ENHANCING PROFESSIONAL COMPETENCE AND CREATIVITY OF FUTURE ENGINEERS THROUGH INTERACTIVE TEACHING METHODS

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Abstract: the rapid advancement of technology and globalization necessitates the development of highly competent and creative engineers. Traditional teaching methods, which focus on rote memorization and passive learning, often fail to equip students with the critical thinking and problem-solving skills required in modern engineering practices. This paper explores the role of interactive teaching methods in fostering professional competence and creativity among future engineers.

Keywords: competence, pedagogical mechanisms, professional mentoring, cooperative education, mastered education, projects.

Introduction: engineering education plays a pivotal role in preparing professionals to tackle complex real-world challenges. In recent years, there has been a growing emphasis on shifting from traditional lecture-based instruction to more dynamic and student-centered approaches. Interactive teaching methods engage students actively in the learning process, fostering deeper understanding and enhancing their ability to apply theoretical knowledge in practical scenarios [1]. This paper examines various interactive teaching techniques and their impact on developing professional competence and creativity in future engineers.

The importance of professional competence and creativity in engineering: professional competence in engineering encompasses technical knowledge, problem-solving skills, teamwork, and effective communication [2]. Creativity, on the other hand, is essential for innovation and the development of new technologies. Engineers must be able to think critically, adapt to changing circumstances, and develop novel solutions to emerging problems. Traditional teaching methods often fail to nurture these skills, making it imperative to integrate interactive learning strategies into engineering curricul.

Interactive teaching methods in engineering education

1. **Problem-based learning (PBL)**

PBL is an instructional approach that encourages students to learn by solving complex, real-world problems. Instead of passively receiving information, students actively engage in research, analysis, and solution development. PBL enhances critical

thinking, collaboration, and self-directed learning, which are crucial for engineering professionals.

2. **Gamification and simulation-based learning**

Gamification involves incorporating game elements, such as rewards, challenges, and competition, into the learning process. Simulations, on the other hand, provide a virtual environment where students can experiment with engineering concepts in a risk-free setting. These methods increase motivation, engagement, and retention of knowledge.

3. **Flipped classroom approach**

The flipped classroom model reverses the traditional learning structure. Students review instructional materials, such as videos and readings, outside the classroom and engage in discussions, problem-solving, and hands-on activities during class sessions. This approach allows for deeper exploration of concepts and fosters collaborative learning.

Challenges and considerations in implementing interactive teaching methods: despite their benefits, interactive teaching methods present several challenges. These include the need for significant faculty training, the demand for resources and technological infrastructure, and the potential resistance from students accustomed to traditional learning approaches [3]. To successfully implement interactive strategies, educational institutions must invest in teacher development, curriculum redesign, and the integration of digital tools. Despite their benefits, interactive teaching methods present several challenges that educators and institutions must address. These challenges include the need for significant faculty training, the demand for resources and technological infrastructure, and potential resistance from students accustomed to traditional.One of the primary obstacles in implementing interactive teaching is the necessity for comprehensive faculty training. Many educators are accustomed to traditional lecture-based teaching methods and may lack the skills required to facilitate interactive learning experiences effectively. Transitioning to student-centered approaches, such as problem-based learning, flipped classrooms, and collaborative projects, demands professional development opportunities, workshops, and access to best practices in interactive pedagogy. Without proper training and institutional support, instructors may struggle to apply these strategies consistently, leading to ineffective learning experiences.Another significant challenge is the requirement for adequate resources and technological infrastructure. Interactive teaching often relies on digital tools such as learning management systems, multimedia content, virtual simulations, and collaborative online platforms. Institutions with limited budgets may find it difficult to invest in the necessary technology, software, and high-speed internet access, particularly in regions where digital infrastructure is underdeveloped. Additionally, maintaining and upgrading these

resources requires continuous financial commitment and technical support. Student resistance is another factor to consider. Learners who are accustomed to passive learning environments may initially struggle with interactive methods that require active participation, collaboration, and independent problem-solving. Some students may feel uncomfortable engaging in group discussions or may perceive interactive activities as more time-consuming compared to traditional lectures. Overcoming this resistance requires clear communication about the benefits of interactive learning, gradual adaptation strategies, and continuous encouragement from educators.To successfully integrate interactive teaching strategies, educational institutions must take a holistic approach. This includes redesigning curricula to incorporate active learning techniques, fostering a culture of innovation in teaching, and ensuring that both students and faculty receive the necessary support to transition smoothly. By addressing these challenges, institutions can create a more engaging, effective, and student-centered learning environment.

Conclusion: interactive teaching methods play a crucial role in developing professional competence and creativity among future engineers. By shifting from passive learning to active engagement, problem-solving, and collaboration, these approaches prepare students to meet the evolving demands of the engineering industry. Educational institutions must embrace these methodologies to ensure that graduates are equipped with the skills necessary for success in the modern workforce. Future research should explore the long-term impact of interactive learning strategies on engineering career outcomes and industry innovations.

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