This research explores creativity and critical thinking in undergraduate engineering students. The study undertook two experiments to better understand the factors that contribute to students’ creative abilities and the effects of the undergraduate engineering curriculum. Experiment 1 focused on the differences in creative and critical thinking skills in freshman versus senior undergraduate engineering students. Experiment 2 centered on the variations in effect of long-term versus short-term creativity training on senior engineering students. Creative skill was measured using the Test for Creative Thinking Drawing Production (TCT-DP), developed by Urban and Jellen (2010). Measurements for critical thinking utilized the Watson-Glaser Critical Thinking Assessment (WGCTA) (Watson & Glaser, 2008).

Experiment 1 found evidence suggesting the freshman engineers within the study were more creative than senior engineers ($T = 1.8$, $P$-Value = 0.037). Surprisingly, there was no evidence suggesting the senior engineers had improved critical thinking skills over the freshman engineers ($T = -1.06$, $P$-Value = 0.292). The study groups’ data was also compared to the normative data provided by the WGCTA test, in order to determine the standing of the two engineering sample groups against the general population. The study’s freshman group’s average ranked in the 70th percentile (freshman engineers’ average) when compared to the normative general population’s average (50th percentile). The senior participants, on the other hand, scored significantly lower than their corresponding normative group, moving from the 50th percentile (normative average) to slightly above the 35th percentile (senior engineers’ average). Based on this evidence, current engineering education methods may be detrimental not only to the creative skills of engineering students, but to their critical thinking capabilities as well.

Experiment 2’s results suggest long-term creativity training provides statistically significant improvements over short-term creativity training ($T = 2.30$, $P$-Value = 0.023). This significance was established even though the long-term group was found to have been trained inadvertently before the start of their official training, simply by their knowledge of the course’s requirements for providing creative solutions. As such, these results suggest that continuous creativity training benefits the recipient individuals. Additionally, beginning a more creative approach to collegiate engineering courses may start as easily as initiating courses with the known expectation of students to use creativity in their problem solving whenever feasible.

This study provides new insights into the state of creativity and critical thinking skills in undergraduate engineers. Based on the resulting data, engineering education must be examined and restructured to provide students with the necessary tools to improve their creative and critical thinking abilities. Through the use of creativity and critical thinking training and instruction methods, educators can effectively address these observed deficiencies, resulting in better preparation of engineering students for their professional lives within the 21st century workplace.

Major: Industrial Engineering

Educational Career:
Bachelor’s of Mechanical Engineering, BS, 2006, University of Central Florida
Bachelor’s of Aerospace Engineering, BS, 2006, University of Central Florida
Master’s of Mechanical Engineering, MS, 2010, University of Central Florida

Committee in Charge:
Robert Hoekstra, Chair, Industrial Engineering and Management Systems
Timothy Kotnour, Co-Chair, Industrial Engineering and Management Systems
Pamela McCauley, Industrial Engineering and Management Systems
Stephen Fiore, Industrial Engineering and Management Systems

Approved for distribution by Robert Hoekstra, Committee Chair, on March 23, 2016.

The public is welcome to attend.