Exploring Gender Differences in Achievement Goal Orientation Among Undergraduate Engineering Students

Zain ul Abideen, Utah State University

Zain ul Abideen is a Graduate Research Assistant and Ph.D. Candidate in the Department of Engineering Education at Utah State University. He holds a Bachelor's degree in Computer Engineering and a Master's in Engineering, bringing over 12 years of teaching experience with undergraduate engineering students. Currently, Zain's research focuses on his Ph.D. dissertation, where he investigates the role of cognitive and motivational factors in problem-solving and cognitive engagement among engineering students. His work aims to enhance understanding of how these factors impact student learning and success in engineering education.

Dr. Oenardi Lawanto, Utah State University

Dr. Oenardi Lawanto is an associate professor in the Department of Engineering Education at Utah State University, USA. He received his B.S.E.E. from Iowa State University, his M.S.E.E. from the University of Dayton, and his Ph.D. from the University of Illinois at Urbana-Champaign. Dr. Lawanto has a combination of expertise in engineering and education and has more than 30 and 14 years of experience teaching engineering and cognitive-related topics courses for his doctoral students, respectively. He also has extensive experience in working collaboratively with several universities in Asia, the World Bank Institute, and USAID to design and conduct workshops promoting active-learning and life-long learning that is sustainable and scalable. Dr. Lawanto's research interests include cognition, learning, and instruction, and online learning.

Dr. Angela Minichiello P.E., Utah State University

Angela (Angie) Minichiello, PhD is a military veteran, licensed mechanical engineer, and Associate Professor of Engineering Education at Utah State University.

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Abstract

Achievement goal orientation is a well-established concept influencing student behavior. It defines the primary reason for students' engagement in academic activities like problem-solving in engineering. This study explores how different genders approach learning and achievement through mastery or performance-oriented goal orientation while solving problems in engineering. Engineering students face distinct academic challenges that can significantly influence their goal orientation. Students with mastery goal orientation tend to have a more comprehensive understanding of the learning material, promoting creativity and problem-solving skills. Students with a performance approach usually employ shallow strategies in problem-solving and desire to surpass their peers in performance and gain positive judgments. Individual characteristics of gender have acquired a particular interest in this research to investigate how different mastery and performance goal orientation profiles vary among men, women, and non-binary individuals in engineering education.

Although the interaction between achievement goal orientation and gender has been studied across different disciplines, findings are still inconclusive in the engineering problem-solving context. This study explored gender differences by addressing the research question: How do engineering students differ in their goal orientations based on gender in problem-based learning? By investigating gender-specific tendencies, this research aims to provide insights into how students' motivations shape their academic behavior and engagement. The research is part of a larger mixed-methods study on how cognitive and motivational factors impact engineering students' cognitive engagement during problem-solving. Data is collected using a validated survey of achievement goal orientation-revised (AGQ-R) administered to second-year undergraduate engineering students at a land-grant public university in the western United States. The survey captured students' preferences across the goal orientation dimensions and examined whether there were significant gender differences.

Achievement Goal orientation has been widely studied in various fields, but there remains a gap in understanding how gender differences manifest in STEM generally and particularly in engineering education, a traditionally male-dominated discipline. By comparing goal orientations across genders, this study provides the foundation for research on specific motivational profiles during problem-solving activity in engineering education. The findings of this study revealed that there is no significant difference in overall achievement goal orientation based on gender among undergraduate engineering students. This research contributes to the development of gender-sensitive pedagogical strategies, enabling educators to foster more inclusive learning environments that cater to the diverse motivational needs of students in STEM fields.

Keywords: achievement goal orientation, gender, engineering, mastery goal orientation, performance goal orientation.

Introduction

Achievement goal theory suggests that students' motivation and achievement-related behaviors can be understood by examining the purposes or reasons they adopt while engaging in academic

tasks [1], [2]. This theory has served as a foundation for extensive research on motivational orientations, shedding light on students' adaptive and maladaptive engagement patterns. Initial research in this field concentrated on two primary goal orientations: mastery and performance. However, more recent studies have expanded this framework to include four key goal orientations [3]. Students with a mastery goal orientation prioritize objectives like acquiring knowledge, enhancing their competence, and overcoming challenges. While students with a performance goal orientation aim to showcase their abilities in comparison to others or seek to openly prove their self-worth. Individuals pursuing performance-oriented goals focus on showcasing their high ability and engage in tasks to achieve this outcome. In contrast, those pursuing performance-avoidant goal orientation aim to avoid the undesired outcome of displaying low ability and engaging in tasks to prevent such demonstrations [4]. These goal orientations were conceptualized as shaping an individual's experience within a given setting, influencing their interpretation of events, and driving patterns of thinking, feeling, and behavior [1], [2]. Students' motivation to deal with problems is enhanced by their goal orientation toward sustainability, within a problem-solving situation [5].

According to Pintrich and Schunk [6], goal orientation is linked to various motivational, affective, cognitive, and behavioral outcomes. Hence, it is vital to investigate the variables associated with goal orientation. Gender has been identified as a factor influencing differences in motivational functioning [7]. However, findings regarding gender differences in achievement goal orientation (AGO) have been inconsistent. While some studies have reported significant variations [7]-[12], others have found no gender-based differences in AGO [13]-[15]. According to Chouinard et al. [14] and Schwinger et al. [16], women tend to exhibit higher average levels of mastery goals compared to men. This suggests that women are more likely to focus on learning, self-improvement, and developing competence for personal satisfaction rather than external validation. Whereas values on performance-oriented approaches and avoidance goals were higher for men [17]-[19]. These gender differences may stem from stereotypes, such as the belief that women put in more effort and are more ambitious in academics, while men are perceived as being more competitive [20]. However, the empirical evidence on gender-based differences in achievement goal orientation is not consistently evident. Evidence also suggests that men may exhibit higher average levels of mastery goals [21] as well as performance and performance-avoidance goals [20].

Exploring these differences can uncover valuable insights into how students from different genders approach mastery and performance goals, enabling educators to tailor interventions that support diverse learning needs. By investigating gendered patterns of achievement goal orientation in engineering education, this research seeks to contribute to the broader understanding of motivational dynamics and address the challenges of creating inclusive learning environments.

Purpose of the Study

The purpose of this study is to explore gender differences in AGO among engineering students, focusing on mastery and performance-approach goals. By exploring these differences, the research aims to identify the underlying motivational factors that influence men's and women's cognitive engagement in academic activities like problem-solving in engineering education. The

research findings are intended to contribute to a deeper understanding of how gender impacts AGO and to inform educational practices that promote gender equity and support diverse learning needs within engineering disciplines. This research is guided by the research question: How do engineering students differ in their goal orientations based on gender in problem-based learning?

Positionality

The research team comprises three individuals, all of whom hold master's degrees in engineering and are actively involved as educators and researchers in the field of engineering education. Among the members, two are tenured faculty members in the Department of Engineering Education with doctoral degrees focused on education, while the other is a senior graduate student working toward a doctoral degree in engineering education. The team members bring a wealth of experience, having taught undergraduate engineering courses, including those centered on problem-solving. This shared professional background fosters a collective commitment to exploring how various motivational and cognitive factors impact problem-solving and cognitive engagement within engineering education.

Methodology

This study employed a quantitative design to investigate gender differences in AGO among undergraduate engineering students. Data was collected by administering the Achievement Goal Questionnaire-Revised (AGQ-R) questionnaire to participants from various engineering majors in electrical, aeronautical, mechanical, and computer engineering. Participants received a detailed explanation of the study's purpose and provided written informed consent before completing the questionnaire. Participation in the study was voluntary. Data was analyzed using descriptives and inferential statistics (one-way ANOVA) to examine the students' achievement goal orientation descriptives and their differences across gender groups. The analysis was conducted in SPSS version 30.

Participants

A total of 103 second-year engineering students participated in the quantitative data collection using the validated survey of AGQ-R at a land-grant public university in the western United States during Fall 2024, including 64.1% men, 33% women, and 2.9% non-binary individuals. The participants were White (81.6%), Hispanic (6.8%), Asian American (8.7%), Pacific Islander (1%), and Biracial (1.9%).

Measures

The 12-item AGQ-R, developed and validated by Elliot and Murayama [13] with three items related to each of the following goals: mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance, will be administered to measure the students' goal orientation. Participants responded on a Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). All quantitative data was generated and collected using Qualtrics, an ad-hoc

web-based survey tool. Before involving participants in this research, we acquired approval for our research protocol from the Institutional Review Board (IRB).

Results

Data Analysis

The quantitative data collected through the AGQ-R questionnaire were analyzed using descriptive and inferential statistics. The reliability of AGQ-R was assessed using Cronbach's alpha in SPSS. Overall, Cronbach's alpha was 0.82, which shows that the questionnaire has satisfactory internal consistency. One-way ANOVA was used to find the statistically significant differences in achievement goal orientation types (mastery goal orientation, performance goal orientation, performance-avoidance goal orientation, and mastery avoidance goal orientation) across the different gender groups.

Table 1. Descriptive Statistics of AGO types across different Genders.

AGO Types	Gender	N	Mean	Std. Deviation
Mastery Approach	Man	66	4.24	0.74
	Woman	34	4.09	0.74
	Non-binary	03	4.34	0.88
Performance Approach	Man	66	3.82	0.86
	Woman	34	3.84	0.79
	Non-binary	03	3.00	1.2
Mastery-Avoidance	Man	66	3.39	0.89
	Woman	34	3.32	0.88
	Non-binary	03	3.34	1.2
Performance-Avoidance	Man	66	3.71	0.96
	Woman	34	3.87	1.1
	Non-binary	03	4.22	0.83
Overall AGO	Man	66	3.79	0.63
	Woman	34	3.78	0.56
	Non-binary	03	3.72	0.69

The results of one-way ANOVA mentioned in Table 2, revealed that there is no significant difference in AGO and its types based on gender. Specifically, the analysis demonstrated that the means of the gender groups (men, women, and non-binary) did not differ significantly across the different types of goal orientation. For the mastery approach, the between-group variance was not significant, $F_{(2,100)} = 0.50$, $p = 0.60$. Similarly, for performance approach goal orientation, there also exists no significant difference, $F_{(2,100)} = 1.4$, $p = 0.25$. For mastery avoidance goal orientation, the analysis again revealed no significant difference, $F_{(2, 100)} = 0.09$, $p = 0.94$. In the case of performance-avoidance goal orientation, the between-group comparison also showed no significant effect, $F_{(2, 100)} = 1.14$, $p = 0.57$. Lastly, for the overall achievement goal orientation, no significant gender differences were found, $F_{(2, 100)} = 0.01$, $p = 0.98$.

Table 2. One-way ANOVA Results

		Sum of Squares	df	Mean Square	F	Sig.
Mastery Goal Orientation	Between Groups	0.56	2	0.28	0.50	0.60
	Within Groups	55.57	100	0.55		
	Total	56.13	102			
Performance Goal Orientation	Between Groups	2.01	2	1.0	1.4	0.25
	Within Groups	71.88	100	0.71		
	Total	73.89	102			
Performance Avoidance Goal Orientation	Between Groups	1.14	2	0.56	0.56	0.57
	Within Groups	102.13	100	1.0		
	Total	103.27	102			
Mastery Avoidance Goal Orientation	Between Groups	0.09	2	0.05	0.06	0.94
	Within Groups	80.24	100	0.80		
	Total	80.34	102			
Achievement Goal Orientation	Between Groups	0.01	2	0.01	0.02	0.98
	Within Groups	37.08	100	0.37		
	Total	37.09	102			

Discussion

The findings of this study revealed no statistically significant differences in achievement goal orientations (AGO) or their types (mastery, performance, and avoidance) across genders (men, women, or non-binary) among undergraduate engineering students. This provides further evidence that students, regardless of identifying as men, women, or non-binary, have similar levels of motivation and goal-setting tendencies. The inclusion of non-binary individuals in the study emphasizes that their motivations are not significantly different from those of their men or women counterparts, promoting a more inclusive understanding of student behavior.

Furthermore, the mean scores for these orientations were comparable between genders, suggesting that motivational inclinations in this academic context are not shaped by gender-based differences. Findings align with previous studies [10], [22], which also reported slight gender-related variations in achievement goal orientation. These results suggest that engineering students, irrespective of gender, are likely influenced more by the shared demands and culture of the field than by inherent gender-specific motivational predispositions. As noted by Urdan and Kaplan [23], " there have not been large or consistent mean differences found in achievement goal orientation between ethnic, gender, or cultural groups." However, this study's findings challenge prior research associating mastery-oriented goals with women indicating that women are more focused on personal growth, understanding, and mastering the learning material [14], [16], and connecting performance-oriented or avoidance goals with men suggesting that men may be more focused on demonstrating their abilities in comparison to others [17]-[19]. Similarly, Alonso-Tapia [12] reported significant gender differences in the relationships between specific types of goals and achievement. Specifically, performance-approach goals demonstrated a positive effect, but only among male participants. Moreover, strong associations were observed between mastery approach and performance-avoidance goals, with these associations being significantly greater in women compared to men. In another research made by Fouladchang et al. [7], male students tend to score higher on performance-approach goal orientation and found no differences in the other two types of goal orientations of mastery approach and performance-avoidance, aligned with the results of this research. D'Lima [9] reported that men exhibited more performance approach and performance-avoidance as compared to women, which is potentially critical for men for long-term outcomes.

Conclusion

This study investigated the relationship between gender and achievement goal orientation, contributing to the broader understanding of motivation in engineering educational contexts. Unlike prior research that has found significant gender differences in specific types of achievement goal orientations, such as men scoring higher on performance-approach goals and women demonstrating stronger relations between mastery and performance-avoidance goals, our findings revealed no significant differences in overall achievement goal orientation based on gender among undergraduate engineering students. This suggests that the traditional gender-based distinctions in achievement goal orientation may be less distinct in contemporary educational settings, potentially reflecting shifts in pedagogical practices or cultural norms. The results contribute to the growing body of evidence advocating for inclusive and equitable educational practices in STEM. By demonstrating the diminishing role of gender in shaping achievement goal orientation, our results encourage the design of gender-neutral interventions aimed at fostering mastery and performance goals for all students. By focusing on strategies that collectively enhance mastery orientation, cognitive engagement, and self-efficacy, educators can better support students' academic success regardless of gender. This involves designing learning environments that prioritize growth, collaboration, and skill development, ensuring that all students are empowered to reach their full potential. Future research should explore additional factors influencing AGO, such as cultural background, teaching methodologies, and students' academic years. Investigating these variables could provide a deeper understanding of what drives students' motivations and goal-setting behaviors. Moreover, longitudinal studies examining how students' achievement goals evolve throughout their engineering education

would offer valuable insights into how their motivations develop and adapt over time. This study could inform more targeted interventions and policies aimed at enhancing student outcomes in STEM fields.

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