The Case for Multi-Disciplinary Capstone Design: A Quantitative Analysis of Impact on Job Placement and Product Quality

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Introduction: Capstone design courses are designed to launch graduating students into industry by challenging them to apply engineering fundamentals and theory toward a solution to a real-world problem (Dym, et al, 2005). Commonly, capstone courses are team-based, constructed of students within a single discipline. In response to accreditation mandates and industry needs, several university programs have begun to take an interest in multi-disciplinary teaming (Educating the Engineer of 2020, 2012; ABET, 2012; Liefer, 1997). As of 2005, approximately 35% of engineering capstone design courses included interdepartmental or multidisciplinary teams, an increase from 21% reported in a 1994 survey of 1724 programs at 350 institutions (Howe & Willbarger, 2005; Todd, et al, 1995). However, there is limited quantitative evidence showing that multi-disciplinary student engineering teams develop higher quality projects or are better prepared for the work force. Therefore, we hypothesized that students who complete a multi-disciplinary capstone design (MCD) course have better outcomes than mono-disciplinary capstone students as measured by job placement and/or independent evaluation of their design products as adjudicated by external experts from industry.

Methods: In this comparative study, a single capstone course treatment was administered to three cohorts of course conditions: mono-disciplinary biomedical (n= 23 students/5 teams); monodisciplinary mechanical engineering (n= 114 students/23 teams); and multi-disciplinary biomedical and mechanical engineering (n=31 students, that is, 20 BME and 11 ME distributed amongst 5 teams). Student teams were formed by self-selection within sections of the course. Students in all three conditions—BME, ME, MCD—signed Institutional Review Board (IRB) approved consent forms to voluntarily participate in the research portion of the study and to allow their course artifacts to be used as data.
After course completion and graduation, students' cumulative GPA, job placement, and design exposition scores were obtained and analyzed. This analysis was performed using a generalized linear model for exposition score and a logistic model for job placement outcomes (Hotaling, et al, 2012).

Results: A general linear model showed that all students who took the MCD course, regardless of major, were able to produce an engineering solution that was rated higher by external indsutry professionals than those of their mono-disciplinary contemporaries. Logistic and multinomial regressions showed that the MCD course increased the odds of employment significantly for the biomedical engineering team-members, as contrasted with mono-disciplinary BMEs.

Conclusions: The MCD teams' performance indicated that they were more capable of mitigating the risks inherent in value creation. As a result, their exposition scores were higher and they were hired more frequently compared with their mono-disciplinary counterparts. An expansion of this study and continued analysis of the value of multi-disciplicary capstone design is recommended.

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