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Prevalence and Gender Distribution of Engineering-Oriented Vocational Interests in Pre-University Students: A RIASEC-Based Study in Honduras

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Abstract*– The choice of engineering careers continues to exhibit a persistent gender gap, despite sustained efforts to promote female participation in STEM fields. This study aimed to estimate the prevalence of engineering-oriented vocational interests in the pre-university population and examine their distribution by gender using the RIASEC model. A cross-sectional, descriptive-analytical study was conducted with a final sample of 1,664 participants from Honduras, collected between May and December 2025. A psychometrically validated vocational interest instrument was administered, focusing on the Realistic and Investigative dimensions and a combined Realistic–Investigative (R+I) profile as an indicator of engineering orientation. Results indicated that 30.2% of participants showed high Realistic interest and 46.3% high Investigative interest. Overall, 25.2% of the sample exhibited a high R+I profile, with comparable prevalence among men and women. However, a statistically significant association emerged between the R+I profile and gender (χ^2, $p < .001$), reflecting differences in the overall distribution of vocational profiles rather than disparities in the prevalence of the high R+I profile itself. These findings indicate that the gender gap in engineering is not primarily attributable to lower female vocational interest, but to sociocultural mechanisms that shape the transition from interest to actual career choice, underscoring the importance of targeted strategies to attract and retain students in STEM engineering programs.

Keywords*-- vocational interests, engineering, RIASEC model, vocational guidance, secondary education.

INTRODUCTION

Vocational interest has been consistently identified as one of the main factors influencing career choices in engineering, both among high school students and university applicants, including traditionally underrepresented populations [1]. In this regard, various studies have shown that interest does not act in isolation, but is linked to key cognitive and affective dimensions, such as mathematical identity, sense of competence, and social recognition, which significantly predict aspirations toward engineering careers [2].

Literature has also documented that the development of vocational interests shows gender differences, particularly in STEM fields. While women's interest in these areas is more closely associated with low levels of math anxiety, men's interest tends to be more influenced by numerical performance and the perception of innate abilities [3]. These differences do not necessarily reflect actual abilities, but rather differentiated socialization and validation processes that begin in the early stages of educational development.

In this context, vocational interest inventories have proven to be effective tools for understanding and anticipating career choice, as well as for predicting future vocational satisfaction, facilitating alignment between individual interests and career paths [4].

Among these approaches, the RIASEC model has been widely used to analyze academic and professional choice patterns in higher education. Recent studies have shown its usefulness in predicting the selection of university disciplines using advanced techniques such as machine learning, highlighting the differentiated influence of different vocational profiles on the choice of fields of study [5]

Likewise, integrative reviews have linked the dimensions of the RIASEC model with transformations in the labor market, highlighting the relevance of investigative and conventional interests closely associated with STEM areas in scenarios of technological change and automation [6]

Within the RIASEC framework, the Realistic (R) and Investigative (I) dimensions are consistently identified as central to engineering-oriented vocational profiles. The Realistic dimension reflects preferences for hands-on activities, technical problem-solving, and interaction with tools, machines, and physical systems. Individuals scoring high on this dimension tend to value practical tasks, applied reasoning, and tangible outcomes, characteristics that align closely with the operational and technical demands of many engineering disciplines.

In contrast, the Investigative dimension captures an orientation toward analytical thinking, scientific inquiry, and abstract problem-solving. High Investigative interest is associated with curiosity, systematic reasoning, and a preference for understanding complex phenomena through logic and evidence. These traits are fundamental to engineering activities that require modeling, experimentation, optimization, and innovation.

When combined, the Realistic–Investigative (R+I) profile represents a complementary configuration that integrates

practical–technical engagement with scientific–analytical reasoning. This combination has been widely recognized as particularly characteristic of engineering careers, as it reflects the dual nature of engineering work: applying scientific principles to solve real-world technical problems. For this reason, the R+I profile is frequently used as an indicator of vocational orientation toward engineering and related STEM fields.

The application of the RIASEC model has also provided a deeper understanding of the educational and perceptual factors that influence interest in engineering. Research focusing on the social image of engineering has shown that students' perceptions, mediated by vocational dimensions of the model, play a key role in the construction of professional interest, opening up opportunities to design educational experiences that are more sensitive to these perceptions [7].

However, despite the presence of demonstrable vocational interest in engineering, a persistent gender gap continues to characterize both enrollment and retention in these fields. Engineering is still widely perceived as a predominantly male domain, a perception sustained by social norms, cultural expectations, and long-standing gender stereotypes that implicitly frame technical competence and engineering work as masculine attributes [8]. These representations operate early in the educational trajectory and progressively discourage female participation, even among students who initially express interest in engineering-related activities [9].

Such dynamics are further reinforced within educational settings, where women often encounter negative academic experiences, limited visibility of female role models, and teaching practices that fail to account for gender-sensitive learning needs. Together, these factors contribute to lower academic self-esteem, reduced sense of belonging, and higher dropout rates among women enrolled in engineering programs [10].

In parallel, contemporary forms of socialization—particularly through digital media and social networks—have amplified the circulation of symbolic stereotypes, such as the notion that engineering careers are incompatible with femininity, social identity, or body image. These narratives introduce additional barriers that shape vocational decision-making processes and may discourage women from translating vocational interest into concrete educational choices [11].

Given this situation, a growing body of research underscores the importance of public policies, institutional interventions, and vocational guidance programs as central mechanisms for reducing persistent gender inequalities in engineering education [12], [16]. These approaches recognize that vocational decisions are not solely driven by individual interests or abilities, but are strongly shaped by structural, cultural, and institutional contexts that influence access, expectations, and persistence in STEM pathways.

Evidence consistently shows that career counseling integrated into university curricula and pre-university stages enhances students' vocational self-efficacy, strengthens career exploration skills, and improves the alignment between personal interests and academic choices [13], [14]. Such interventions are particularly relevant for female students, as they provide tools to counteract internalized stereotypes, clarify professional trajectories, and navigate male-dominated educational environments.

In both international and Latin American contexts, institutional initiatives that combine vocational guidance with inclusive pedagogical practices and visible role models have demonstrated positive effects on attraction to engineering programs, academic persistence, and retention over time [15]. These findings suggest that addressing gender disparities in engineering requires coordinated strategies that operate beyond the classroom, integrating guidance, policy, and institutional culture to support sustained participation in STEM fields.

Likewise, the need to consider the diversity of backgrounds and sociocultural contexts including rural areas and historically excluded groups in efforts to broaden participation in engineering has been highlighted [17].

Despite these advances, there is still a need for empirical studies that analyze the prevalence of engineering-oriented vocational interests prior to entering higher education, as well as their distribution according to key sociodemographic variables. Within this framework, the objective of the present study was to identify the prevalence of engineering-oriented vocational interests in the pre-university population, based on the Realistic and Investigative dimensions of the RIASEC model, and to analyze their distribution according to gender.

MATERIALS AND METHODS

A cross-sectional, descriptive-analytical study was conducted in Honduras, with data collected between May and December 2025, aimed at analyzing the prevalence of vocational interests associated with engineering among the pre-university population.

A non-probabilistic convenience sampling approach was used, recruiting participants mainly among high school seniors and individuals interested in pursuing university studies. The initial sample consisted of 1,831 participants. After applying previously defined screening criteria, including response time control, exclusion of implausible values, and elimination of invalid response patterns, a final sample of 1,664 participants was obtained.

Data collection was conducted online using a self-administered questionnaire administered in a school setting. Participation was voluntary, anonymous, and preceded by the acceptance of an informed consent form.

A vocational interest instrument based on the RIASEC model was used, with items on a four-point Likert scale. The instrument underwent a psychometric validation process to verify the adequacy of its structure and the consistency of its measurements. Exploratory Factor Analysis (EFA) confirmed the factorizability of the data and allowed for the identification of an interpretable structure, which was subsequently evaluated using Confirmatory Factor Analysis (CFA). The fit indices of the confirmatory model indicated an adequate fit (CFI = .915, TLI = .905, RMSEA = .051).

The internal reliability of the factors was satisfactory, with Cronbach's alpha and McDonald's omega values above .70 in all constructs. Likewise, adequate evidence of convergent and discriminant validity was observed, supporting the consistency and differentiation between the dimensions of the instrument.

For this study, the Realistic and Investigative dimensions were considered, as well as a combined Realistic–Investigative (R+I) profile, operationalized based on high scores in both dimensions to identify a vocational interest clearly oriented toward engineering. Scores for each RIASEC dimension were averaged and categorized as low (≤1.99), moderate (2.00–2.99), and high (≥3.00).

A high R+I profile was defined when both the Realistic and Investigative dimensions simultaneously reached the high level. Statistical analysis was performed using Jamovi software, employing descriptive statistics (frequencies and percentages) and χ^2 independence tests, complemented by the calculation of effect size using Cramér's V, to examine the association between the high R+I profile and gender. The study was conducted in accordance with the ethical principles of research involving human subjects.

RESULTS

The final analytical sample consisted of 1,664 participants, of whom 1,116 were women (67.1%) and 548 were men (32.9%). Participants were primarily students in the final years of secondary education and individuals interested in pursuing university studies, representing a pre-university population. The age distribution corresponded mainly to late adolescence and early adulthood, consistent with the educational stage of the sample. This demographic composition provides an appropriate context for examining vocational interests related to engineering prior to formal entry into higher education.

In the sample analyzed, 30.2% of participants showed a high level of Realistic vocational interest oriented toward engineering, while 44.6% exhibited a moderate level and 25.2% a low level of interest. This distribution indicates that nearly half of the participants are positioned at an intermediate level of Realistic interest, whereas approximately one third display a clearly defined orientation toward practical and technical activities characteristic of engineering fields.

Realistic vocational interest

In the sample analyzed, 30.2% of participants showed a high level of Realistic vocational interest oriented toward engineering, while 44.6% exhibited a moderate level and 25.2% a low level of interest. This distribution indicates that nearly half of the participants are positioned at an intermediate level of Realistic interest, whereas approximately one third display a clearly defined orientation toward practical and technical activities characteristic of engineering fields.

When examining the distribution by gender, the high level of Realistic interest was more frequent among men (16.4%) than among women (13.8%). In contrast, the moderate and low levels of Realistic interest were concentrated in a higher proportion of women. These differences are reflected across the three categories of interest, showing a distinct gender-based distribution in the expression of Realistic vocational preferences within the pre-university population.

Investigative Vocational Interest

Regarding Investigative vocational interest, 46.3% of participants showed a high level, 46.0% a moderate level, and 7.8% a low level of interest. This distribution indicates that the vast majority of the sample is concentrated in the high and moderate categories, with a relatively small proportion reporting low levels of Investigative interest.

When the distribution was examined by gender, the high level of Investigative interest was more frequent among women (29.5%) than among men (16.8%). In addition, women were more frequently represented in both the moderate and low categories of Investigative interest. This pattern reflects a gender-differentiated distribution of Investigative vocational preferences across all levels of interest within the analyzed population. Whether the observed difference between the proportions of high Realistic interest (30.2%) and high Investigative interest (46.3%) is statistically significant should be reported, for instance using a test for the difference between two proportions or McNemar's test if measures are treated as paired, consistent with the inferential approach applied to the R+I profile.

Realistic–Investigative Interaction

A total of 25.2% of participants exhibited a high Realistic + Investigative (R+I) combined profile, considered indicative of a vocational interest clearly oriented toward engineering, while the remaining 74.8% were classified into other vocational profiles (Table 1). This distribution shows that approximately one quarter of the pre-university population presents a vocational configuration aligned with both technical–practical and analytical–scientific orientations characteristic of engineering fields.

When the combined R+I profile was examined by gender, the proportion of participants classified in the high R+I category

was similar among men (12.5%) and women (12.7%). However, despite this apparent similarity in proportions, the χ^2 test of independence revealed a statistically significant association between the R+I profile and gender ($\chi^2(1, N = 1664) = 70.8$, $p < .001$), indicating differences in the overall distribution of vocational profiles across gender groups.

Specifically, the distribution was characterized by a higher concentration of women within the non–R+I profile, whereas men showed a relatively higher concentration within the high R+I group when the full categorical distribution was considered. The magnitude of this association was moderate, as indicated by Cramér's V = 0.206, reflecting a non-trivial gender-related difference in the distribution of the combined vocational profile.

Table 1
Distribution of the Combined Realistic–Investigative (R+I) Profile by Gender

R+I Profile	Men (n, %)	Women (n, %)	Total (n, %)
Non–R+I (0)	340 (20.4)	905 (54.4)	1,245 (74.8)
High R+I (1)	208 (12.5)	211 (12.7)	419 (25.2)
Total	548 (32.9)	1,116 (67.1)	1,664 (100)

Note. $\chi^2(1, N = 1,664) = 70.8$, $p < .001$; Cramér's V = 0.206.

This pattern was further supported by the odds ratio analysis, which indicated that men were significantly more likely to exhibit a high R+I profile compared to women (OR = 2.62, 95% CI [2.09–3.30]), reinforcing the presence of a gender-based disparity in vocational orientation toward engineering when the full profile distribution is considered.

DISCUSSION

The results of the study show a differentiated pattern of vocational interests according to the dimensions of the RIASEC model, which allows for a more nuanced interpretation of interest in engineering. In the Realistic dimension, traditionally associated with technical, mechanical, and operational activities that characterize many engineering tasks, a higher prevalence of high interest was observed among men compared to women. This pattern is consistent with a substantial body of literature indicating that vocational preferences are shaped early in life through gender-differentiated socialization processes, in which boys are more frequently exposed to and encouraged to engage in activities involving tools, construction, experimentation, and problem-solving with physical objects [3], [9].

These early experiences tend to reinforce self-perceptions of competence and familiarity with technical environments, which later translate into higher levels of confidence and interest in careers perceived as technically demanding. Conversely, girls often experience more limited access to such activities or receive implicit messages that discourage engagement with mechanical or operational domains, contributing to lower levels of expressed interest in the Realistic dimension despite comparable abilities. As a result, the observed gender differences in Realistic interest should not be interpreted as inherent preferences, but rather as the outcome of cumulative social and cultural influences that shape vocational development long before formal career decisions are made.

In contrast, the results in the Investigative dimension show an inverse pattern, with a higher proportion of women showing high levels of interest. This finding is particularly relevant, as investigative interest is linked to analytical, scientific, and complex problem-solving skills, which are fundamental competencies in multiple fields of engineering [2], [6]. This pattern is consistent with research conducted in Latin American educational contexts, where women's academic performance in science and mathematics is comparable to or exceeds that of their male peers, further corroborating that observed interest differences reflect differential socialization rather than cognitive capacity. The coexistence of greater investigative interest in women and greater realistic interest in men suggests that the differences are not due to a lower female affinity for the cognitive demands of engineering, but rather to the way in which different components of the vocational profile are stimulated and socially legitimized.

When analyzing the combined Realistic–Investigative (R+I) profile, the results show that the prevalence of a vocational interest clearly oriented toward engineering is similar in men and women, even though the distribution by individual dimensions differs. This finding is key, as the combined R+I profile captures a more stringent vocational configuration associated with engineering, integrating both practical–technical orientation and scientific–analytical interest beyond the isolated contribution of each dimension. When these core components are considered together, vocational potential appears comparable between the two sexes. However, this equivalence contrasts with the persistent underrepresentation of women in engineering classrooms, reinforcing the hypothesis that the gender gap does not originate in vocational interest, but rather in sociocultural factors, gender stigmas, and institutional norms that influence the transition from interest to actual career choice [4], [11].

Overall, the results suggest that strategies to reduce the gender gap in engineering must go beyond promoting academic interest and consider interventions that actively challenge stereotypes associated with the realistic dimensions of these careers, while recognizing and enhancing the high level of research-oriented interest present in women [13]. From an educational perspective, this implies rethinking the messages, role models, and learning environments that shape vocational decisions toward engineering.

Taken together, these findings address the study objective by providing empirical evidence on the prevalence of engineering-oriented vocational interests in pre-university

populations and by highlighting how gender-related sociocultural factors shape the interest–choice gap, offering valuable insights for the design of strategies aimed at attracting and retaining students in STEM engineering programs.

Among the main strengths of the study are the sample size, the inclusion of the pre-university population, and the use of a psychometrically validated instrument, which lends strength to the estimate of the prevalence of engineering-oriented vocational interests. However, the cross-sectional design limits causal analysis, and self-reported information may be subject to bias. Future longitudinal studies could further explore the factors that mediate the transition from vocational interest to the actual choice of engineering careers. To further strengthen this line of research, future work could expand the sample to include pre-university students from other Spanish-speaking countries, broadening the geographic scope and enabling cross-national comparisons. Additionally, extending the observation period — for example, from 2026 to 2030 — with annual partial results would allow longitudinal tracking of trends in vocational interests over time. From a policy and practice perspective, it is important to inform the general population about the societal benefits of increasing the number of women in STEM fields, to support women through mentoring programs led by female role models in engineering, and to advocate for government policies that actively promote gender equity in STEM education and careers.

CONCLUSIONS

This study identified the prevalence of vocational interests oriented toward engineering among pre-university students, showing that a significant proportion of participants have profiles compatible with these areas. The results reveal different patterns in the Realistic and Investigative dimensions according to gender; however, when considering the combined Realistic–Investigative profile, the prevalence of vocational interest oriented toward engineering is similar among men and women.

This finding suggests that the persistent gender gap observed in engineering programs is not explained by a lower female vocational inclination, but rather by sociocultural factors, gender norms, and stigmas that influence the transition from interest to actual career choice. In this context, the findings provide valuable evidence to inform institutional policies, outreach initiatives, and vocational guidance strategies aimed at improving the attraction and retention of students in STEM engineering programs.

Among the main strengths of the study are the sample size, the use of a psychometrically reliable instrument, and the incorporation of descriptive and inferential analyses. However, the cross-sectional design limits the possibility of establishing causal relationships. Future studies could further explore vocational trajectories through longitudinal designs and incorporate contextual and institutional variables to better understand the mechanisms influencing engineering career choice.

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