Chapter 11
Integrating Multidisciplinary DBR in Mechanical Engineering Education, Challenges, and Opportunities:
Innovating ME Education via Cross-Discipline DBR

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ABSTRACT

This chapter explores the challenges and opportunities of integrating multidisciplinary design-based research (DBR) into mechanical engineering education. As engineering problems become more complex, there is a growing need for graduates who can work across disciplines. DBR enhances the mechanical engineering curriculum by fostering collaboration, promoting real-world problem-solving skills, and bridging theory and practice. The chapter addresses challenges in implementing DBR, including resistance to change, resource constraints, and assessment issues, while highlighting opportunities for improved student engagement, creativity, and industry partnerships. Case studies of successful DBR integration in mechanical engineering programs are presented, showcasing innovative approaches and out-

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comes. Finally, the chapter proposes strategies to overcome barriers and maximize the benefits of multidisciplinary DBR, contributing valuable insights for educators seeking to prepare students for the evolving demands of the engineering profession.

INTRODUCTION

Design Based Research (DBR) has emerged as a powerful methodology for enhancing educational practices and outcomes across various disciplines (Anderson & Shattuck, 2012). In the field of mechanical engineering education, the integration of DBR offers a unique opportunity to bridge the gap between theoretical knowledge and practical application, while simultaneously addressing the growing need for interdisciplinary skills in the engineering profession (Borrego et al., 2014). As engineering challenges become increasingly complex and multifaceted, there is a pressing demand for graduates who can navigate across disciplinary boundaries and apply diverse perspectives to problem-solving (National Academy of Engineering, 2004). The incorporation of multidisciplinary approaches within DBR frameworks presents a promising avenue for cultivating these essential skills in mechanical engineering students, preparing them for the evolving demands of industry and society (Johri & Olds, 2011).

OVERVIEW AND PRINCIPLES OF DESIGN-BASED RESEARCH

DBR came out as a response to the limitations of traditional educational research, which often failed to improve classroom practices due to its controlled, laboratory-like settings (Collins, 1990; Brown, 1992). DBR addresses this by engaging researchers and practitioners in an iterative process of designing, implementing, and evaluating educational innovations in real-world contexts. At its core, DBR is characterized by several key features that distinguish it from other research methodologies. It is grounded in theories of learning that inform the design of instructional tools and are, in turn, refined through the research process (Cobb et al., 2003; Barab & Squire, 2004). DBR aims to produce measurable changes in student learning within authentic classroom settings (Anderson & Shattuck, 2012; McKenney & Reeves, 2013) and generates design principles that guide the development and implementation of future instructional tools, making the research findings broadly applicable (Edelson, 2002).

The DBR process typically involves multiple iterations of design, implementation, and evaluation. Researchers collaborate closely with practitioners, viewing them as co-participants and co-investigators rather than mere subjects of study (Barab & Squire, 2004; Collins, 1990). This collaborative approach ensures that the research