiasm. Following implementation, students' learning outcomes have shown significant improvement, with increased innovation and practical abilities. The study further investigates the profound integration of OBE and personalized concepts within the curriculum, emphasizing a student-centered approach, focusing on learning outcomes, making personalized adjustments to course content, and utilizing digital teaching tools to enhance interactivity and practical application. Curriculum design is optimized through feedback and evaluation to ensure students meet learning objectives, enhance teaching quality, and support individualized development.

Keywords: OBE concept, individualized learning, mechanical innovation design, digital course implementation, personalized instruction

1. Introduction

Technological advancements and evolving educational philosophies pose both challenges and opportunities for higher education, particularly in the realm of mechanical engineering. To address the demand for innovative talent, it is crucial to investigate and integrate new educational concepts into the mechanical innovation design curriculum. The Outcome-Based Education (OBE) philosophy focuses on student-centered, outcome-driven design and assessment of teaching methodologies. In mechanical engineering, OBE aids in defining clear learning objectives for students and in fostering their motivation for learning and innovation. The Thousand Talents training model advocates for personalized education, tailoring teaching content and methods to align with students' interests and needs, thereby maximizing each student's potential and creativity. The mechanical innovation design course demands that students possess a high level of innovation, practical skills, and comprehensive qualities [1]. The integration of the OBE concept with the Thousand Talents model can significantly enhance students' innovative and practical capabilities.

The proliferation of digital technology has made digital courses a vital component of higher education, offering technical support for the implementation of the OBE philosophy and the Thousand Talents model. Digital platforms enable teachers to access learning analytics, provide individualized guidance to students, and encourage self-directed and collaborative learning [2]. The application of the OBE concept and the Thousand Talents model to the digital course of mechanical innovation design is of great importance for the innovation of educational concepts and the transformation of educational models. It also aids in cultivating mechanical engineering professionals who embody an innovative spirit and practical skills.

2. Overview of the OBE Teaching Concept and the Training Mode of Thousands of Talents

2.1. OBE Teaching Concept

Outcome-Based Education (OBE), a student-centered educational model, focuses on learning outcomes. It requires educators to establish clear, specific, and measurable learning objectives to assist students in understanding their progress and results, adjusting their learning strategies, and enhancing their learning outcomes. The essence of OBE lies in addressing students' needs, interests, and abilities by offering personalized learning resources and guidance, emphasizing teaching according to individual aptitudes, respecting personality differences, and providing the most appropriate educational methods and resources [3].

Continuous improvement is a critical component of the OBE teaching philosophy. Educators must regularly reflect on and refine their teaching methodologies and assessment mechanisms to ensure that students achieve their learning goals while stimulating their interest and potential. The OBE teaching framework underscores student initiative and autonomy, positioning them as the primary agents of their learning. This encourages active participation in the learning process and fosters innovative thinking and practical skills.

The OBE teaching philosophy holds significant promise for application in higher education, particularly in the context of digital courses for mechanical innovation design. It can offer students personalized, innovative, and practical learning experiences, cultivate creative thinking and hands-on capabilities, and lay a solid foundation for future career development. When implementing the OBE teaching philosophy, it is essential to focus on setting clear learning objectives, providing tailored learning resources and guidance, and continuously enhancing teaching approaches and evaluation systems to optimize the learning process, deliver superior educational services, and nurture high-caliber talent.

2.2. The "Thousand Faces, Thousand Talents" Personnel Training Model

A model for training thousands of talents, as an innovative educational concept, emphasizes the uniqueness and individual needs of students, advocates teaching according to aptitude, and aims to stimulate their potential. Education is no longer an "assembly-line operation" but is instead refined and customized based on the characteristics of students. The core of this model lies in respecting the individual differences among students, recognizing that each student possesses unique interests, abilities, and potentials. Educators should take these individual needs into account, provide tailored learning programs and resources, stimulate interest and enthusiasm for learning, leverage strengths, and maximize self-worth. The implementation of this model facilitates meeting individual needs by providing personalized learning opportunities and resources to help students achieve self-development [4]. In contrast, the traditional education model often restricts individual development. The "thousands of faces" model offers students appropriate learning plans based on their actual situations and needs, thereby enhancing teaching effectiveness. Teaching according to aptitude enables educators to accurately assess students' learning status and challenges, provide targeted guidance, improve learning efficiency, and cultivate independent learning and problem-solving skills.

The model infuses new vitality into talent development, fostering and supporting students' innovative thinking and practical capabilities while cultivating an innovative mindset and creativity. Personalized training also enhances teamwork skills and social adaptability, enabling students to approach future challenges with greater poise and confidence. The implementation of this model necessitates educators possessing a high level of professional competence and educational acumen, thoroughly understanding the characteristics and needs of students, mastering diverse teaching methodologies, and delivering the most appropriate educational services. Furthermore, educators must engage in continuous learning and self-renewal to accommodate emerging changes and challenges within the educational domain. In practice, educators can draw inspiration from successful cases, such as the personalized recommendations made by e-commerce platforms through big data analytics. This "thousands of faces" marketing strategy can be adapted to education, assisting educators in better comprehending students' needs and preferences and providing precise, tailored educational services. The talent development model represents an innovative and pragmatic educational concept that prioritizes individualized instruction and training to meet students' unique requirements and developmental potential [5]. The realization of this model aims to cultivate more high-caliber talents with an innovative spirit and practical abilities, contributing to societal advancement and progress.

2.3. Combination of OBE with Thousands of People

The integration of the OBE teaching philosophy and talent cultivation model in higher education focuses on individual differences and learning outcomes among students. OBE emphasizes a student-centered approach, establishing clear, specific, and measurable learning objectives, while organizing teaching activities around these goals. The Thousand Faces model highlights personalized instruction tailored to individual aptitudes, advocating for customized training to meet the diverse learning needs and developmental directions of students. In the digital course on mechanical innovation design, the combination of OBE and the Thousand Faces model demonstrates significant advantages. Clearly defined learning objectives enable educators to guide students more precisely in mastering core knowledge and skills, thereby ensuring anticipated learning outcomes. Meanwhile, the Thousand

Faces model assists educators in gaining deeper insights into students' characteristics and requirements, providing personalized learning resources and targeted tutoring.

Educators can customize learning paths and project tasks for students based on their interests, abilities, and career development directions. For instance, students interested in mechanical design are provided with relevant design cases and practical opportunities, while those interested in digital technology are offered programming and simulation learning resources. By integrating OBE (Outcomes-Based Education) with personalized approaches, educators can stimulate students' interest and enthusiasm for learning. When students perceive that their needs and interests are acknowledged and satisfied, they become more proactive in their studies, actively exploring and solving problems, which enhances both learning outcomes and innovative thinking.

Educators must also reflect on and refine their teaching methods and evaluation mechanisms. Through teaching feedback and student evaluations, they can gain insights into learning conditions and adjust teaching strategies and resource allocation accordingly. Big data and artificial intelligence technologies will be leveraged to analyze students' learning behaviors and outcomes, providing a scientific foundation for personalized training. The integration of OBE with innovative methodologies brings fresh perspectives and techniques to the digital curriculum of mechanical innovation design. By setting clear learning objectives and utilizing personalized learning resources, educators can effectively guide students to master core knowledge and skills, thereby stimulating interest in learning, improving teaching effectiveness and learning outcomes, enhancing students' innovation and practical capabilities, and infusing new vitality into higher education [6].

3. Analysis of the Practice Status of Digital Course of Mechanical Innovation Design

3.1. Challenges of Digital Course Practice

Digital curriculum holds significant potential in the domain of mechanical innovation design; however, it also encounters several challenges. The continuous technological updates necessitate that both teachers and students possess adequate information literacy. Nevertheless, some educators and learners encounter difficulties in applying information technology, which in turn constrains the full realization of the curriculum's advantages. Additionally, the high costs associated with the development and maintenance of digital curricula present a substantial challenge for colleges and universities with limited resources. Therefore, there is an urgent need to design courses that align with the teaching philosophy of Outcomes-Based Education (OBE) while addressing the requirements of individualized talent cultivation.

Digital curriculum evaluation and feedback mechanisms require enhancement. Traditional evaluations focus predominantly on knowledge mastery while overlooking comprehensive assessments of qualities such as innovation capabilities. Therefore, it is essential to construct a scientific and rational evaluation and feedback system that can more effectively monitor students' learning progress and offer targeted guidance. To address existing challenges and issues, greater investment in information technology training is necessary, thereby enhancing the digital literacy and practical application skills of both educators and learners. Additionally, government and societal support for digital curriculum development through resource allocation and funding provision is crucial. Universities should also reform their evaluation and feedback frameworks to align with the requirements of OBE (Outcomes-Based Education) teaching methodologies and talent cultivation objectives. These strategies will collectively contribute to improving the efficacy and quality of digital curricula [7].

3.2. Problems Existing in the Practice of Digital Curriculum

There are some problems in the practice of digital course of mechanical innovation design, which affect the teaching quality and students' learning effect. The course goal is not clear, the lack of clear learning goal leads to the confusion of students' learning, affecting the motivation and effect of learning. The content of the course is simple, too much emphasis on theory and technical details, neglect of innovative thinking and practical ability training, need to enrich the teaching resources. The teaching method is single, the traditional method is teacher-centered, and a variety of teaching methods should be explored, such as project-based learning and flipped classroom. The lack of practical links restricts students from applying knowledge to practice. The design of practical links needs to be strengthened to provide more practical opportunities. In order to improve students' innovative ability and practical ability, it is necessary to comprehensively reform the curriculum objectives, contents, methods and practical links.

3.3. The Improvement Direction of Digital Curriculum Practice

To solve the problem of designing digital course for mechanical innovation, it needs to be improved from many aspects to conform to OBE teaching concept and personalized talent training mode. The key to improve the teaching effect is to make the course objective clear. Under the OBE concept, specific and measurable learning objectives should be set, covering basic knowledge, skills and innovation. This helps students to have a clear learning direction and to study in a targeted way. The content of the course should be rich and personalized to meet the needs of different students. In addition to basic theories, various teaching resources such as case base and project practice should be provided, and personalized content should be recommended by using big data analysis [8].

Improving teaching and assessment methods is crucial to improving curriculum effectiveness. Flexible teaching methods such as flipped classrooms and group discussions should be adopted, with emphasis on process assessment and diversified assessment to comprehensively evaluate students' learning outcomes. Strengthening practical links is the key to improving students' innovation and practical ability. Through virtual simulation experiments and school-enterprise cooperation, more practical opportunities are provided to help students understand and apply knowledge and cultivate innovative thinking and practical ability. Through the above improvement measures, the teaching effect and learning results of the digital course of mechanical innovation design can be improved, students' innovation and practical ability can be cultivated, and new vitality can be injected into the field of mechanical engineering.

4. Course Design Based on OBE and the Concept of Thousands of Faces

4.1. Course Goal Setting

We set the course objectives of mechanical innovation and digital design according to the OBE teaching concept, and ensure that the objectives are clearly directed to students' learning outcomes. The course emphasizes that students master the basic principles and methods of mechanical innovative design, and deepen their understanding through case studies and practical projects. The course focuses on cultivating students' ability to solve practical engineering problems by introducing real engineering cases, guiding students to analyze and solve them, and exercising their practical and problem solving abilities.

The course objectives also include cultivating students' innovation awareness and practical ability, encouraging students to propose new design concepts and schemes, and supporting students to carry out innovative design and research and development activities through platforms such as innovation LABS. We require students to understand the cutting-edge technology and development trend of mechanical innovation design, and broaden their horizons and knowledge through lectures and exchanges with industry experts. Through specific and measurable course objectives, we guide students to develop in an all-round way, master professional knowledge and skills, have innovation awareness and practical ability, and lay a solid foundation for future career development.

4.2. Curriculum Content Planning

When designing the digital course of mechanical Innovation and design, we follow the principle of individuation and build a systematic course system that includes three modules: basic knowledge, professional skills and innovative practice. Each module has its own unique teaching objectives, which together constitute a comprehensive learning experience. The Foundation knowledge module is the foundation of the course and includes the basic principles and methods of mechanical innovation design, helping students master core concepts and professional skills through explanations, cases and interactive activities. The professional skills module provides customized training based on students' interests and career plans, respects individual differences, and provides opportunities for in-depth technical research and improved problem-solving skills [9].

The innovative practice module is a distinctive feature of the course, offering practical opportunities via virtual simulation experiments and school-enterprise collaboration. This enables students to engage in real-world projects, interact with industry experts, and develop both innovative thinking and practical skills. The course content is dynamically updated based on student feedback and learning outcomes, ensuring its relevance and timeliness while addressing students' needs and fostering success. To enhance personalization and differentiation within the curriculum, each module integrates diverse teaching resources and interactive elements, including digital courseware, expert-led lectures and workshops, as well as an open-ended practice platform that encourages students to participate in innovative projects. The meticulously designed digital course in Mechanical Innovation Design aims to provide students with a holistic and personalized learning experience, fulfilling their requirements for knowledge acquisition, skill development, and innovative practice, thereby equipping them to become leaders in their respective fields.

4.3. Teaching Methods and Strategies

In the digital course of mechanical innovation design, it is very important to choose the appropriate teaching methods and strategies to achieve the course objectives. Teachers need to flexibly use a variety of teaching methods to stimulate students' interest and cultivate their abilities. Case teaching helps students understand principles and methods by introducing typical design cases. Cases should be representative and enlightening, leading to deep thinking. Teachers can use interactive methods such as group discussion and role play to enhance students' problem-solving and critical thinking skills. Project-based learning allows students to apply knowledge to real situations and develop a sense of practice and innovation through practical project design and implementation. Projects should be challenging and practical, stimulating interest in learning and creativity. Teachers should give students autonomy and support, encourage experimentation and innovation, and improve their ability to learn and innovate independently.

Under the flipped classroom model, students learn independently before class and the classroom is used for discussion and practice. This method improves the learning efficiency and independent learning ability, and promotes the communication between teachers and students. Teachers need to carefully design classroom activities to ensure students' participation and benefit.

Teamwork Students' teamwork and communication skills are developed through group learning and practice. Students collaborate with each other to complete tasks, enhance team awareness, and adapt to future work needs. Case teaching, project-based learning, flipped classroom and teamwork are common teaching methods. Flexible selection and combination according to students' situation and course needs can achieve course objectives and improve teaching effectiveness and learning outcomes.

5. Digital Curriculum Practice Implementation and Effect Evaluation

5.1. Implementation Process

Digital curriculum practice encompasses three critical stages: preparation, implementation, and summary. During the preparation stage, teachers are tasked with planning and designing the course, setting clear objectives, determining appropriate content, selecting effective teaching methods and evaluation tools, understanding student needs, and customizing learning resources accordingly. In the implementation stage, teachers execute the planned curriculum, guiding students to explore and practice through online platforms and virtual simulations. Simultaneously, teachers must actively monitor student feedback, adjust teaching strategies as needed, and foster a collaborative learning community. In the summary stage, teachers assess student learning outcomes, critically reflect on the teaching process, and refine future instructional practices for continuous improvement. Digital curriculum practice must remain adaptable to technological advancements and educational innovations. Teachers should cultivate insight and maintain an open mindset, continuously refining their teaching strategies and methods to ensure the curriculum remains vibrant and effective, thereby supporting students' holistic development and lifelong learning.

5.2. Methods of Effect Evaluation

In digital curriculum, teaching effect evaluation is the key to ensure and optimize teaching quality. We use a variety of evaluation methods and indicators. We value the assessment of learning outcomes and demonstrate quantified student knowledge and skills through tests, assignments and projects. This helps to understand how well students are learning and provides teachers with feedback on their teaching.

During the assessment of the learning process, it is necessary to gain insight into students' learning attitudes and problem-solving abilities by observing classroom performance, discussion engagement and self-directed learning. This helps to discover students' potential and provides a basis for personalized teaching. Students are encouraged to assess themselves, guided to reflect on their learning outcomes and processes, improve their self-cognition and management abilities, and cultivate their ability to learn independently and for lifelong learning.

In order to fully understand the teaching effect, we use questionnaires and interviews to collect feedback. Analyzing these data helps us to find and improve the problems in teaching and ensure the continuous improvement of teaching effect. Through multiple evaluation methods and indicators, we comprehensively and objectively evaluate the teaching effects of digital courses, ensure the quality of teaching, and promote the sustainable development and improvement of courses.

5.3. Evaluation Results and Analysis

The digital curriculum evaluation demonstrates that the curriculum design, which integrates OBE principles and the concept of "thousands of faces," has substantially enhanced students' learning outcomes. By setting clear objectives and incorporating personalized content, the course effectively reinforces students' knowledge and skills in mechanical innovation design. Students' interest and enthusiasm for learning are stimulated, while diverse teaching methods—such as case-based teaching and project-based learning—further improve learning effectiveness and deepen their appreciation for mechanical innovative design.

The teaching effectiveness has been significantly enhanced, as evidenced by students' high praise for the course content and teaching methods, alongside teachers offering personalized guidance to address students' needs. Students' practical skills and innovative thinking are effectively developed through practical opportunities provided by the course, such as virtual simulation experiments. As a result, students demonstrate excellent performance in practical projects. The course design, grounded in OBE principles and the concept of "thousands of faces," has yielded notable achievements in the digital mechanical innovation design curriculum. Moving forward, it will continue to evolve and refine its approach to further contribute to the advancement of mechanical engineering education.

6. Conclusions

In the digital era of mechanical innovation design, the implementation of OBE (Outcomes-Based Education) and personalized curriculum configuration face significant challenges. To address these challenges, substantial preliminary work is required, such as assessing students' abilities, designing differentiated teaching content, and integrating resources effectively. It is recommended to establish a dynamically updated teaching resource library and optimize resources based on students' needs and feedback. Teachers must balance teaching progress with individual differences, which necessitates enhancing their professional capabilities.

Strengthening teacher training programs is suggested, along with utilizing teaching management systems to monitor students' progress and adjust teaching strategies in a timely manner. Additionally, the establishment and refinement of an evaluation system are critical, as traditional assessment methods fail to fully capture students' learning outcomes. Therefore, it is essential to develop a diversified assessment framework that includes process evaluation, outcome evaluation, and feedback mechanisms, enabling precise understanding of students' learning results and guiding continuous teaching improvement.

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