

Work in Progress: Comparing Creativity and the Perception of Creativity of First-Year and Senior Engineering Students

Mr. Caleb Sean Cunningham, Bucknell University

Dr. Kaela M. Martin, Embry-Riddle Aeronautical University, Prescott

Kaela Martin is an Assistant Professor of Aerospace Engineering at Embry-Riddle Aeronautical University, Prescott Campus. She graduated from Purdue University with a PhD in Aeronautical and Astronautical Engineering and is interested in increasing classroom engagement and student learning.

Dr. Elif Miskioglu, Bucknell University

Dr. Elif Miskioglu is currently an Assistant Professor of Chemical Engineering at Bucknell University. She graduated from Ohio State University in 2015 with a PhD in Chemical Engineering, and is interested in student learning in engineering. In particular, her work focuses on various aspects of students' development from novice to expert, including development of engineering intuition, as well as critical thinking, problem-solving, and communication skills.

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Introduction

This work-in-progress describes preliminary studies on assessing the relationship between changes in perceived and demonstrated creativity between first-year and senior engineering students' solutions to an open-ended problem. Previous work by Davis et al. has shown that engineering student's perception of their creativity increases as they reach graduation [1], whereas work by Kazerounian and Foley shows that students feel that they lack the element of creativity in the classroom [2]. We ultimately seek to understand how creativity and the self-perception of creativity may change between the beginning and end of engineering students' college careers.

In this work, we present engineering students at the beginning and end of their university career, first-year and seniors, with an open-ended design challenge. The students are unaware that the metric being tested is creativity. The open-ended question does not require intensive technical engineering background to develop a solution, so both the senior-year and first-year students are equally able to generate a solution. The students sketch and briefly summarize the features of their designs, which will be judged by a group of experts who will score each students' solution in regard to its creativity and viability. In accordance with prior research done by Christiaans [3]-[5], if a group of experts believe a solution is creative, then the solution is deemed creative. The judges will be guided by material developed by the Association of American Colleges and Universities that define creative thinking as, "Both the capacity to combine or synthesize existing ideas, images, or expertise in original ways and the experience of thinking, reacting, and working in an imaginative way characterized by a high degree of innovation, divergent thinking, and risk taking" [6]. To date, the judging has not been completed, and this paper will not detail the judged results. The expert analyses will be used, in future work, to decide if this testing methodology could be used to measure creativity through self-assessment. The group of experts will consist of a team of engineering professionals with doctorates in their respective fields. Students also completed a survey that captured their perception of their creativity in the solution. Comparing the survey results to the experts' assessment of creativity will provide insight as to whether perception and creative skill are correlated, as well as whether significant differences in either exist between first-year students and seniors.

Data Collection and Analysis

To investigate the perception of creativity of first-year and senior engineering students, we presented students with an open-ended design problem. When presented with the problem, the students were told that the study would compare first-year and senior year student design solutions but were not told that the creativity was being investigated. All participants were enrolled at the same private university located in the southwestern United States. The data collected from first-year students was collected at the end of their

first semester, and the data collected from senior students was collected at the beginning of either their final or penultimate semester. The students were given 15 minutes to develop their design solutions to the following open-ended prompt:

You and two other people are on one side of a river. The river is 3 feet deep and you are tasked with getting everyone to the other side of the river without getting wet. You can use anything you can find in nature to help you accomplish this task. Please write a description (in bullets, sentences, etc.) along with a sketch of your solution. You have 15 minutes to complete this challenge.

After the students finished sketching and describing their solution, they were given five minutes to self-assess the validity and overall creativity of their solution. The students were asked to score themselves on a scale (1-100) and justify their score. A One-Way ANOVA test was done comparing the first-year and senior-year students' perception of the creativity and validity of their solution. Table 1 shows the data for the students' perception of the validity of their solution.

Table 1: Summary of Self-Assessed Validity Scores of First-Year and Senior Year Students

	N	Mean	SD
First-Year	145	73.63	18.39
Senior	61	69.25	25.28
Total	206	72.34	20.70

There was no significant effect of the validity scores on the student year for the three conditions [$F(1,204) = 1.93, p = 0.167$]. This result is not a surprise to researchers, as the researchers expected both first-year and senior-year students to develop valid solutions as the problem did not require engineering knowledge to complete.

Table 2 shows the data for self-assessed creativity of the students' solutions. There was no significant effect of the creativity scores on the student year for the three conditions [$F(1,205) = 0.0926, p = 0.761$]. Statistically, we are unable to conclude that in this problem-solving activity first-year and senior-year students perceived themselves to develop solutions of varying levels of creativity.

Table 2: Summary of Self-Assessed Creativity Scores of First-Year and Senior Year

	N	Mean	SD
First-Year	146	51.46	29.45

Senior	61	50.08	30.25
Total	207	51.05	29.62

In regard to both class-years, a matched-pair test showed that overall students believed their solutions were more viable than creative.

The students' solutions are to be reviewed and scored by a group of three engineering experts, distinguished by achieving doctorates in an engineering discipline. The judges will score each solution based on validity and how creative the expert believed the solution was. Each judge will be given a of the Creative Thinking VALUE Rubric developed by the Association of American Colleges and Universities to guide their grading, but the overall creativity score (1-100) is at the discretion of the judge [6]. To date the data from the judges is still being collected.

Conclusions and Future Work

Our preliminary analysis shows no statistically significant difference in students' perceived creativity or validity of their solutions across first-year and senior year students, but data analysis is still ongoing. We hope to revisit the study by rewriting the open-ended question to include more constraints (river length or width, too shallow for a boat, etc.) to force students to develop nonobvious solutions, which in this case was a boat. Furthermore, we are interested in testing different engineering disciplines and comparing their self-assessed and judged scores. This research effort continues, and we plan to elaborate by presenting first-year and senior-year students with more open-ended problems multiple times throughout a semester. Additionally, our panel of experts are still judging the students' solutions for creativity and validity. In the future, we may expand our judging panel to include engineers from industry as their perception of creativity may or may not be different. The small sample size of judges may lead to variance in scoring, but we hope that future studies include more judges to decrease possible variability in scoring. We are particularly interested if there is a discrepancy between the judged creativity in the first-year and senior-year students.

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