

Impact of a Creative Design Course on Undergraduates' Creative Confidence

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ABSTRACT

This study was conducted as part of an effort to critically analyse and assess student outcomes in Creative Design, an undergraduate course at The College of New Jersey. Topics covered in the course include, but are not limited to: the design process, technical drawing, working with tools and materials, modelling a product or design, and design elements and principles. While some students (e.g. Technology and Engineering Education majors) are required to take this course, it is also open to students in all majors, and is a Literary, Visual, and Performing Arts liberal learning course option. There are typically several sections of the course offered each semester, and it is taught by a variety of instructors. The research aimed to investigate how Creative Design impacted undergraduate students' creative thinking, creative self-efficacy, and spatial thinking skills. Students were asked to complete instruments to assess each of these areas, both at the beginning and end of a semester in which they were enrolled in the course. Students also completed a demographics survey, which allowed outcomes to be explored further, for example, by major (STEM/non-STEM). The focus of this manuscript is creative self-efficacy, measured by the Short Scale of Creative Self (Karwowski, 2011). Results indicate that Creative Design may raise female students' creative confidence, resulting in female students feeling nearly as creatively confident as male students by the culmination of the course. While the results of this study are specific to Creative Design, further research could explore the effects of other design, creativity, and technology courses on undergraduate student outcomes.

Key Words: Creativity, Creative confidence, Creative design, Undergraduate education

1. INTRODUCTION

Creative Design is an undergraduate level course offered at the author's institution. It is housed in the School of Engineering within the Department of Integrative STEM Education. The course is a requirement for some majors on campus, including Technology and Engineering Education. However, it is also a liberal learning course that fulfils a Literary, Visual, and Performing Arts requirement. Thus, students from programs all across campus enrol in Creative Design. The course description is as follows:

This is a foundational course that looks at the elements and principles of design as related to practical products, systems, and environments. It introduces students to the creative process practiced by artists, designers, and engineers, valuable to them as both future producers and consumers. Content includes thinking, drawing, and modeling skills commonly used by designers; development of a design vocabulary; the nature and evolution of technological design; the impacts of design on the individual, society, and the environment; patents and intellectual property; human factors; team design; and appropriate technology, risk analysis, and futuring techniques. Design problems are presented within real-world contexts, using field trips and outside speakers. Students complete a major design project, document their work through a design portfolio, and present their solutions before the class. Weekly critiques of class projects build fluency, confidence, and creativity. (The College of New Jersey, n.d.)

The goal of this research is to explore how Creative Design impacts undergraduate students' creative thinking, creative self-efficacy, and spatial thinking skills. This manuscript will focus on creative self-efficacy, which was measured using the Short Scale of Creative Self (Karwowski, 2011).

2. LITERATURE REVIEW

This study builds on previous research from Huffman and Figueroa (2017) and Huffman and Zrada (2021) on the Creative Design course at The College of New Jersey. Prior work has investigated design thinking and creativity (Huffman & Figueroa, 2017) as well as creative pedagogy employed by Creative Design instructors (Huffman & Zrada, 2021).

Recent studies have explored aspects of undergraduate creativity (Daly et al., 2014; Miller & Dumford, 2016; Snyder et al., 2019), specifically creative confidence (Mathisen & Bronnick, 2009; Payne & Whitworth, 2021; Pretz & McCollum, 2014; Rauth et al., 2010; Stolz et al., 2022; Vally et al., 2019). There is evidence that various types of learning experiences can positively impact creative confidence. Mathisen and Bronnick (2009) demonstrated that participation in a five-day creativity training course significantly improved undergraduate students' creative self-efficacy. Vally and colleagues (2019) investigated a university-level "creativity and innovation course" (p. 72), which resulted in a significant improvement in students' creative self-efficacy. Payne and Whitworth (2021) explored creative confidence in an undergraduate biochemistry course. They found that students who were challenged to design experimental protocols during a laboratory exercise experienced improved creative self-efficacy (Payne & Whitworth, 2021). Each of these examples illustrates ways in which various educational experiences can impact creative confidence.

There is evidence that creative self-efficacy is directly related to other factors that are important to learning. Alvarez-Huerta and colleagues (2022) found that creative self-concept and critical thinking disposition were positively correlated. Alvarez-Huerta and colleagues (2021) also found creative self-concept and student engagement to be positively correlated. Further, they explored predictors for creative self-concept, and determined all of the following to be predictors: "collaborative learning, student-faculty interaction, higher-order learning, reflective and integrative learning, and high-impact practices" (Alvarez-Huerta et al., 2021, p. 7). Both of these

studies highlight the importance of understanding creative confidence, how it can be fostered in education, and its impacts on learning.

Creative self-efficacy has also been studied with respect to gender. As stated above, Alvarez-Huerta and colleagues (2021) investigated creative self-concept as it related to a number of student engagement factors. The results of this study indicated that male students had a higher creative self-concept than female students, both during their first and fourth year of schooling. However, both male and female creative self-concept scores improved from year one to year four (Alvarez-Huerta et al., 2021). Kijima and Sun (2021) researched the creative confidence of female middle school students, and reported that these students experienced improved creative confidence after a three-day design thinking intervention.

The research presented in this manuscript fits into the broader research scope on creativity in undergraduate education. It explores the impact of a creative design course on undergraduate students' creative self-efficacy, with particular attention to major (STEM/non-STEM) and gender. Applications for this work include design and technology education, but also undergraduate education broadly.

3. METHODOLOGY

3.1. Participants

All study participants were enrolled in Creative Design at The College of New Jersey during the Fall 2021 semester. Participants were enrolled in one of three sections of the course, which were taught by two different instructors. Both instructors included the study measures in their course(s) as homework assignments. Students were able to indicate on the Informed Consent form whether or not they agreed to have their data used for research purposes.

After verifying both beginning and end of semester agreements and matching anonymous identifiers, the final sample included 32 students. Each of The College of New Jersey's seven schools were represented by this sample: Arts and Communication, Business, Education, Engineering, Humanities and Social Sciences, Nursing and Health Sciences, and Science. End-of-semester demographics responses indicated that 18 students identified as male and 11 students identified as female. The remaining students either did not complete this item or selected "Prefer not to say" for this item.

3.2. Methodological tools

Participants completed four assessments within this study, both at the beginning and end of the semester, listed here in order of completion: Short Scale of Creative Self (Karwowski, 2011), Guilford's Alternate Uses Task (Guilford et al., 1978), Purdue Spatial Visualization Test: Rotations (Guay, 1976), and a demographics survey. The demographics survey asked students to provide the following information: Gender, Year, Major(s), Minor(s), Course section, All other courses you are taking this semester.

This manuscript will focus on student responses to the Short Scale of Creative Self (Karwowski, 2011), which is an eleven item survey. Respondents self-assess beliefs about their own creativity, ranking each item on a Likert scale from 1 (Definitely not) to 5 (Definitely yes). Responses to the eleven items are averaged to generate a Creative Self-Concept Scale (Karwowski, 2011). Statistical analyses were performed using IBM SPSS Statistics.

3.3. Implementation

All participants completed an online Informed Consent form that had been approved by The College of New Jersey Institutional Review Board. As stated in section 3.1, students were required to indicate how their data could be utilised: “It is okay to use my anonymous data for research purposes” (Yes/No). Each study instrument was completed virtually via a Qualtrics survey. Students were asked to complete the instruments in one sitting, without the assistance of any outside resources. Students participated both at the beginning and end of the semester in which they were enrolled in Creative Design.

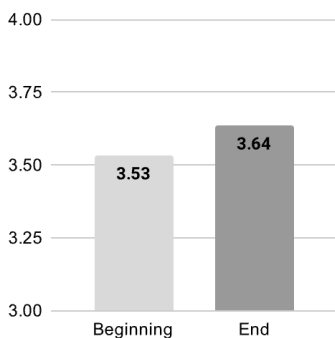
4. RESULTS

As measured by the Short Scale of Creative Self (Karwowski, 2011), creative confidence did not change significantly from the beginning ($M = 3.53$, $SD = 0.646$) to the end of the semester ($M = 3.64$, $SD = 0.676$), $t(29) = -1.032$, $p = 0.311$ (Figure 1).

Figure 1.

Creative Self-Concept Scale results for all participants at the beginning and end of a semester in which they were enrolled in Creative Design.

Creative Self-Concept Scale

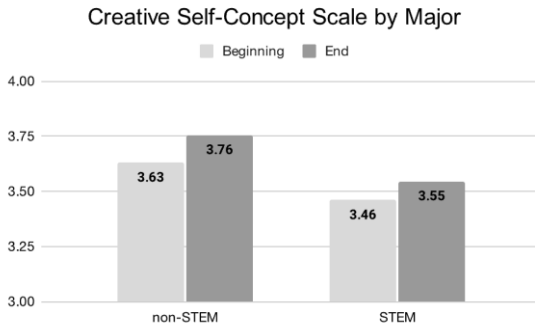


The differences between non-STEM and STEM majors were investigated at both the beginning and end of the semester (Figure 2). The acronym STEM stands for Science, Technology, Engineering, or Mathematics. 13 students were categorised as STEM majors and 17 students were

categorised as non-STEM majors. Non-STEM majors did not experience a significant change in creative confidence from the beginning of the semester ($M = 3.63$, $SD = 0.689$) to the end of the semester ($M = 3.76$, $SD = 0.704$), $t(12) = -1.173$, $p = 0.263$. Similarly, STEM majors did not experience a significant change in creative confidence from the beginning of the semester ($M = 3.46$, $SD = 0.621$) to the end of the semester ($M = 3.55$, $SD = 0.661$), $t(16) = -0.540$, $p = 0.596$. Further, there was no significant difference in creative confidence between non-STEM and STEM majors at the beginning of the semester ($t(28) = 0.706$, $p = 0.486$) or at the end of the semester ($t(28) = 0.834$, $p = 0.411$).

Figure 2.

Creative Self-Concept Scale results, presented by major type, at the beginning and end of a semester in which participants were enrolled in Creative Design.

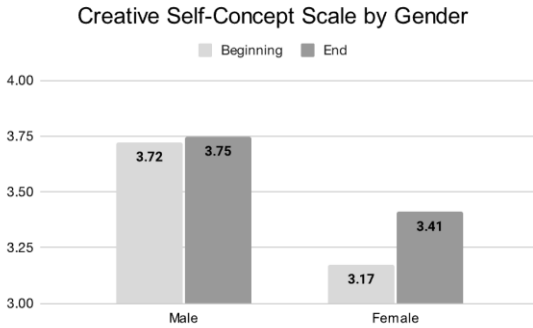


The differences between male and female students were investigated at both the beginning and end of the semester (Figure 3). 18 students identified as male and 11 students identified as female. Male students did not experience a significant change in creative confidence from the beginning of the semester ($M = 3.72$, $SD = 0.416$) to the end of the semester ($M = 3.75$, $SD = 0.586$), $t(17) = -0.195$, $p = 0.848$. Similarly, female students did not experience a significant change in creative confidence from the beginning of the semester ($M = 3.17$, $SD = 0.822$) to the end of the semester ($M = 3.41$, $SD = 0.795$), $t(10) = -1.429$, $p = 0.184$.

A further comparison was conducted to investigate differences between male and female creative confidence both at the beginning of the semester and at the end of the semester (Figure 3). The difference between male and female creative confidence at the beginning of the semester was nearly significant ($t(13.187) = 2.054$, $p = 0.060$); equal variances not assumed ($F = 6.396$, $p = 0.018$). However, the difference between male and female creative confidence at the end of the semester was clearly not significant ($t(16.673) = 1.240$, $p = 0.232$); equal variances not assumed ($F = 5.149$, $p = 0.031$).

Figure 3.

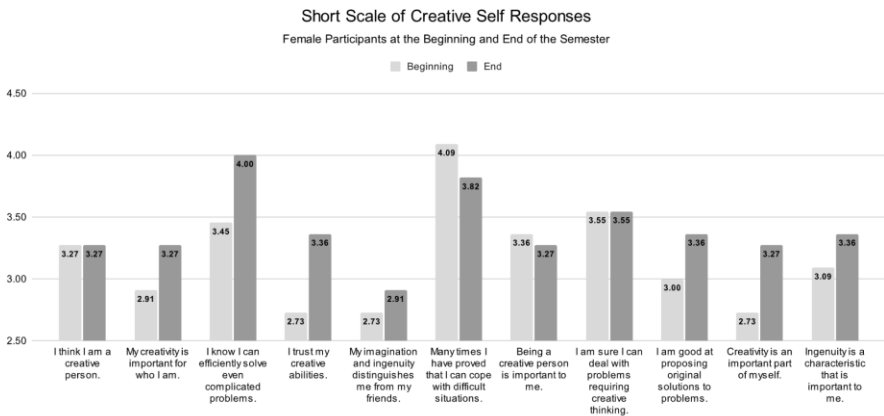
Creative Self-Concept Scale results, presented by gender, at the beginning and end of a semester in which participants were enrolled in Creative Design.



Further analyses explored female participants' responses on each item of the Short Scale of Creative Self (Karwowski, 2011) (Figure 4). There was a nearly significant difference on two of the survey items from the beginning of the semester to the end of the semester: Item 3 ("I know I can efficiently solve even complicated problems.") and Item 10 ("Creativity is an important part of myself.") (Karwowski, 2011). Female students rated their confidence in solving complicated problems (Item 3) lower at the beginning of the semester ($M = 3.45$, $SD = 1.293$) than at the end of the semester ($M = 4.00$, $SD = 0.894$), $t(10) = -2.206$, $p = 0.052$. Female students also rated the importance of creativity (Item 10) lower at the beginning of the semester ($M = 2.73$, $SD = 1.191$) than at the end of the semester ($M = 3.27$, $SD = 1.191$), $t(10) = -2.206$, $p = 0.052$.

Figure 4.

Creative Self-Concept Scale results by item for all female participants.



5. DISCUSSION

The data analyses indicate that enrollment in Creative Design did not significantly improve students' creative confidence over the course of the semester. This finding held true when looking across majors: both non-STEM and STEM majors did not experience a significant change in creative confidence. This finding also held true when looking at gender: both male and female students did not experience a significant change in creative confidence. However, it is interesting to note that at the beginning of the semester, male students were more confident than female students at a probability that is approaching significance. By the end of the semester, there was clearly no significant difference between female students' and male students' creative confidence.

Exploring responses to specific items on the Short Scale of Creative Self (Karwowski, 2011) may provide additional insight into what aspects of one's creative confidence were improved by participating in a Creative Design course. Female students experienced a nearly significant increase on two survey items: "I know I can efficiently solve even complicated problems." and "Creativity is an important part of myself." (Karwowski, 2011).

5.1. Limitations

While these findings are not wholly aligned with those of previous studies discussed in the Literature Review section, one must acknowledge several limitations that may have impacted the results. Despite recruiting from three different sections of Creative Design, the number of students who participated was ultimately quite low. It would be ideal to have a much larger sample of students. On a similar note, multiple sections of the course result in various course instructors and experiences. While all Creative Design professors adhere to the same general content, there are certainly differences in assessments and teaching styles.

5.2. Future directions

Future iterations of this study would ideally focus on the Short Scale of Creative Self (Karwowski, 2011); it may have been too overwhelming to ask students to complete four instruments in one sitting. The plan moving forward is to collect data from more Creative Design sections, perhaps across multiple semesters/years. This should provide an ample amount of participants.

Additionally, delving into more qualitative data may provide additional insight on what specific experiences are most valuable in boosting creative confidence. This data could include, but is not limited to, reflections, interviews, and course artefacts.

Finally, this research was specific to one course, but could be expanded upon to explore how other design and technology courses might impact creative self-efficacy, or how creative self-efficacy changes over the course of one's undergraduate career.

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