

A RESEARCH-BASED APPROACH TO TEACHING MATHEMATICS FOR ENGINEERS USING THE CASE METHOD

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ABSTRACT

In modern engineering education, mathematical knowledge must serve not only as a theoretical foundation but also as a practical tool for solving complex real-world problems. However, traditional teaching methods in mathematics often rely on passive transmission of information and emphasize abstract computation over contextual understanding. This paper explores a research-based pedagogical alternative, the Case Method, as a transformative approach to teaching mathematics to engineering students. Rooted in constructivist learning theory and active learning principles, the Case Method engages students in realistic scenarios that demand analytical thinking, mathematical modeling, and collaborative problem-solving.

By integrating mathematics instruction with authentic engineering cases, the Case Method facilitates deeper cognitive processing, enhances motivation, and fosters long-term knowledge retention. This approach shifts the role of the instructor from lecturer to facilitator and challenges students to take ownership of their learning. Through guided exploration, they apply core mathematical concepts, such as linear systems, differential equations, optimization, and numerical methods, to address challenges drawn from disciplines such as civil, mechanical, and electrical engineering.

The paper provides a theoretical framework for using the Case Method in STEM education, supported by findings from the literature on research-based teaching. It presents concrete examples of classroom implementation, highlighting how mathematical concepts can be taught through structured case studies involving engineering scenarios such as heat transfer, structural stability, or construction logistics optimization. The observed impact on student engagement, critical thinking, and communication skills confirms the method's value in developing both academic competencies and professional attitudes.

While the Case Method presents certain challenges, such as increased preparation time and the need for flexible assessment methods, it aligns closely with the goals of modern engineering education, which prioritize problem-solving, interdisciplinary thinking, and applied knowledge. The study concludes that embedding the Case Method within mathematics courses contributes significantly to preparing future engineers for the demands of their profession, offering a powerful synthesis between theoretical rigor and practical relevance.

Keywords Case Method \cdot Engineering education \cdot Mathematics teaching \cdot Research-based learning \cdot Applied mathematics \cdot Active learning \cdot Problem-based instruction

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