Designing Engineering Courses for Design

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Abstract *¾ Over the last 18 months the Electrical Engineering and Computer Science Department at West Point has migrated its mandatory freshman introduction to engineering/information technology course to a design-centric, problem solving course. This course emphasizes the use of a standard, iterative problem solving process: analyze, design, implement, and test. Course feedback from previous semesters indicates that students do not see the value of designing a solution prior to implementation. Our students struggle with two options. The first is to jump right in and try various implementations until they succeed (which is at odds with the course material and many times leads to non-working implementations). The second is to take the time to develop a coherent design and the corresponding implementation. To combat the practice of implementation before design, we refocused our course using a series of pedagogical measures. We broke down the course into loosely coupled modules. Each lesson within a module displays strong cohesion with the other lessons in the module. We ensured that each module integrated design principles. Next, we developed a set of pre-class learning objectives and a set of in-class learning objectives using Bloom's Taxonomy of Learning. The pre-class objectives are knowledge and comprehension based and lower on Bloom's scale and support the higher application and synthesis based in-class objectives. Our instructors do not directly cover any pre-class objectives in class. The in-class objectives emphasize design with a hands-on, in-class exercise during most lessons. We also integrated a design-only project that forces the students to think through the design of a moderately complex problem. This design-only project compels the students to use all of the common design principles presented in the course to develop a plan to solve the problem. We integrated a graded design in every project during the semester. Lastly, the final course project is of such complexity that cadets are unlikely to succeed without a well-conceived design. Student course feedback from last semester has demonstrated an overwhelming success. Students understand the criticality of design before implementation.*