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Investigating the Variables Impacting the Research Interest Among Undergraduate Students in STEM Fields

Zubair Ahmad, Ehsan Raza, Mohammad Ammar, Nitha Siby, Noora J. Al-Thani, Almaas Sultana

Qatar University Young Scientists Center (QUYSC), Qatar University, Doha, Qatar.

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Abstract

This research delves into the determinants impacting the research inclinations of undergraduate students in Science, Technology, Engineering, and Mathematics (STEM) fields. Stemming from global concerns regarding a shortage of qualified STEM professionals, the study examines the dynamics surrounding the encouragement of STEM disciplines and career paths. Utilizing a survey of 472 undergraduate students, quantitative data was collected and subjected to statistical analyses to uncover significant variations in research interests based on factors such as gender, undergraduate discipline, motivations for pursuing STEM programs, and class attendance habits. The findings suggest a necessity to enhance the exposure of male students, particularly in engineering and technology subjects, to STEM fields. These insights contribute to a better understanding and approach to addressing challenges in fostering research interests among undergraduate students.

Keywords: *Educational Reform; STEM Education; Capacity Building; Higher Education; Undergraduate; Research Interest*

1. Introduction

Science, Technology, Engineering, and Mathematics (STEM) fields play a crucial role in today's globally competitive economies. Governments worldwide invest in STEM to drive economic growth and address real-world challenges (Creel et al., 2017). However, despite the merits associated with STEM education, an alarming pattern has emerged, indicating a substantial reduction in the level of student interest in STEM programs (Chen, 2021). This decline poses a serious challenge for educators worldwide who are grappling with engaging students and cultivating enthusiasm for STEM education and careers (Smith & White, 2022).

Numerous studies in this context have highlighted the significance of students' research interests in STEM, asserting a direct correlation with their learning experiences (Krapp & Prenzel, 2011). Moreover, researchers agree that the research interests of students play a pivotal role in influencing their understanding of a subject, thereby serving as a precursor to the overall learning process (Ward et al., 2002). In addition, a study performed by Russell et al. suggest that enthusiasm plays a pivotal role in fostering interest in STEM research and pursuing higher degrees, emphasizing the importance of early exposure to such experiences (Russell et al., 2007). Research interests are often shaped by various pedagogical approaches, which include interactive learning environments and the integration of real-world applications into the curriculum. These approaches are found to stimulate student interest and engagement significantly (National Academies of Sciences, Engineering, and Medicine, 2016).

Given these insights, there is a necessity to delve into the dynamics surrounding the promotion of STEM disciplines and careers, considering the various influences that either stimulate or discourage student interest in STEM. For this, the current study explores the following research question:

- Which factors affect the research interests of undergraduate students in STEM programs?

2. Methods

In this study, we aimed to collect data on undergraduate students' research interests in STEM to assess how various factors affect their interests. This section discusses the data collection methods, tools, and quantitative analyses used in the study.

2.1. Survey Instrument

In an effort to examine the research interests of undergraduates, a questionnaire was designed to gather (a) demographic information regarding the students and (b) empirical data pertaining to their STEM-focused research inclinations. The interest in the research construct, as proposed by Bishop and Bieschke in 1994 is rooted in the social-cognitive model of interest development articulated by Lent and colleagues in 1994 (Bishop & Bieschke, 1994). According to Lent et al. (Lent et al., 1994), interest in research is shaped by various factors, including personal characteristics, environmental influences, research self-efficacy, and expectations regarding research outcomes. The survey was designed based on these theoretical groundings to incorporate measures that evaluate the research interests of students. Further, a five-point Likert scale (highly disagree to highly agree) was employed to evaluate six closed objects to explicitly measure students' research interests as listed in Figure 1. For each of these items, students were given response choices depending on the type of question. The survey instrument used was

approved by Qatar University's Research Ethics Board (QU-IRB 1721-EA/22) and was offered in English.

2.2. Participants

The survey was distributed to a randomly selected group of undergraduate students at Qatar University. Data collection took place in the year 2022-2023. The poll necessitated the acquisition of informed consent from participants and was totally optional, allowing individuals the freedom to withdraw at any point. The poll received responses from a total of 472 participants representing diverse undergraduate STEM disciplines. The demographics of the students comprising the sample size for this study are presented in Table 1.

Table 1. Student demographics. Source: By authors.

Variable	Sub-categories	Percentage	N
Gender	Male	43.9	207
	Female	56.1	265
Age Group	Under 18	2.1	10
	18 to 21	53.0	250
	22 to 25	40.3	190
	Over 25	4.7	22
Undergraduate discipline	General Science	14.0	66
	Engineering	65.0	307
	Medicine and Health Sciences	21.0	99

2.3. Data Analysis

2.3.1. Statistical Analysis

The data underwent analysis utilizing IBM SPSS Statistics (Version 29.0). The utilization of significance tests was employed to identify statistical variations in the research interests among different groups. The Shapiro-Wilk test was employed to assess the normality of the data distribution, aiding in the selection of either parametric or non-parametric significance tests. The Mann-Whitney U and Kruskal-Wallis H tests were utilized for data that exhibited skewed distributions.

2.3.2. Research Interest Score

This study employs the use of research interest score (RIS) as a metric derived from survey data to quantify and categorize the level of research interest exhibited by each student (Figure 1). The survey responses provided by students were categorized into dichotomous variables by assigning a value of negative, neutral, or positive to indicate low, neutral, or high levels of research interests, respectively. To derive a comprehensive measure, the scores of the six survey questions were aggregated, resulting in a single RIS that ranged from -6 to 12. The score depicted the comprehensive magnitude of each student's research interests in STEM areas. The descriptive statistics and reliability of the RIS measure is given in Table 2.

Table 2. Descriptive statistics and reliability of the Research Interest Score (RIS) measure. Source: By authors.

	Construct Reliability				Descriptive Statistics					
Variable	No. of items	Cronbach Alpha	Kaiser–Meyer–Olkin (KMO) value	p	Mean	Median	SD	Range	Minimum	Maximum
Students' Research Interests	6	0.739	0.757	<0.001	6.28	7.00	4.28	18.00	-6.00	12.00

N = 472

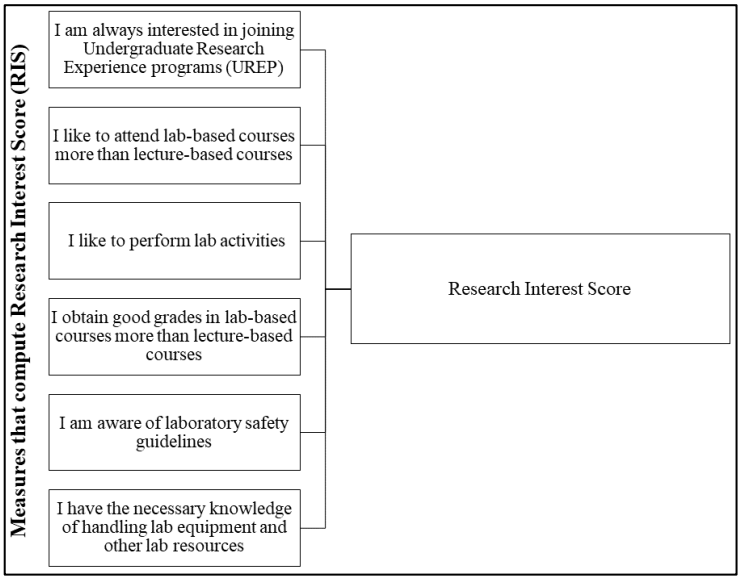

Figure 1. Specific research interest measures which compute the overall Research Interest Score (RIS) measure. Source: By authors.

3. Results

A statistical analysis using the Mann-Whitney U test was conducted to examine the differences in research interest between various sociodemographic and academic factors (see Figure 2). The findings of the study (Table 3) revealed a statistically significant disparity ($U = 30935.5$, $p = 0.017$) between male and female students, indicating female participants (mean rank = 249.74) to have higher research interests than male participants (mean rank = 219.55). Further, Kruskal-Wallis H test based on discipline revealed a statistically significant difference in RIS across students of different disciplines, $\chi2(2) = 276.11$, in general science group (see Table 4). The RIS in medicine and health sciences 263.94. Similarly, the RIS in engineering discipline is 219.14. The research interest of students in general science and medicine and health sciences is higher as compared to engineering discipline. Also, the Mann-Whitney U test showed a significant difference ($U = 16794$, $p < 0.05$) between Friends and Family motivation and Self-motivation in joining undergraduate STEM programs (see Table 3). Furthermore, the Mann-Whitney U test also showed a significant difference ($U = 31274$, $p < 0.05$) between responses with yes and no in skipping classes (see Table 3). These findings revealed that students who did not have a habit of skipping classes developed higher research interests as opposed to those who did.

Table 3. Independent-Samples Mann-Whitney U Test Summary for research interests based on gender, reason to join undergraduate programs, and habit of skipping classes. Source: By authors.

Measures	Gender	Reason to join undergraduate programs	Habit of skipping classes
Mann-Whitney U	30935.500	16794.000	31274.000
Standard Error	1465.609	1244.734	1467.104
Standardized Test Statistic	2.394	-2.402	2.584
p	.017	.016	.010

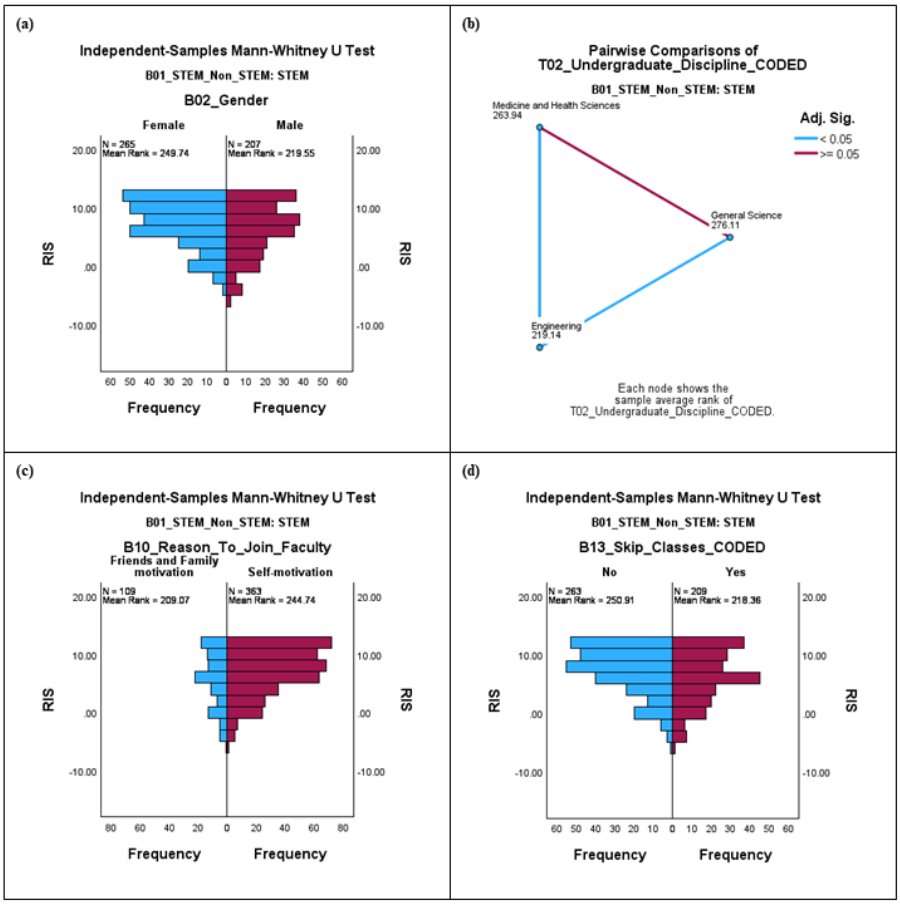

Figure 2. Significance tests for research interests based on students' (a) gender (b) discipline (c reason to join undergraduate programs (d) habit of skipping classes. Source: By authors.

Table 4. Pairwise Comparisons of Undergraduate Discipline. Source: By authors.

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Adj. Sig.[a]
Engineering-Medicine and Health Sciences	-44.809	15.713	-2.852	.013
Engineering-General Science	56.971	18.446	3.089	.006
Medicine and Health Sciences-General Science	12.162	21.604	.563	1.000

4. Discussion

The findings of our data analysis indicate the factors that impact the aspirations and research interests of undergraduate students in STEM are contingent upon the specific context. The findings of our study indicate that variables such as students' gender, undergraduate discipline, motivation for joining STEM programs and their habits of skipping classes were significant predictors of research interest in STEM disciplines of study. Our analyses of gender disparities in student aspirations and interests in research indicate that female students were more enthusiastic about research than their male counterparts. This outcome contradicts the conclusions drawn from the majority of prior research, which has demonstrated that males have a greater inclination towards research in STEM-related disciplines or professions (Delaney & Devereux, 2019). **The differential impact of** ~~Further,~~ discipline and motivation behind joining STEM being factors which influence research interests have also been discussed in previous literature (Laursen et al., 2010; National Academies of Sciences & Medicine, 2017). Absenteeism was an additional significant factor influencing students' research interests in STEM. This discovery is consistent with the outcomes of an extensive meta-analysis conducted by Marcus et al. (Credé et al., 2010), which concluded that class attendance is a robust indicator of the academic attributes and conduct of undergraduates. **The link between** academic attendance and grade point average (GPA) are ostensibly linked through the particular interests of students (Batres, 2011). There exists a positive correlation between increased student attendance and developed research interests, which can potentially facilitate the attainment of high grades in both attendance and GPA. As a result, it is imperative that educators and policymakers place a premium on increasing undergraduate research participation in STEM fields. Moreover, additional research on attendance could assist in determining whether it correlates with the attrition rate among undergraduate STEM students.

4. Conclusion

In conclusion, this study sheds light on critical factors influencing research interests among undergraduate students in STEM programs. The observed gender differences, disciplinary variations, and the impact of motivation and class attendance habits emphasize the multifaceted nature of students' engagement in STEM research. These findings provide valuable insights for educators, policymakers, and institutions aiming to enhance research interest and participation among undergraduate students in STEM disciplines and similar contexts.

The present study sheds light on crucial factors affecting research interests among undergraduate students in STEM programs, with observed differences across gender, disciplines, and motivational aspects influencing their engagement in STEM research. These insights are vital for educators, policymakers, and institutions striving to foster deeper involvement and enhance research interest among students. To further this goal, institutions

should consider implementing targeted mentorship programs that connect students with experienced researchers to inspire and guide their research endeavors. Additionally, developing workshops and seminars that focus on current STEM advancements can stimulate curiosity and engagement among students. Schools could also integrate more hands-on, project-based learning in the curriculum, which has been shown to increase interest in STEM by providing real-world context and applications of theoretical knowledge. By addressing these aspects, we can create a more stimulating educational environment that not only maintains but boosts student interest in STEM fields, preparing them for future challenges and innovations.

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