



EXPLORING GENDER DIFFERENCES IN SUBJECT PREFERENCES AND EDUCATIONAL APPROACHES AMONG STEM UNDERGRADUATES AND GRADUATES OF OUSL

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This study explores gender-based differences in subject preferences (students' inclination toward theoretical, analytical, or practical components of their academic disciplines) and educational influences (the external factors shaping students' academic choices) among STEM undergraduates and graduates at the Open University of Sri Lanka (OUSL). Grounded in 'Super's Life-Span, Life-Space Theory' and 'Eccles' Expectancy-Value Theory'; the study examines how these theoretical frameworks explain gender-based differences in academic preferences. While prior research has frequently focused on school-aged students, this study targets university students who have already made considerable academic choices, offering more informed perspectives. A well-structured, validated questionnaire was administered to 123 participants using a quantitative cross-sectional survey approach. Gender preferences across theoretical, analytical, and practical components (hands-on, applied tasks within STEM disciplines) as well as influencing factors such as personal interest, parental influence, and societal or institutional expectations were addressed. Reliability and validity were confirmed through pilot testing, with Cronbach's alpha at 0.60 and intraclass correlation at 0.742. Principal component analysis and discriminant analysis confirmed strong construct validity. Statistical analyses included Mann-Whitney U tests and Chi-square tests to examine gender associations. Results showed no statistically significant gender difference in how theoretical, analytical, or practical components were ranked. However, males tended to rate practical components slightly higher, though this was not significant. Most perceptions about gender and learning were consistent with Super's and Eccles' theoretical predictions, indicating limited influence of the respondents' own gender. Of all influencing factors, parental influence was the only one to show a statistically significant gender association ($p = 0.010$), with female participants reporting greater influence. Additionally, more male students (35.9%) than female students (16.7%) perceived that school curriculum and counseling services shaped their subject preferences; a statistically significant difference in perception ($p = 0.022$). Overall, the study suggests that while direct gender-based differences in subject preference were not prominent, differences do exist in how external influences are perceived. These findings underscore the need for tailored academic counseling and gender-sensitive career guidance that account for both familial and institutional factors influencing students' choice.

Keywords: Gender differences, STEM education, subject preferences, parental influence, educational approaches, university students, Sri Lanka

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Introduction

In the wider framework of educational landscape of Sri Lanka, like in many other countries, a distinctive pattern in subject preferences among students specifically based on gender differences can be observed. For example, it is reported that, college students prefer to choose their academic majors based on a variety of influencing factors which includes potential economic returns, interest in engaging classes and opportunities to help other people. (Kim et al., 2015). Previous studies suggest that gender plays a significant role in academic major selection. (Davies and Guppy 1997; Mullen 2014). In particular, with men and women tending to choose their majors in a very diverged manner depending on their preferences for the areas of study they perceive as most appropriate, accessible, and aligned with their personal and societal expectations. (Quadlin, 2020). Evidence from the study by Weeden et al. (2020) indicated that in U.S. higher education system, young women are more likely than young men to attend and complete college. Moreover, young women were underrepresented in earning degrees in science, technology, engineering, and mathematics (STEM) fields, instead it was observed that the females tend to earn degrees in the humanities and social sciences. (Weeden et al., 2020). In the academic literature, the segregation of men and women across college majors is understood as both a reflection of higher educational gender disparities and a predictor of gender segregation in the workforce, including the inequalities in income, autonomy, job security, and occupational prestige. Therefore, a comprehensive understanding of these preferences and the underlying factors behind these choices are of utmost importance, especially at the undergraduate and graduate levels. This can be primarily attributed to the fact that they are at a formative stage in their lives where they play a significant role in shaping their career paths and channeling their skills and talents across various sectors. Numerous studies have explored subject preferences among school-aged children and on the role of parental influence in those preferences. However, a significant gap remains in research that primarily focuses on undergraduates and graduates, who are at critical points in their academic and professional development. Thus, this focused demographic approach is particularly significant, as the target population is composed of graduates and undergraduates, they have already made substantial academic and career related decisions. Owing to their relative maturity and experience, they are more likely to exhibit well-defined preferences and provide more informed reasoning behind their choices compared to school-aged



students. This aligns with ‘Super’s Life-Span, Life-Space Theory’, which emphasizes that career and subject preferences become more crystallized as individuals progress through stages of growth and exploration into early adulthood (Super, 1990). Similarly, ‘Eccles’ Expectancy-Value Theory’ explains that as students gain academic experience, their expectations of success and the subjective value they attach to different subjects become more clearly differentiated, leading to stronger and more rationalized preferences (Eccles & Wigfield, 2002).

This study aims to explore the decisive factors that influence the STEM subject preferences based on gender and how they relate to individual aspirations and familial influence along with the societal, cultural and career-oriented expectations. The findings of this study are expected to contribute towards the understanding of gender dynamics in Sri Lanka’s higher education system, thereby enabling the effective strategies to support students in making well oriented, efficient and empowered subject and career decisions. Additionally, the study aims to offer insights into aspects where gender-specific interventions may be warranted, such as career guidance, orientation programs, mentorship initiatives, career guidance programs, and awareness-raising efforts.

Methodology

This study aimed to examine gender-based differences in subject preferences among STEM undergraduates and graduates of OUSL to explore the influence of parental, societal, and institutional factors on these preferences, and to compare how male and female students value theoretical, analytical, and practical components in their educational approaches. An additional objective was to assess whether gender plays a role in shaping perceptions of career prospects and future academic plans. To address these objectives, a quantitative cross-sectional survey was conducted using a structured questionnaire administered via Google Forms. The study was guided by a conceptual and theoretical framework previously described in the introduction, which draws on ‘Super’s Life-Span, Life-Space Theory’ (Super, 1990) and ‘Eccles’ Expectancy-Value Theory’ (Eccles & Wigfield, 2002) to frame gender-based differences in academic preferences. Data were collected across three main categories: demographic characteristics (gender, age, ethnicity, residence, employment status, and plans for further education), study component preferences (theoretical, analytical, practical), and factors influencing academic and career choices (parental influence, societal expectations, institutional guidance, and career prospects). The questionnaire was developed based on existing literature on subject preferences, educational approaches, and related factors. Questionnaire items included a combination of multiple-choice, short answer questions, and Likert-scale questions with responses recorded on a five-point scale reflecting levels of agreement or behavioural frequency. The questionnaire was validated using reliability and validity assessments. The reliability of the questionnaire was assessed using internal consistency measures and test-retest reliability. The validity of the questionnaire was ensured by evaluating the content validity, construct validity, and criterion predictive validity. The content validity was established by a review conducted by subject-matter



experts, while the construct validity was assessed using discriminant and convergent validity. The criterion validity of the questionnaire was evaluated using criterion predictive validity. A pilot test was conducted with 24 participants to validate the questionnaire. Internal consistency of the responses was assessed using Cronbach's alpha and test-retest reliability was ensured by calculating the Intraclass Correlation. Principal Component Analysis (PCA) was employed to evaluate the construct discriminant and convergent validity. Finally, a discriminant analysis was conducted to examine the criterion predictive validity.

Once the questionnaire was validated, it was administered among undergraduates and graduates enrolled in STEM fields at the Open University of Sri Lanka (OUSL). A quantitative data analysis was performed using IBM SPSS Statistics (Version 20). Cross-tabulation and the Chi-square test were used to examine associations between gender and subject preferences. Additionally, parametric (Independent Samples t-test) and non-parametric (Mann-Whitney U test) statistical tests were employed to compare educational approaches between male and female students, depending on the normality of data distribution.

Results and Discussion

Prior to the main analysis, the questionnaire was validated. Internal consistency of the responses was assessed using Cronbach's alpha, which yielded a coefficient of 0.60, indicating acceptable reliability. As for the test-retest reliability, the Intraclass Correlation value was 0.742, which reflects a strong reliability of the questionnaire. Principal Component Analysis (PCA) extracted six components with eigenvalues greater than 1, accounting for an excellent 78.4% of the total variance. All the questionnaire items loaded strongly on their respective components above 0.5, reflecting distinct underlying constructs. Thus, confirming acceptable construct discriminant and construct convergent validities of the questionnaire. The discriminant analysis for the criterion predictive validity accounted for 100% of the variance (Eigenvalue = 1.949), with a canonical correlation of 0.813, indicating a strong relationship between the discriminant scores and group membership of the questionnaire items. Thus, the questionnaire demonstrated acceptable reliability and validity, supporting its suitability to be administered among the study population.

Responses for the validated questionnaire were collected from 123 participants. Among the respondents, 68.3% were female and 31.7% were male. A majority of the participants resided in Colombo (43.9%), followed by Kandy (12.2%) and the rest of the districts. A 61.8% of the study population was between the ages of 23 to 27 years, followed by the age group 28 to 32 years (19.5%), 18 to 22 years (14.6%), 40 and above (2.4%), and 33 to 39 (1.6%). It was also noted that the majority of the respondents belonged to the Sinhalese ethnic group (62.6%) whereas Muslims ranked as the second major group (30.9%) followed by Tamil (4.1%) and Burgher (0.8%). In terms of educational level, 91.9% participants were undergraduates while only 8.1% were graduates. In terms of employment, 61% of participants were not employed, 11.4% were in part-time work, and 27.6% were in full-time work. Regarding future educational plans, nearly half (46.3%) intended to



pursue an MSc, while 28.5% aimed for a PhD, and only 22.8% had no immediate plans for further study.

The questionnaire items primarily represented the study components (theoretical, analytical and practical) that are required to determine whether there is a significant difference between the genders and the way they have ranked their study components. It was analyzed using Mann-Whitney U test, which indicated no significant difference, $U = 1552.5$, $Z = -0.515$, $p = 0.607$, with mean ranks of 59.81 for males ($N = 39$) and 63.02 for females ($N = 84$). When evaluating the analytic component, although the female respondents (mean rank = 65.35, $N = 84$) had a higher average rank than their male counterparts (mean rank = 54.79, $N = 39$), this difference was not statistically significant ($U = 1357.0$, $Z = -1.675$, $p = 0.094$). In contrast, in the assessment of the practical component preference rankings between the two genders, male respondents (mean rank = 70.09) ranked higher than the female students (mean rank = 58.24). However, this was also observed to be statistically insignificant ($U = 1322.5$, $Z = -1.859$, $p = 0.063$). A Chi-square test was conducted to evaluate the association between gender and the belief that gender influences one's engagement with theoretical, analytical and practical components of the study. The results did not account for a significant association, $\chi^2(1, N = 123) = 0.518$, $p = 0.472$ which suggested that the respondents' belief about gender-based learning differences were not significantly dependent on their own gender. Both genders had similar proportions of responses to this questionnaire item.

Moreover, to gain further insight into the gender influence on subject preferences, a series of non-parametric tests were conducted. The Mann Whitney U test revealed no statistically significant differences between males and females regarding their views on whether gender stereotypes influence subject preferences in Sri Lanka ($U = 1337.5$, $Z = -1.760$, $p = 0.078$). Similarly, the Chi Square test indicated no significant association between gender and the belief that one's own gender influenced their choice of field of study ($\chi^2(2) = 1.720$, $p = 0.423$). In addition, the extent to which career prospects impacted subject preferences did not significantly differ between genders, as evidenced by another Mann Whitney U test ($U = 1618.5$, $Z = -0.113$, $p = 0.910$). Furthermore, an additional Chi Square test was performed to determine whether the respondents would prefer switching fields if the career prospects in their current field were perceived to be limited. This analysis yielded no statistically significant association with gender ($\chi^2(2) = 3.749$, $p = 0.153$), reinforcing the notion that gender did not play a decisive role in shaping such decisions. Collectively, these findings suggest that the respondents' views on examined influencing factors were largely independent of gender.

This study also explored the gender-based differences in the factors influencing the respondents' choice of academic field. Five key factors were assessed: personal interest, parental influence, societal expectations, career opportunities and school/college environment. Based on the chi-square test for independence results, only the factor 'parental influence' demonstrated a statistically significant association with gender ($p = 0.010$), indicating that female participants were more



influenced by parental expectations in their choice of field of study compared to males. Although, the factor 'school/college environment' did not exhibit a statistically significant difference ($p = 0.130$), the one-sided test value ($p = 0.075$) suggested a mild trend, with females appearing more influenced by their academic environment than males. However, this result should be interpreted with caution, as it does not meet the conventional threshold for statistical significance, with larger and more balanced sample, an outcome of statistical significance may be expected. For the remaining factors which were the personal interest, societal expectations and career opportunities, there were no significant gender differences in response which implied that both genders generally valued these factors equally in making academic choices. To further examine whether perceptions of specific influencing factors varied by gender, a Chi-square test was performed for five perceived factors: societal norms, family expectations, peer influence, availability of resources/opportunities and school curriculum and counseling. Among these, only school curriculum and counseling exhibited a statistically significant gender difference in perception (Exact Sig. 2-sided = 0.022; 1-sided = 0.018). A greater proportion of male respondents (35.9%) compared to females (16.7%) believed that the school curriculum and counseling influenced subject preferences, highlighting a gender-based perception in this area. For the remaining factors: societal norms, family expectations, peer influence and resource opportunities, there were no statistically significant gender differences. Although the results for peer influence ($p = 0.076$) and resource availability ($p = 0.071$) approached the conventional threshold for significance marginally, they did not meet the standard significant threshold value. These findings should therefore be interpreted with caution.

Conclusions

This study aimed to explore gender differences in subject preferences and the influence of various factors among STEM undergraduates and graduates at the Open University of Sri Lanka. The majority of the findings revealed no statistically significant gender-based differences in how students ranked the theoretical, analytical, or practical components. However, male respondents showed a tendency to prefer the practical component relative to the female students. Although this finding was not statistically significant, it highlights a potentially meaningful trend that warrants further investigations, especially with a larger and more balanced sample. Notably, both male and female students expressed similar views on whether gender affects learning or subject engagement, suggesting that such perceptions are not strongly shaped by one's own gender.

Among the various influencing factors examined, parental influence stood out as the only factor showing a statistically significant association with gender. Female students were more likely to be influenced by parental expectations in selecting their field of study. In addition to this, a statistically significant difference was also seen in how students perceived the impact of structural influences, where more male students felt that the school curriculum and counseling had shaped their



subject preferences compared to female students. This suggested that while both genders experience pressure, they may respond differently to the sources of that pressure, with females more influenced by family expectations and males more attuned to institutional determinants within the educational system.

In summary, while clear gender-based differences in subject preferences were not strongly evident, the way external influences are experienced does seem to differ. These findings suggest the importance of providing more balanced guidance, supportive counseling, and better awareness on academic and career decision-making, so that all students, regardless of gender are empowered to make choices that genuinely align with their interests and aspirations.

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