Problem-solving Methods used by Engineering Students

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Abstract

A large component of the curriculum of college engineering programs is devoted to instructing and facilitating problem-solving skills so the graduating engineer can troubleshoot and perform critical thinking tasks (Marra et al., 2000; Engineering Education and Practice in the United States, 1985; U.S. Department of Labor, 1991). This perquisite of engineering graduates is noted by several agencies such as the Accreditation Board for Engineering and Technology (ABET) that considers the abilities to identify, formulate, and solve engineering problems as essential learning outcomes for any engineering program (Fini, 2010; Gattie, Kellam, Schramski & Walther, 2011; Marra et al., 2000).

The focus of this paper is specifically oriented on identifying the techniques that engineers use to solve computer-based problems. Preliminary research has identified that these problem-solving techniques are framed within several Standard Problem-Solving Methodologies (SPSM) (Sickafus, 2006). This arrangement means that engineers can use many combinations of techniques within multiple frameworks or methodologies. Because of this complexity, the researcher used the traditional SPSM that consists of problem definition, root causes, alternative solutions, implementation, and evaluation (Halpern, 2003). This enabled the researcher to isolate and identify problem-solving techniques.

Problem-solving techniques include heuristics, backward thinking and other mental processes that facilitate solving the major steps of the SPSM framework (Krieger, 2003; Bingham & Eisenhardt, 2011). This dynamic means for each step, such as the second step, root causes, the engineer can use a problem-solving technique to further analyze the problem.

The final part of this research was grouping the problem-solving techniques into logical categories that could be used by educators within college engineering programs. This grouping

was achieved by using qualitative investigation based on critical communicative methodology (Flecha, 2000). This methodology uses a dialogue format between the researcher and the participant where the participant solves a hypothetical problem and then reflects on the problem-solving process after completing the problem.

The significance of this research is an improved understanding of the many types of problem-solving techniques. With this information the college engineering educators can begin to link problem-solving techniques with different structured frameworks to see if meaningful improvements can be made in the critical thinking process. These improvements may necessitate a new way for engineering educators to perceive the teaching of problem-solving where the frameworks and techniques work in conjunction with the goal of solving a problem.

Concurrently other benefits of this research would be the awareness of engineering educators that each engineer uses techniques they are familiar with and they find are most helpful with certain problems. This may require an analysis by engineering educators into the types of problem-solving techniques that are relevant to a particular task. In all of these situations, this diversified set of research data will assist the college engineering educators in facilitating discussions with the engineering students so they can be more effective in solving problems in the diverse and evolving engineering environments.

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