Development and Preliminary Validation of Enrolment in Engineering and Robotic Sensing Scale (EERSS)

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This study addressed the persistent gender disparity in STEM fields, particularly in engineering and robotics, by developing a survey instrument, "Enrolment in Engineering and Robotics Sensing Scale (EERSS)." The results of the study demonstrated good psychometric properties for the EERS scale, supporting the interpretation and use of the scale for understanding and measuring factors that influence the participation of female students in STEM fields.

Keywords: Engineering, Robotics, STEM, Gender Enrolment, Psychometrics, Scale development

STEM education makes learning real by allowing students to see the connections between the content they are studying and the application of that content in relevant ways (NSTA, 2024). At the K-12 levels, the involvement of boys and girls is integral in promoting STEM education (Merayo & Ayso, 2023). Despite ongoing efforts to ensure gender inclusivity in STEM education, the enrollment of girls in engineering and robotics remains disproportionately low compared to their male counterparts (Merayo & Ayuso, 2023). Studies have highlighted various factors and barriers, including lack of exposure, students' interest, motivation, self-efficacy (Msambwa et al., 2024), perception of STEM, and role model influence (Dasgupta & Stout, 2014). Other barriers include gender stereotypes (Cheryan et al., 2017), inadequate support systems, confidence in STEM, engagement, educational policies, attitudes, and pedagogy (Ibanez, 2022; Van der Hurk et al., 2019).

Research suggests that fostering interest and confidence, ensuring a compelling and inclusive school vision, etc., in STEM subjects like engineering through early interventions can significantly increase the likelihood of pursuing engineering-related careers, especially for girls (Ibanze, 2022; Wang et al., 2023). These factors, which influence the decision of students to enroll in STEM careers, especially engineering and robotics, need to be precisely measured and understood through evidence-based strategies. Thus, the study developed and validated a survey instrument (Enrolment in Engineering and Robotic Sensing Scale-EERSS), to identify these factors that could influence females' enrolment in engineering and robotics careers. The study addressed the research question: What are the psychometric properties of EERSS?

This paper reported on several stages of survey development, such as item generation, expert validation, and pilot testing. The scale has a demographic section addressing students' grade level, gender, race, and language and engineering. The generated items were reviewed by subject experts to ensure the content and face validity of the scale. A pilot study was then conducted on a sample of 96 secondary school students to refine the instrument through exploratory factor analysis (EFA) and reliability testing. The study used the Partial Credit Model (PCM) to evaluate the psychometric properties of the EERS scale. The results all showed acceptable fit indices for the EERS scale. These findings presented empirical evidence that supports the interpretation and use of EERS scale in the measurement of students' enrolment in engineering and robotic sensing discipline.

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