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Influential Factors in the Career Decision-Making of Gen Z in Engineering Education

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Abstract

Context

Generation Z individuals have a diverse and socially conscious cohort that values inclusivity, equality, ambition, and adaptability with a strong focus on career success. While numerous studies highlight the accomplishments of Gen Z across various domains such as technology, entrepreneurship, research and innovation. Very little research is done focusing on the career decision-making process of Gen Z.

Purpose or Goal

The purpose of the study is to exclusively addresses the gap on how parameters like passion and personal interest, gender bias, family and friends influence, career growth opportunities, and role models/mentors influence the career decisions of GEN Z, aiming to offer valuable insights into the complex dynamics of career decision-making and empower individuals to make informed and fulfilling choices for their careers.

Methods

Based on these five themes, a survey instrument was developed and administered to engineering students at an autonomous college in South India in the fall of 2023. A total of 260 responses were collected, and after data cleaning, 253 participants were included in the testing dataset. Exploratory factor analysis was performed to ascertain the survey instrument's factor structure, resulting in the confirmation of the hypothesized five factors.

Outcomes

The analysis revealed five factors as hypothesized with a minimum and maximum loading of 0.35 and 0.61. The internal consistency reliability index Cronbach's α ranged from 0.67 to 0.92, representing a strong consistency.

Conclusion

This survey instrument can be used in any education institutions to comprehensively capture the elements/factors that exert an influence on the career-decision making process of Generation Z. The insights gathered from this survey can serve as valuable input for shaping policies and interventions focused on mitigating gender biases and stereotypes, improving career guidance, and fostering environments that facilitate both personal and professional development.

Keywords—Career, Decision-Making, Family and Friends Influence, Passion, Gender Bias, Generation Z

I. INTRODUCTION

IN today's society, a career is not just a means of making a living; it's a lifelong journey of professional advancement within a chosen occupation can use it to prepare your manuscript. Students are often encouraged to envision careers in fields like education, sports, medicine, research, or politics, driven solely by their own preferences. (Hodkinson, P. et al.,1997)

However, the reality is more complex, as societal influences play a significant role. Past knowledge and societal norms can shape students' career choices, leading them to align their paths with prevailing trends rather than pursuing their genuine interests. The challenge lies in adapting to evolving corporate cultures, where students often struggle to update their approaches. (Duffy, R. D.et al., 2009)

Amid the ever-evolving landscape of higher education and workforce dynamics, a crucial aspect understands the driving forces behind career decisions. This quantitative research focuses on the influential factors guiding career choices among Generation Z (Gen Z) students within the context of engineering education. (Schwieger et al., 2018)

Born between the mid-1990s and early 2010s, Gen Z is characterized by their familiarity with advanced technology and a rapidly changing global landscape. As these digital natives embark on a journey in higher education, especially in fields like engineering, their career decisions are molded by a complex interplay of factors that distinguish them from earlier generations (Seemiller, C. et al., 2017)

The realm of engineering, a cornerstone of global innovation and progress, has witnessed the influx of Generation Z (Gen Z) students, who navigate a complex interplay of personal, societal, and educational influences when shaping their career choices. (Boutellier, R. et al., 2008)

This empirical research endeavors to unravel the intricate web of these multifaceted influences through a quantitative lens, shedding light on the decision-making patterns of this generation within the landscape of engineering education (Wendell, K. B. et al., 2017).

This dynamic landscape of career choices can lead to uncertainty and hinder the development of expertise in specific

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sectors, potentially impeding their future success. Thus, the intricate dance between Generation Z's tech-savvy lifestyle and their career decisions presents a multifaceted panorama that merits thorough exploration and understanding (Haibo et al., 2018)

Against this backdrop, the primary objectives of this research are threefold: first, to examine the extent to which passion and personal interest impact Gen Z's career choices in the field of engineering; second, to elucidate the influence of gender bias on the decision-making process, particularly regarding the underrepresentation of women in engineering; and third, to explore the roles of family, friends, career growth opportunities, and role models/mentors (Binani, S. et al., 2023) in shaping the career trajectories of Gen Z in the engineering domain.

Understanding the influential factors in Gen Z's career decision-making process within the realm of engineering education has broader implications for educational institutions, policymakers, and industry stakeholders. (Aryani, F. et al., 2020) Insights gained from this research can inform targeted interventions aimed at promoting diversity, inclusivity, and informed career choices within the engineering institutions.

II. LITERATURE

The study's supporting literature addresses the concept of generations, defined as individuals sharing a common chronological, social, and historical context, and the corresponding generational theory that suggests similar characteristics and behaviors among individuals born within the same generation (Twenge, J. M. et al., 2010).

This notion has been widely explored in the context of evolving career preferences across different generational cohorts, such as baby boomers, generation X, and millennials. However, the focus now shifts to Generation Z (Gen Z), a cohort born between the mid-1990s and early 2010s, characterized by distinct experiences, values, and technological familiarity. As Gen Z enters higher education, particularly in engineering, understanding the factors shaping their career decisions becomes pivotal (Törőcsik, M. et al., 2014)

Generation Z, born between 1995 and 2010, emerged during a period of rapid information dissemination and technological accessibility (Ebadi, S. et al., 2021). The intrinsic connection to internet technology and smartphones is emblematic of their daily lives, with a substantial proportion consistently accessing online platforms (Szymkowiak, A. et al., 2021). An essential trait of Gen Z is their inclination to prioritize comfort and flexibility in career choices, displaying a tendency to eschew rigid routines and commitments. This characterization influences their selection criteria and their propensity to explore a diverse range of careers (Barhate, B. et al., 2022).

The Generation Z cohort holds a predominant presence in the digital workforce and exhibits both strengths and weaknesses when it comes to career selection. Research conducted by Paina & Irini (Racolţa-Paina et al., 2021) indicates their inclination toward opting for virtual roles, favoring positions that offer flexibility without stringent work routines or long- term commitments. Gen Z's adeptness in virtual communication, proficiency in utilizing diverse tools, video editing, content creation, and mastery of emerging job roles in the era of Industry 4.0 position them favorably to meet the demands of evolving job markets (Binani, S.et al., 2022).

Nevertheless, their propensity to gravitate towards roles lacking routine, characterized by low commitment and freelance arrangements, contributes to a frequent job- switching trend, often deviating from their inherent potential (Wheatley, A. C. et al., 2019). This predisposition engenders uncertainty in career selection, hindering the establishment of expertise in specific domains and impeding the development of a coherent career identity necessary for future success (Haibo et al., 2018).

Furthermore, the onset of the industrialization era 4.0 has substantially transformed perceptions about life, work, and career choices. Generation Z, predominantly composed of digital natives, is highly influenced by rapid information technology development, manifesting in their adoption of the internet, social media, and smartphones as integral components of their lifestyle (Ozkan, M et al., 2015). This tech- savvy orientation significantly informs their career selection, shaping their career preferences and trajectories (Gabrielova, K. et al., 2021).

Whereas, in the context of Asian society, a career choice extends beyond individual responsibility, encompassing a familial dimension that significantly impacts the sociocultural fabric (Gentina et al., 2020). The selection of a career path is intertwined with family obligations, and its repercussions reverberate within the family's societal context. Opting for a career aligned with personal aspirations and receiving parental endorsement yields comprehensive psychological and material backing. This robust support framework contributes to the cultivation of elevated career self-efficacy. Conversely, instances where a chosen career does not garner parental approval necessitate heightened support, particularly in the psychological realm. This circumstance leads to a tendency towards insecurity regarding the chosen career and the manifestation of diminished career self-efficacy. Concurring with the findings of (Kantamneni N. et al., 2018) an array of factors, including parental, peer, influencer, and social media support, intricately influence career self-efficacy through the channels of guidance, assistance, inspiration, and role modeling.

This literature review emphasizes the distinctive nature of Generation Z and the factors that impact their career decision-making, particularly in the field of engineering education. As this study delves into the empirical examination of these influential factors, it seeks to contribute to a more profound understanding of Gen Z's career choices and inform strategies

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to enhance their decision-making processes within the engineering profession.

III. METHODS

After careful consideration of multiple factors influencing methodological selection, a quantitative approach has been adopted for this study. A comprehensive set of 25 items was initially employed to gather responses, aimed at assessing various constructs across five dimensions: Personal Interest and Passion (comprising 5 items), Gender Bias and discrimination/stereotypes (comprising 5 items), Influence of Family and Friends (comprising 5 items), Career Growth Opportunities (comprising 5 items), and Role Model/Mentor Influence (comprising 5 items). The administration of the instrument took place electronically during the spring of 2023, targeting engineering students within an autonomous institute situated in South India. The data collection employed the SPSS software, with subsequent analysis conducted through its utilization. The internal consistency of the five dimensions, as indicated by Cronbach's alpha coefficients, exhibited a range between 0.67 and 0.92, signifying a commendable level of coherence among the items. (Binani, S. et al., 2023).

The design of the survey instrument drew inspiration from an extensive literature review ((Binani, S. et al., 2022) shaped by the recognition of an impending landscape wherein the workforce is projected to be predominantly of Generation Z employees in the forthcoming years. The data collection phase occurred during the autumn of 2023. This survey was meticulously crafted to gauge the manner in which specific parameters such as personal passion, gender bias, familial and social influences, opportunities for career advancement, and the impact of role models and mentors collectively shape the career choices of individuals belonging to Generation Z. Additionally, the survey encompasses distinct demographic inquiries pertaining to students' backgrounds, encompassing aspects such as gender identity, field of engineering specialization, and educational board affiliation. The author meticulously developed a set of 25 interconnected items and questions, intricately designed to assess the intricate interplay of diverse factors influencing the career decision-making processes of Generation Z individuals.

Table-1 presents an in-depth understanding of the item formulation process for each scale, effectively clarifying the fundamental essence of the variables and showcasing exemplar items. Survey participants were guided to appraise each variable using a Likert scale spanning from 5 (strongly agree) to 1 (strongly disagree). Through the incorporation of this evaluative approach, the authors adeptly conducted a meticulous analysis, delving into the noteworthy impact of diverse factors on the career decision-making journey of Generation Z.

TABLE I
OUTLINE OF FIVE CONSTRUCTS

Construct	Definition of Construct	Example Items
Passion and Personal Interest	Passion and personal interest denote an individual's strong emotional inclination and intrinsic attraction towards a specific subjector pursuit.	I believe that my personal interests and passions will change over time, so it is not essential to pursue a career that aligns with them • I strongly agree that my personal interest align well with my career aspirations in the engineering field.
Gender Bias	Gender bias refers to the systematic and unequal treatment of individuals based on their gender, resulting in disparities and inequities.	• Gender plays a significant role in career decisions • I strongly agree that gender bias exists in the field of engineering.
Influence of Family and Friends	The impact exerted by family and friends on an individual's choices and decisions.	• I moderately agree that the opinion of my family and friends has an impact on my choice to pursue a career in engineering. • I strongly agree that I have the comfort to go against the opinions of my family and friends to pursue a career in Engineering.
Career Growth Opportunities	Career growth opportunities encompass pathways and prospects for professional advancement, skill development, and upwardmobility within one's chosen field.	• It is important to continue learning and gaining new skillsthroughout one's educational career. • I believe that there are amplecareer growth opportunities available to me in my field of work
Role Model/ Mentor Influence	Role model/mentor influence refers to the effect of exemplary individuals or guides on shaping the attitudes, behaviors, and decisionsof individuals.	• I feel that the influence of my role models or mentors onmy career decisions is positive and empowering . • I moderately agree that my career decisions have been influenced by role models or mentors in my life.

A. Construct 1: Passion And Personal Interest

This factor explores the extent to which personal passions align with chosen career paths, shaping decisions and aspirations. Through an examination of this construct, the study seeks to unveil the intricate interplay between inherent interests and the vocational trajectories pursued by young engineers.

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B. Construct 2: gender bias and discrimination / stereotypes

This factor scrutinizes the impact of societal stereotypes, biases, and expectations on career pathways, shedding light on the multifaceted dynamics that shape the decision-making process. Through a meticulous examination of gender-related influences, this construct aims to contribute to a comprehensive understanding of the intricate interplay between gender bias and career aspirations within the Gen Z cohort.

C. Construct 3: influence of family and friends

This factor delves into the impact of familial and social networks on the career choices of Generation Z engineering students. Through a meticulous analysis, the research uncovers how interactions within this sphere shape and guide their career trajectories.

D. Construct 4: career growth opportunities

This factor investigates how Generation Z individuals perceive the prospects of skill development, upward mobility, and future job roles. It assesses their attitudes towards aligning their career choices with opportunities for growth and progress in the ever-evolving landscape of engineering.

E. Construct 5: role model/mentor influence

This factor explores how guidance from accomplished individuals shapes attitudes, decisions, and aspirations, ultimately influencing career trajectories. Investigating the role model/mentor influence construct provides insight into the dynamic interplay between personal inspiration and external guidance in the career decision-making process of young engineers.

IV. DATA ANALYSIS AND RESEARCH FINDINGS

Following the distribution of the survey questionnaire, responses were collected, categorized, and reviewed prior to conducting relevant descriptive statistical analyses using the SPSS software. Face validity was established through the engagement of three volunteers to review the questionnaire, furnishing feedback on language and terminology; the volunteers affirmed the adequacy of phrasing and word choices within the survey instrument. Out of a total of 260 responses, 253 were retained for analysis after data cleaning.

Data points from respondents who completed less than 50% of the survey were excluded, and respondents answering "yes" to all questions were omitted from analysis. Missing data was addressed using the group mean substitution method. The survey, with a duration of approximately 8 minutes, utilized a five-point Likert scale encompassing the options: strongly disagree, disagree, neutral, agree, and strongly agree. A reminder was issued to students after three days to encourage survey completion if they had not done so earlier.

TABLE II
PARTICAPANTS DEMOGRAPHIC INFORMATION

#	Category	N	%
	Total	253	100
1	Gender		
	Male	144	56.9
	Female	109	43.1
2	Engineering discipline		
	Computer science and engineering	89	35.2
	Data Science (DS)	26	10.3
	Cybersecurity (CS)	48	19
	Internet of things (IoT)	48	19
	Artificial intelligence and Machine learning (AI & ML)	42	16.6
3	Future Plans		
	Job	149	58.9
	Higher studies	90	35.6
	Other	14	6.5
4	Geographic Location		
	Urban	225	88.9
	Rural	28	11.1

The demographic data of participants, including gender identity, engineering discipline, future plans and Geographic

Location, are presented in Table 2. Among the 253 students who responded, 56.9% were male and 43.1% were female. Course distribution included various college disciplines (35.2% - CSE, 16.6% - AI & ML, 10.3% - DS, 19% - IOT, 19% - CSC). The predominant secondary education board among respondents was identified as having an 81.9% representation, highlighting demographic variance.

Table 3 presents the comprehensive descriptive statistics pertaining to all survey items employed in the study. An exploratory factor analysis methodology was undertaken in this research endeavor. To assess the appropriateness of items for factor analysis, Bartlett's test for sphericity was applied, with a significance level set at p=0.00. Additionally, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, with a threshold of KMO 0.84, was employed to evaluate the variance captured by the extracted factors (Kittur, J. et.al 2020)

Guidance for factor analysis was derived from multiple sources including parallel analysis, scree plots, and Kaiser's criterion. While parallel analysis of 5 factors and the scree plot / kaiser indicated the presence of seven factors. In alignment with the hypothesized number of factors, the decision was made to proceed with five factors. Given correlations exceeding 0.33 among the factors, the Promax rotation method was adopted (Kittur, J. et.al 2020)

The conclusive factor loadings for the five identified factors are detailed in Table 4. Within Table 3,it is observed that four factors (items 2, 3, 6, 7, 9, 13, 14, 15, 20, 22, 23, 24, 25) demonstrated cross-loading on more than one factor > 0.3 (

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McNabb, D. E. 2020). Consequently, these 13 items were excluded from the analysis, resulting in a final compilation of four factors encompassing a total of 12 items. The factor loadings for factor 1 ranged from 0.32 to 0.50, while factor 2 exhibited loadings between 0.38 and 0.43. Similarly, factor 3 displayed loadings of 0.41 to 0.69, factor 4 ranged from 0.35 to 0.61, and factor 5 demonstrated loadings spanning to 0.38 ranging from 0.67 to 0.92, underscoring the strong reliability of the identified factors. (Kittur, J. et.al 2020) reliability coefficient Cronbach's α, showcased robust values The evaluation of internal consistency, as measured by the participants.

Table III. Descriptive Statistics of Five Constructs

#	**Measure**	Mean	SD
	Personal Interest and Passion		
1	Do you think your personal interests are in line with your career aspirations in the engineering field?	3.8	0.8
2	I believe that having a career aligned with my personal interests and passions will lead to greater job satisfaction.	4.1	0.7
3	When making career decisions, I prioritize my personal interests and passions over external factorssuch as salary or job availability.	3.7	0.9
4	I am comfortable deviating from societal or culturalexpectations in order to achieve a career aligned with my personal interests and passions.	3.6	0.9
5	I believe that my personal interests and passions will change over time, so it is not essential to pursue a career that aligns with them.	3.4	1.0
	Gender Bias and Discrimination/Stereotypes		
6	Do you believe that gender bias exists in the fieldof engineering?	3.0	1.1
7	Gender plays a significant role in career decisions	2.9	1.1
8	Do you think education and awareness programs can help overcome gender bias and stereotypes in engineering?	3.7	0.9
9	I feel that my gender has impacted my careeropportunities and advancements.	2.9	1.1
10	I feel that my educators have helped me navigategender-based barriers in my career.	3.3	0.8
	Role Models and Mentors Influence		
11	Have your career decisions been influenced by rolemodels or mentors in your life?	3.6	0.8
12	I feel that my role models or mentors have helped me develop a strong sense of purpose and direction in my career.	3.6	0.9
13	I feel comfortable discussing career-related issueswith my role models or mentors.	3.5	0.9
14	I feel that the influence of my role models or mentors on my career decisions is positive andempowering.	3.6	0.8
15	My role models or mentors have provided me with emotional support during challenging times in my career	3.4	0.9
	Influence of Family and Friends		
16	Does the opinion of your family and friends have an impact on your choice to pursue a career in engineering?	3.7	0.9
17	Do family and friends encourage you to pursue acareer that aligns with my interests and passion?	3.7	0.9
18	Do you have the comfort to go against the opinions of your family and friends to pursue a career in engineering.	3.5	0.9
19	I feel comfortable discussing career-related issueswith my family and friends.	3.7	0.9
20	Have you included your family and friends in yourcareer decision-making process?	3.7	0.8
	Career Growth Opportunities		
21	I believe that a higher education degree isnecessary for a successful career in engineering	3.7	1.0
22	It is important to continue learning and gaining newskills throughout one's educational career	4.1	0.8
23	I feel that my current institute values and supportsthe career growth and development of its students	3.6	0.8
24	I feel that my institute provides the necessary training and development programs to help me advance in my career	3.5	0.9
25	I believe that there are ample career growthopportunities available to me in my field of work	3.8	0.8

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Table IV. Survey Instrument Ultimate Factor Loadings

#	Measure	F1	F2	F3	F4
	Personal Interestand Passion				
1	Do you think your personal interestsare in line withyourcareer aspirations in the engineering field?	0.501			
2	I am comfortable deviating fromsocietal or cultural expectations in order to achieve a career aligned withmy personalinterests and passions.	0.423			
3	I believe that my personal interestsand passions will change over time, so it is not essential to pursue a career that aligns with them.	0.329			
	Gender Bias and Discrimination/ Stereotypes				
4	Do you think education and awareness programs can help overcome gender biasand stereotypes in engineering?		0.382		
5	I feel that my educators havehelped me to navigate gender-based barriers in my career.		0.43		
	Role Models and Mentors Influence				
6	Have your career decisionsbeen influenced by rolemodels or mentors in yourlife?			0.412	
7	I feel that my role models or mentors have helped me to develop a strong sense of purpose and direction in my career.			0.696	
	Influence of Family and Friends				
8	Does the opinions of your family and friends have an impact on your choice to pursue a career inengineering?				0.358
9	Do family and friends have encouraged you to pursue a career that aligns with my interests and passion?				0.61
10	Do you have the comfort to go against the opinions of your family and friends to pursue a career in engineering.				0.429

V. CONCLUSIONS

The objective of formulating and creating a survey instrument was to comprehensively capture the elements/factors that exert an influence on the career-decision making process of Generation Z. Through an exploratory factor analysis, a total of five distinct factors were identified: personal passion and interests, the impact of gender bias, the role of family and peer influence, opportunities for career advancement, and the significance of role models and mentors in shaping career choices for Generation Z individuals. Subsequent to the collection of evidence for face validity, the factors displayed loadings ranging from 0.38 to 0.61, with Cronbach's α values spanning from 0.67 to 0.92. This survey instrument holds the potential to be adopted within various educational contexts, serving as a valuable tool to comprehend the influential determinants shaping Generation Z's decision-making process regarding careers, particularly within the domain of engineering education. Furthermore, the ethical implications of utilizing such a tool must be carefully considered, ensuring that participants' privacy and confidentiality are upheld throughout the data collection and analysis phases (Binani, S. et al., 2022). The broader implications of this research extend to educational institutions, policymakers, and industry stakeholders. The insights derived from this study offer guidance for targeted interventions aimed at fostering diversity, inclusivity, and well-informed career selections within the engineering profession

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