Advancing Equity: Exploring the Experiences of Transgender and Gender Non-Conforming Students in a Pre-College Engineering Course (WIP)

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Background:

- ***Systemic barriers:*** TGNC students persist in STEM majors at a rate ~10% lower than their cisgender peers.
- ***Research gaps remain:*** Most JEE studies (1998–2012) focus on binary gender and undergraduates, overlooking TGNC identities and pre-college populations.
- **Early education discrimination:** 60% of transgender teens report harassment or denial of affirming treatment in K–12 settings.

Purpose: This work-in-progress paper aims to investigate the impact of pre-college engineering courses on the self-efficacy of high school students, with a focus on TGNC students, to advance a more equitable engineering education environment.

RQ: How do TGNC students' self-efficacy in engineering compare to those of male and female students before and after participating in a pre-college engineering course?

Methods

Participants:

- High school students from 33 schools located in 20 states
- 788 students during the 2022-2023 academic year
- 658 students completed the pre-survey and 338 completed the post-survey (anonymously)

Table 1. Students' Gender Demographics.

Gender	Pre-test	Post-test
Male	338	204
Female	253	120
TGNC	22	5
Not mentioned	45	9
Sum	*658*	*338*

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Limitation:
We recognize the small sample size as a key limitation of this study. While the sample size is limited, it reflects the underrepresentation of TGNC individuals in engineering.

Moreover, LGBT+ students in STEM face risks and unfair burdens when navigating visibility without meaningful institutional inclusion efforts.

Methods

Survey and Data Analysis:

- Framework: Social Cognitive Career Theory (SCCT)
- 7 constructs and 54 survey items were investigated

Engineering-related self-efficacy (11)
Engineering curiosity (14)
Engineering identity (5)
Interest in engineering (5)
Intentions and commitment (3)
Outcome expectations (9)
Support and barriers to pursue an engineering degree (7)

- Likert scale ranging from 0 (no confidence) to 4 (complete confidence)
- t-test & ANOVA

Appendix A: Example Survey Items

Scale: 0 = no confidence; 1 = low confidence; 2 = moderate confidence, 3 = high confidence; 4 = complete confidence

Engineering-related self-efficacy
Q1 Understand engineering in class
Q2 Understand engineering outside of class
Q3 Apply engineering to solve a problem

Results

T-test:

- Statistically significant increase ($p = 0.0002 < 0.01$) in self-efficacy
- Significant increase in self-efficacy for both male ($p = 0.0196 < 0.05$) and female ($p = 0.0067 < 0.01$) students, while no change was observed for TGNC students.

Table 2. T-test Results Comparing Pre- and Post-Survey Construct Scores.

Construct	All	Male	Female	TGNC
Self-efficacy	0.0002**	0.0196*	0.0067**	0.3097
Engineering Curiosity	0.8817	0.5449	0.5779	0.8834
Engineering Identity	0.0776	0.2273	0.3777	0.2617
Engineering Interest	0.8922	0.6365	0.9404	0.6801
Intentions & Future Plans	0.9635	0.728	0.9727	0.9316
Outcome Expectations	0.598	0.5902	0.9934	0.8975
Support & Barriers	0.0805	0.4568	0.1836	0.5968

Results

ANOVA:

- Male and female students had statistically significant differences across most constructs
- The pre-survey data revealed a statistically significant difference between male and TGNC students in support & barriers ($p = 0.006 < 0.01$), which disappeared in the post.

Table 3. ANOVA Results Comparing Gender Groups within Pre- and Post-Survey.

Construct	Pre or Post Data	Male vs Female	Male vs TGNC	Female vs TGNC
Self-efficacy	Pre	0.16	0.932	1
	Post	1	1	1
Engineering Curiosity	Pre	0.000**	0.443	1
	Post	0.091	1	1
Engineering Identity	Pre	0.000**	0.382	1
	Post	0.000**	1	0.622
Engineering Interest	Pre	0.000**	0.364	1
	Post	0.001**	1	1
Intentions & Future Plans	Pre	0.000**	0.075	1
	Post	0.000**	0.876	1
Outcome Expectations	Pre	0.000**	0.34	1
	Post	0.001**	0.972	1
Support & Barriers	Pre	0.000**	0.006**	0.556
	Post	0.054	1	1

Summary of preliminary quantitative analysis:

- High school engineering courses have the potential to improve self-efficacy for male and female students, though this effect was not observed in TGNC students
- Compared to male students, the course appears to have a greater impact on enhancing engineering curiosity among female students
- Additionally, the course contributed to increased feelings of support for pursuing an engineering degree among both female and TGNC students.

Thank you!
Q&A

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