

Embracing a Problem Based Learning through Vertical Integration in STEM

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Commonly adopted engineering pedagogy, more often than not, tends to be lecture-based, and places students in a passive and predominantly secondary role. Research in the field of engineering education also highlights the ineffectiveness of such strategies and strongly advocates that faculty adopt advanced education strategies that actively engage learners. Citing medical education as an example, engineering education research suggests problem-based learning (PBL) and vertical integration (VI) as two key strategies that will assist in facilitating the active engagement of learners. Investing in educating engineering students by embracing innovative pedagogical paradigms equips them with advanced professional skills as well as preparing them to resolve real life problems. This research innovatively combines both methods to achieve its objective. The novel of this innovative framework is that PBL reveals real life problems to students, while VI improves their professional skills. The authors first piloted the vertically integrated PBL framework in the Spring 2014 semester, and lessons learned resulted in a more refined and restructured framework. The second implementation, in the Spring 2015 semester, resulted in course project themes that better reflected one another to promote VI. The third implementation, which this research will focus on its results, considered both lessons learned and provided a collective project that ensured face-to-face project interaction between both student bodies. The research engaged a third party education evaluator to monitor an evaluation service, which analyzes the students' comments and qualifications pre and post the VI. This research is not only taking the initiative to document the outcomes of embracing a PBL through VI of two courses, but also proposing a framework that could be replicated within STEM.

Student engagement is critical to student retention within a program, as well as essential to the success of the program overall. Another major problem is that a high percentage of freshmen engineering students do not end up completing an engineering degree, either due to un-stimulating methods of teaching, poor performance that results in frustration or a loss of social life. Although engineering students are smart and creative lending a preference to active discussions, engineering education usually tends to be auditory, sequential and passive. Opposite to active learning styles, traditional teaching styles place students in a more passive than active role, hindering their learning overall. Therefore, there is an obvious gap between the methods of engineering education and the skill competence of engineering students. Specifically, research shows that many students leave their STEM majors not for the demanding or difficult workload, but for uninspiring and ineffective introductory courses. Embracing innovative pedagogical practices promote student engagement to the educational paradigm; this research will merge two specific teaching methods, the PBL and VI, into a single pedagogy framework. PBL methods propose real world critical thinking problems to students, which expose students to more realistic concepts. VI successfully connects two groups at different educational levels to encourage integration of knowledge and professional skills. This framework requires courses to be offered during the same semester and the assignments require both student bodies to spend extra time outside classroom to collaborate. Moreover, the instructors have to dedicate time to planning the logistics for this tedious integration. It is advisable to include a third party evaluator to ensure unprejudiced feedback and results. Furthermore, the assigned problem needs to be relevant, applicable and updated each semester. The framework lacked an opportunity for inter-related reliability index, as we cannot track the progress or promises once the course is concluded. Results suggest that VI is broadly applicable across civil and construction courses and shows promise for improving technical knowledge, professional development skills, and promoting retention among students in both courses involved in the integration. This innovative paradigm helps students thrive to achieve their potential and was one of the prominent reasons Arizona State University is currently acknowledged across US colleges as the number one academic institution in the field of innovation.

Keywords: Vertical Integration, Innovative Pedagogy, Problem Based Learning