Gender and Programming Experience as Mediators between Programming Attitudes and Computational Thinking Skills in Engineering Students

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Abstract. Due to the ongoing integration of the virtual and real worlds, researchers are constantly looking for more efficient ways to encourage students' development of Computational Thinking (CT) skills in programming classrooms, particularly for Science, Technology, Engineering, and Mathematics (STEM) courses. In elementary schools, teachers should enhance kids' internal attitudes toward programming (PAs) to improve CT skills. In addition, PAs differ by programming experience (PE) and gender. However, there is a gap in the literature on developing CT skills among college students. This study examines the connection between PAs and CT skills among engineering students, considering the impact of gender and PE. In 2022, we modified a scale initially for children and surveyed undergraduates to gather information. Our sample comprised 171 first-year engineering undergraduates from a university in Chile. The gathered data were statistically examined using structural equation modeling (SEM) and hierarchical regressions. Results indicated that there is still a considerable gender difference in PE. Women lacked PE, whereas men did not. Also, men demonstrated greater PAs and CT abilities. Considering the five PAs' components, "self-efficacy" is relevant and predicts CT skills in men favorably. While "social needs" is important and negatively predicts CT skills in women. Discussion is held regarding the implications of fostering CT skills and a pro-programming mindset in engineering courses. It is advised to hold specific events in the early years of engineering school to pique women's interest in learning programming. Especially those that encourage women to participate in programming and help them gain confidence regularly.

Keywords: Education in STEM; Digital Literacy; Programming Classes

1 Introduction and Objectives

Studies indicate that PE may improve students' CT skills [1,2]. Computer programming and CT literature frequently discuss gender as a subject. The results, nevertheless, often conflict. Stereotypes suggest that men and boys work more in engineering and computational fields. A study indicated that women and girls require more time in training to reach the same level of CT

skills as men [3, 4]. Nevertheless, a survey of elementary school students found that girls had a higher CT level than boys [1]. This study examines how engineering students' programming attitudes (PAs) and computational thinking (CT) skills relate. Additionally, to investigate how gender and programming expertise (PE) may affect this relationship. The following hypotheses were investigated [2]: H1. There are significant differences in PAs and CT skills by gender among engineering students. H2. Engineering students' PAs can significantly predict their CT skills. H3. Engineering students' PE may affect their CT skills and PAs.

2 Method

The Universidad Católica del Norte (UCN), Chile, has two campuses (Coquimbo and Antofagasta) with several engineering courses. In 2022, 729 new engineering students (564 men and 165 women) were on both campuses. In other words, 77.4% were men, and 22.6% were women. The adopted method was based on [2]. In the second semester of 2022, random first-year students voluntarily answered a survey about their PAs, then answered a test on CT skills. A sample of 171 answers was considered valid; 134 (78.4%) were men, and 37 (21.7%), were women. This sample size (171) corresponds to a confidence level of 85% with an error margin of 5% (>162). The data was analyzed through SEM and hierarchical regressions.

3 Expected results and Final Remarks

H1 is supported. H2 and H3 are supported only for men. Men had PE, whereas women did not. Women had lower PAs and CT skills. Among the five factors of PAs, "social needs" is important and predicts CT skills negatively in women's CT performance. "Self-efficacy" is relevant and favorably predicts CT skills in men. Theoretical implications for further research and practical implications for programming classes are discussed. Activities that encourage women to participate in programming and help them gain confidence regularly are strongly recommended.

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