

Understanding Career Choices of Engineering Students: A Study of Persistence in STEM Fields in Lebanon

Jana Sabra, American University of Beirut

Jana Sabra (she/her) is a Research Assistant at the Department of Chemical Engineering and Advanced Energy at the American University of Beirut. She works as part of the Pipeline Initiative team under the supervision of Dr. Elsa Maalouf, contributing to research and programs that support equitable access, mentorship, and representation in STEM fields. Jana holds a Bachelor of Science in Chemistry from the American University of Beirut. She is also the Director of Communications at All Girls Code, where she leads efforts to promote STEM education and awareness among girls.

Elsa Maalouf, American University of Beirut

Dr. Elsa Maalouf is an Assistant Professor at the Department of Chemical Engineering and Advanced Energy at the American University of Beirut (AUB). She earned her doctorate degree from the University of Texas at Austin. Her work focuses on sustainable subsurface energy applications and the use of sustainable materials. She is the lead of the Pipeline and Mentorship initiative at AUB that supports women in engineering and offers mentorship to university students until after they graduate. Her current research investigates enrollment trends in engineering programs in Lebanon and examines how parental influence, sociopolitical factors, and cultural perceptions shape students' decisions to pursue engineering education.

Aya Mouallem, Stanford University

Aya Mouallem (she/her) is a PhD candidate in Electrical Engineering and MA candidate in Education at Stanford University. She received a BEng in Computer and Communications Engineering from the American University of Beirut. Aya is a graduate research assistant with the Designing Education Lab at Stanford, led by Professor Sheri Sheppard. Her research designs, develops, and evaluates education technology and pedagogy to broaden the accessibility of engineering education and fundamentally transform how we prepare future engineers. She is supported by the Knight-Hennessy Scholars program and the DARE and RAISE doctoral fellowships.

Rasha Malaeb, American University of Beirut

Rasha Malaeb (she/her) is a Computer and Computer Engineering student at the American University of Beirut (AUB), currently pursuing a Master's in Engineering with a focus on Machine Learning and Cybersecurity. She is a research assistant and event coordinator for the Pipeline and Mentorship Initiative at AUB, where she works on student support projects such as Peer2Peer Mentorship. Her research focuses on Machine Learning, Cybersecurity, and supporting women in engineering.

Understanding Career Choices of Engineering Students: A Study of Persistence in STEM Fields in Lebanon

Abstract

Across the Middle East and North Africa (MENA) region, and specifically in Lebanon, engineering majors continue to attract a large share of undergraduate students. Nevertheless, there are students with undergraduate engineering degrees in the region who transition to non-STEM career paths after graduation, reflecting a notable shift away from STEM fields in the region. In Lebanon, students' pursuit of STEM career trajectories is influenced by both personal and institutional factors that shape the career decisions of engineering graduates. Therefore, this study examines how personal expectations and aspirations, as well as workplace and job market factors, shape engineering graduates' decisions to pursue careers in STEM fields. The data for this study were collected through a mixed-methods survey conducted among 2,490 respondents, female (32.6%) and male (67.3%), engineering alumni of the American University of Beirut in Lebanon, a consistently highly ranked and prominent University in the MENA, between 2019 and 2024. The survey included quantitative questions about student plans after graduation and experiences with the job search journey, as well as qualitative questions that explored the factors affecting decisions to pursue graduate studies and the impact of internships on career choices. Adopting a grounded theory building approach, the qualitative data were analyzed using open coding, followed by focused coding to reveal core themes and patterns. The analysis results were then examined in the context of the Social Cognitive Career Theory (SCCT). Findings show that across 2019-2024, approximately half of the respondents pursued STEM-aligned early career pathways (Engineering or AI & Technology), highlighting both continued engagement with engineering and notable movement toward non-STEM fields. Job market conditions in Lebanon and opportunities abroad were frequently associated with persistence in STEM and with transitions to non-STEM pathways. Internships contributed to career decision-making for 89% of respondents, although only 16.8% reported that an internship directly led to employment. Finally, this study concludes by examining the dynamic interplay between personal interests and contextual factors to better understand engineering graduate students' career choices and their persistence in STEM fields in Lebanon.

Keywords: engineering education, STEM fields, STEM retention, Lebanon, Social Cognitive Career Theory, STEM careers

1. Background

1.1 Related Work / Literature Review

Global Trends

Engineering undergraduate programs continue to attract a significant percentage of both male and female students, often due to the perceived career stability, technical skill development, and socioeconomic security they offer [1]. However, research across diverse national contexts, such as the US and China, has shown that a considerable share of engineering graduates do not persist in STEM careers after graduation [1],[2],[3]. This gap raises questions about the impact of engineering and STEM education in encouraging students to pursue careers in these same fields.

Postgraduation career choices are shaped by both personal motivations and contextual factors. Zhou and Shirazi [1] conducted a systematic review of 159 studies on STEM career aspirations and found that interest, financial security, and the social utility (contribution to society) are strong motivators for students to continue in STEM. However, global research on STEM persistence of male and female students shows that even when students begin their studies with interest, maintaining engagement through to a STEM career is not always guaranteed [4],[5]. For instance, data from the Baccalaureate and Beyond Longitudinal Study (B&B), which followed 11,192 U.S. college graduates, showed that only 53-62% of STEM graduates were employed in jobs closely related to their major within 1-10 years after graduation, reflecting the attrition from STEM careers [3]. Similarly, Rosenzweig et al. [6] conducted an online survey of 1,727 undergraduate STEM students in the U.S. and found that shifting career plans within STEM fields was common and linked to lower motivation, satisfaction, and certainty regarding career objectives and pathways.

Research on post-graduation career outcomes also shows the importance of practical experience, mentorship, and readiness for work on career decisions post graduation [1],[5],[7]. Using data from B&B, researchers found that engagement in practical coursework, internships, and extracurricular activities significantly enhances graduates' preparedness for STEM employment and increases the likelihood of entering STEM occupations. Complementing this, structured mentorship has been shown to improve academic satisfaction, strengthen STEM identity, and foster career persistence [8]. These findings emphasize that experiential learning is needed to support students while transitioning from education to sustained STEM careers.

Beyond educational support, economic, and labor market conditions shape STEM career trajectories. Longitudinal data indicate that financial incentives, job security, and local employment opportunities influence graduates' decisions to remain in STEM [3],[9]. In contexts where career advancement or financial rewards are limited, graduates are more likely to seek employment abroad or transition to non-STEM occupations, contributing to continued attrition from STEM fields [2],[10]. At the same time, global labor market shifts driven by emerging fields such as AI, robotics, and consulting are reshaping demand and influencing graduates' career choices [11],[12].

MENA and Lebanon Trends

Postgraduation pathways for STEM graduates across the MENA region are heavily shaped by labor market conditions, structural constraints, and socio-cultural factors. Across the region, nearly one-third of STEM graduates work in occupations unrelated to their field of study, often facing prolonged job searches due to limited entry-level positions and employers' expectations of prior experience [13]. Professionals across the MENA region anticipate substantial changes in their work due to AI, with 86% reporting that widespread adoption of AI will affect their professions, reflecting the growing role of technology in shaping career trajectories and workforce expectations [14]. Gendered barriers further reduce persistence in STEM careers: although women comprise 34-57% of STEM graduates in MENA, workforce participation remains low, with socio-cultural norms, family responsibilities, and rigid work environments contributing to reduced retention and progression of graduates in STEM careers [15],[16]. Structural factors such as skill mismatches, uneven access to digital competencies, and limited alignment between university curricula and labor market needs exacerbate these challenges [13].

In Lebanon specifically, labor market outcomes pose a significant challenge for graduates across nearly all disciplines, including engineering, due to ongoing socio-economic and political instability [17]. High unemployment rates (approximately 29.6%) and widespread skill mismatches between university curricula and employer requirements leave many graduates underprepared for practical engineering roles [17],[18]. Limited local employment opportunities, low wages, and weak research infrastructure contribute to a persistent brain drain, with a large percentage of college-educated graduates seeking opportunities abroad to secure better career prospects and higher compensation. Salary considerations are frequently a decisive factor in accepting or declining job offers, while insufficient structured internships and postgraduate pathways further affect graduates' readiness for the labor market [17],[18].

To contribute to global and regional literature, this study examines the interplay between engineering students' interests and aspirations, job market conditions, and experiential learning opportunities (internships and postgraduate studies) to understand how these factors collectively shape career decisions and persistence in STEM fields among engineering graduates in Lebanon, as illustrated in Figure 1.

Factors Influencing Engineering Graduates' Career Decisions and Persistence in STEM in Lebanon

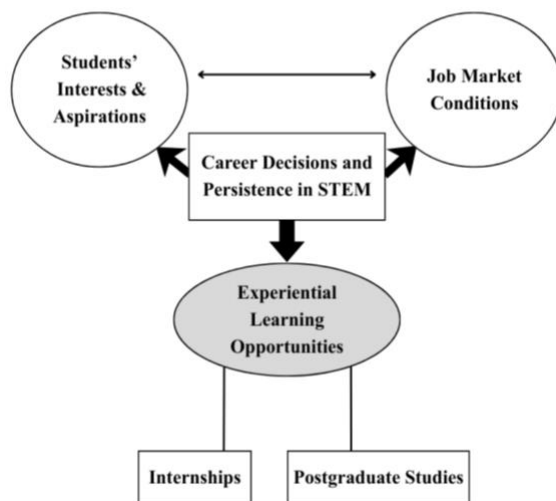


Figure 1. Factors influencing engineering careers in Lebanon and persistence in STEM.

1.2 Related Theories

In this study, we adopted the Social Cognitive Career Theory (SCCT) to understand the career pathways of engineering students in Lebanon. SCCT is a robust framework that studies influential factors of an individual's career decisions and behaviors, examining the interplay between personal, behavioral, and environmental contextual factors.

SCCT includes three core constructs: self-efficacy, outcome expectations, and personal goals [19]. Self-efficacy is the individual's belief in their ability to successfully perform tasks required for their career achievement. Outcome expectations consist of perceived consequences of career-related actions, such as the possibility of securing employment, career advancement, or personal satisfaction. Finally, personal goals demonstrate the intentions and aspirations that guide career-related behaviors, which include choosing to persist in STEM fields [19]. SCCT also tackles the influence of environmental factors on

career advancements, both as supports and barriers [20]. Supports consist of access to mentorship, internships, and networking opportunities, whereas barriers may include economic instability, labor market constraints, gender-related biases, or limited workplace opportunities [20].

Applying SCCT permits the analysis of the interplay between personal interests and expectations and contextual factors on the deciding postgraduation pathways among engineering graduates. It provides a robust framework for understanding why some students persist in STEM careers while others diverge into alternative non-STEM pathways. By grounding the mixed-methods analysis in SCCT, the study can explore how personal agency and external conditions interact to shape career pathways amidst Lebanon's challenging socio-economic environment.

Research has used SCCT to explore how personal agency, environmental challenges, and self-efficacy interact to shape engineering career choice and retention, providing insights into how individual differences and contextual factors influence career pathways [21]. Longitudinal studies have also shown that engineering students' self-efficacy and outcome expectations are key predictors of persistence intentions over time, with changes in these constructs being associated with persistence behavior during students' first semester of engineering courses [22].

1.3 Our Context

Lebanon's higher education system is recognized regionally for offering meticulous academic programs and producing highly skilled and knowledgeable graduates. However, the ease in transition from university to the job market is constrained by the severe economic and structural challenges. Research on Lebanon's economy shows ongoing knowledge-based economic obstacles that affect employment prospects, innovation, and talent optimization [17]. Political instability, weak institutional infrastructure, and brain drain inhibit the realization of a sustainable knowledge-based economy, with direct implications for engineering graduates' career pathways [23]. Given the deteriorating economy since 2019, studies on the country's job market and education sector note that the former is faced with low activity, high unemployment rates, and severe skill-mismatch problems, particularly for technical disciplines [24].

Within this broader socio-economic context, engineering education in Lebanon attracts a high percentage of students with its perceived prestige and technical knowledge. Yet literature on curriculum effectiveness reveals that many engineering graduates perceive gaps between academic preparation and practical workplace skills, which affects their employability and career pathways [25]. In this context, practical experiences, including internships, contribute to developing and strengthening graduates' professional skills. [25].

Research on persistence in STEM fields highlights that persistence is influenced by academic confidence, sense of belonging, and institutional support. A recent global study shows that social integration and academic confidence are key predictors of whether students remain in their chosen fields by completing and pursuing a career in it [26]. This provides a theoretical reference for understanding why some students persist in STEM careers while others deviate post-graduation. Additionally, research on STEM persistence literature reveals the importance of active learning, mentoring, and early exposure to real-world problem solving on this topic [5]. Together with the economic and workplace conditions, these factors

influence whether engineering graduates persist in engineering careers, pursue further education, or transition to alternate pathways.

In this work, we analyzed quantitative and qualitative insights from 2,490 undergraduate engineering students, collected as part of the American University of Beirut's faculty of Engineering alumni exit survey after one year from graduation from classes 2019-2024. The American University of Beirut, at which the study was conducted, is a leading research-intensive university in Lebanon and is consistently ranked among the top institutions nationally and within the top global tier of universities. The institution maintains a 59% undergraduate engineering faculty acceptance rate in 2024, alongside a high student retention rate of 97% for the same cohort [27]. Its diverse student body, from Lebanon and international countries, combined with its strong positioning within national and regional higher education systems and its influence through partnerships, alumni networks, and contributions to national dialogue, makes it a critical and relevant setting for examining patterns of student persistence and career decision-making in engineering and STEM fields.

This study aims to contribute to the literature on youth's persistence in STEM careers, considering one institution as a case study in Lebanon and potentially broadening our understanding of the factors influencing students' career choices after completing their undergraduate programs in the broader context of the MENA region.

2. Research Questions

1. What postgraduation pathways do engineering graduates in Lebanon follow in terms of employment, further education, and persistence in STEM fields?
2. How do job market conditions and the economic context (local vs. abroad) relate to graduates' persistence in STEM fields after graduation?
3. How are personal interests, expectations, and self-perceived alignment with engineering reflected in graduates' career outcomes?

3. Positionality

Our research team is composed of four Lebanese women: the principal investigator, co-investigator, and two research assistants. Together, the team brings forward knowledge and diverse expertise in engineering education, STEM outreach programs, and gender-inclusive mentorship. Elsa Maalouf is an assistant professor in Chemical Engineering and the lead of an engineering and women empowerment mentorship initiative. Aya Mouallem is a Computer Engineering alumna of the university and a current PhD candidate in Electrical Engineering and MA candidate in Education at Stanford University, where she conducts engineering education research. Jana Sabra holds a Master's degree in Energy Studies from the same university and is a current director of an initiative that supports women in STEM in Lebanon. Rasha Malaeb is pursuing her Computer Engineering Master's degree at the same university. With this, the team comes from common roots that represent diverse experiences associated with the university at which the alumni exit survey from which the data was collected is conducted, as well as a variety of Lebanese lived experiences.

4. Methods

4.1 Data Collection

The target audience of this study is male and female engineering students who have completed their undergraduate studies at the American University of Beirut in Lebanon. The data was collected through an institutional survey developed by the university, entitled and referred to in this study as “alumni exit survey.” This voluntary survey was completed by the target audience one year after they graduated from the university’s various engineering programs (Chemical Engineering, Civil Engineering, Computer and Communications Engineering, Mechanical Engineering, Industrial Engineering, and Electrical Engineering). As discussed previously, the American University of Beirut provides a relevant and informative context for exploring broader trends in STEM persistence in Lebanon through the surveyed pool, especially given the lack of publicly available institutional data on engineering enrolment in higher education across Lebanon’s universities. The anonymized data of 2,490 respondents (32.6% women and 67.3% men) were obtained by the research team after the study received the Institutional Review Board (IRB) approval, ensuring all ethical standards were met. The survey included both qualitative, open-ended short questions, quantitative, and multiple-choice questions about the students’ experiences during their undergraduate studies and their career trajectories, including questions on employment, internships, and postgraduate studies. A sample of the survey questions is available in Appendix A.

4.2 Data Analysis and Validity

This study employed a mixed-methods approach, utilizing both quantitative and qualitative data to examine engineering graduates’ career pathways and persistence in STEM fields in Lebanon [28]. The quantitative data were retrieved from the alumni exit survey and included answers on employment status, internship experience, and postgraduation choices. The qualitative component of the survey included insights on internship experience and the choice of postgraduate education. All data of 2,490 respondents (32.6% women, 67.3% men) spanning 2019 to 2024 were cleaned and organized. This process involved checking for missing values and ensuring consistency in categorical responses for quantitative data. The qualitative data were thematically coded using an iterative coding process. Codes were organized into categories reflecting key factors influencing graduates’ career decisions and alignment with personal interests. The codes were initially created inductively in an open coding approach to produce as many codes as possible. Open coding was then used for focused coding to merge, edit, and refine codes into clear clusters and themes. Quantitative and qualitative data together were used in this study’s findings to provide a comprehensive understanding of persistence in STEM pathways.

To enhance the validity of the findings, the study employed both methodological triangulation and investigator triangulation [29]. Methodological triangulation was achieved by combining survey questions to verify trends observed in quantitative data with contextual insights from qualitative responses. Investigator triangulation involved multiple researchers independently reviewing the coding data for any discrepancies. This process reduced individual bias and enhanced the credibility of qualitative coding.

5. Findings

5.1 Postgraduation Career Pathways

In this section, we report the immediate postgraduation pathways of engineering graduates using data from the alumni exit survey completed by 2,490 respondents. Graduates were asked to indicate their primary plans following graduation (see Question 3 in Appendix A), and the distribution of responses is presented in Figure 2. The majority of the survey respondents were still seeking employment at the time of graduation (35.95%), and almost an equal number of graduates were either starting a job (26.4%) or going into postgraduate studies (24.4%). 171 out of the 2,490 respondents (6.9%) reported being undecided on their next step after graduation, while the remaining respondents were either continuing to work in their existing jobs, pursuing a training or internship program, or choosing to simultaneously pursue a job and graduate studies.

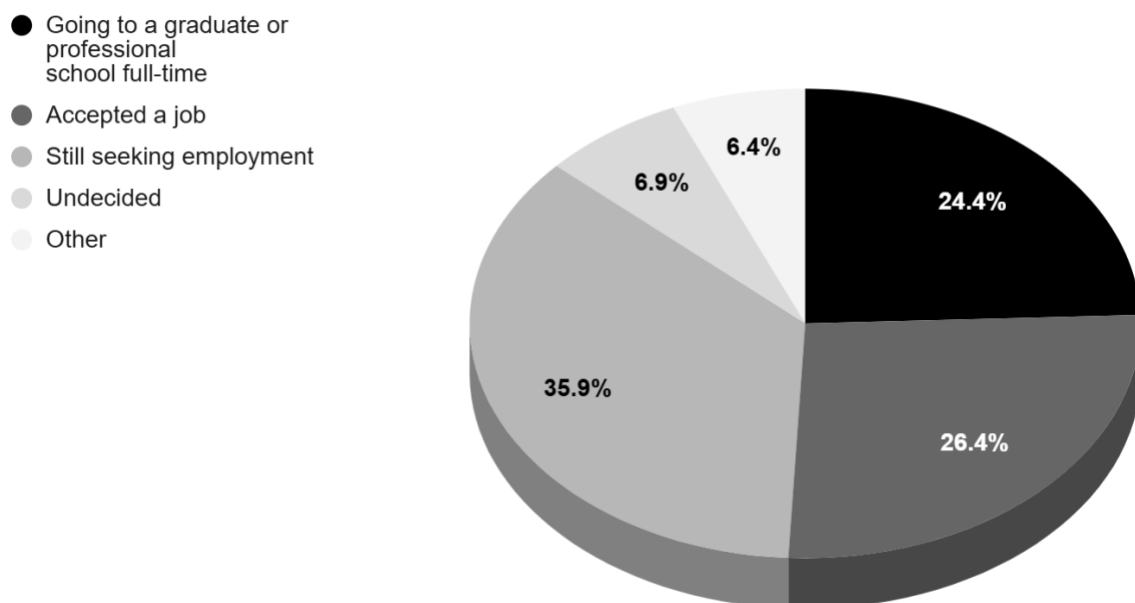


Figure 2: Primary postgraduation activity reported by engineering graduates at the time of graduation (N = 2,940 respondents)

Figure 3 depicts the location of the main activity the graduates would be engaging in after graduation. The majority (31.6%) of the respondents aimed to relocate from Lebanon to an Arab country (30.9% to an Arab Gulf country, 0.7% to a non-Gulf Arab country) for their work or further studies. 29.7% indicated plans to remain in Lebanon, 22.8% to move to Europe, and 12% to relocate to North America. A smaller group of graduates (3.9%) reported plans to move between countries, mainly between the Arab Gulf and Europe.

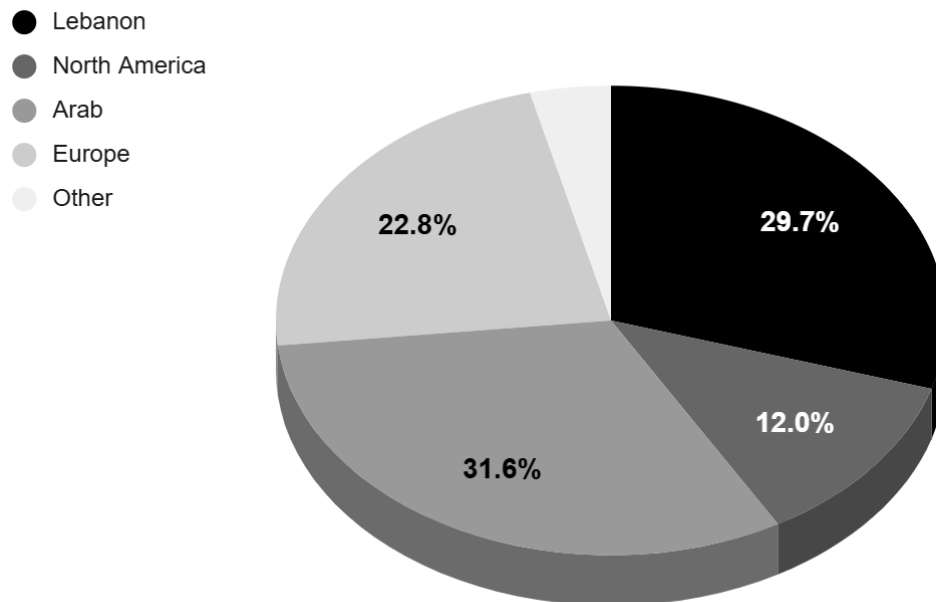


Figure 3: Intended locations of graduates' primary postgraduation activity (N = 2,940 respondents)

Figure 4 illustrates the respondents' answers regarding their primary career choice immediately after graduation. The data collected as names of fields and career clusters was cleaned and categorized by the authors into four career clusters: AI & Tech, Engineering, Consulting, Business, in addition to the Undecided and Others categories. The Engineering cluster encompasses all branches of engineering, robotics, and energy. The Business cluster includes finance, marketing, economics, and other managerial corporate roles. The Consulting cluster primarily comprises management consulting roles. The AI & Technology cluster encompasses roles in artificial intelligence, machine learning, and IT. The Undecided category encompasses the undecided and unsure answers, while the Others category includes careers such as teaching and the public sector. Across the six years (2019-2024), persisting in STEM through careers in Engineering and AI & Tech represented the most common postgraduation pathway, accounting for a combined average of 66% of respondents. Although AI & Technology careers constituted the smallest share across the identified career clusters, interest in this field has increased over time, with a notable rise beginning in 2020 and a peak in 2023, reaching 29.3%. The Consulting (average: 25.78%) and AI & Tech (average: 22.33%) clusters exhibited comparable trends and participation levels across most years. In contrast, the Business cluster exhibited a steady, near-linear increase, rising from 2.9% in 2019 to an average of 4.95% over the six years. Meanwhile, the Undecided category consistently accounted for a smaller share of respondents, averaging 2.47% over the same period. Finally, the Others category, averaging at a value of 0.8%, is not represented on the figure, which explains why the sum of the percentages across the five categories is slightly below 100%.

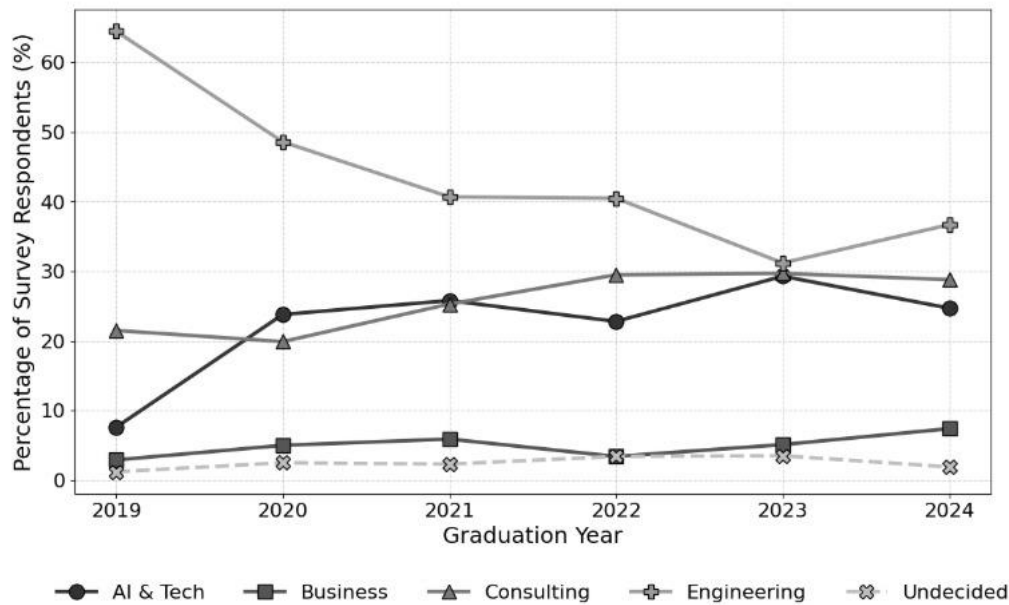


Figure 4: Distribution of survey respondents in percentage across career clusters from 2019 to 2024 (N = 1383)

Finally, survey respondents were asked in Question 17 in Appendix A about their overall satisfaction with their postgraduate plans, encompassing the immediate career actions, geographic locations, and career fields presented. Figure 5 shows that although the majority of the respondents were satisfied (30.9%) or highly satisfied (28.77%) with their plans, a close number had a neutral viewpoint (28.36%).

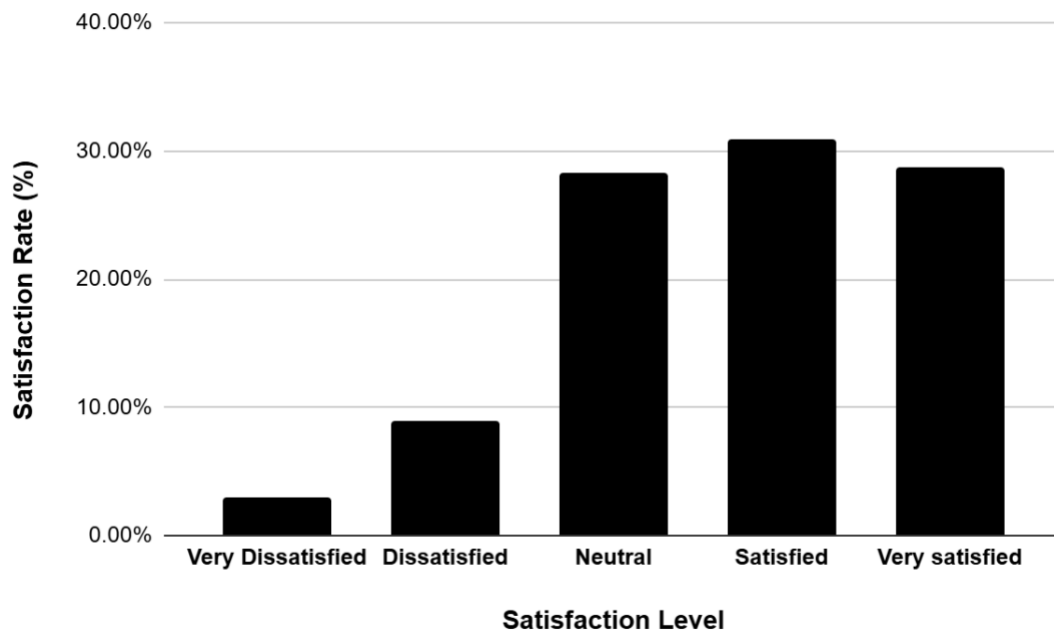


Figure 5: Satisfaction level of the postgraduate career plans of engineering students (N = 1,929 respondents)

5.2 Job Market Status and Economic Context

5.2.1 Employment Status Postgraduation

In the survey, students were asked a series of questions about their employment status postgraduation. As not all respondents were seeking employment or had secured a job offer at the time of the survey, the sample size varied in the reported data below. Percentages are based on respondents for whom the question was applicable; “Does not apply” responses were excluded.

The questions on the timing of job attainment (Question 11) and employment type (Question 12) in Appendix A applied only to respondents with secured jobs (N = 657). As those questions did not apply to 73.61% of the total sample (N = 2,490) who selected “Does not apply,” the results are reported as percentages based on the reduced, eligible subsample to exclude non-relevant responses. 91.89% obtained their job position immediately before or upon graduation, 6.25% obtained it three months after graduation, 0.84% six months after graduation, 1.01% one year after graduation, and 10.98% chose the option “Other”.

Moreover, 98.02% of those with secured jobs were employed on a full-time basis (on average 30 hours or more per week), while the rest (1.98%) were employed on a part-time basis (on average less than 30 hours per week).

548 out of 2,490 respondents answered the survey question on the number of job offers received after graduation (see Question 13 in Appendix A). As shown in Figure 6, the majority of these respondents reported receiving a single job offer (56.4%). Smaller percentages reported receiving two offers (22.3%) or three offers (14.4%), while 4.0% indicated receiving four or more offers. The remaining 2.9% of respondents reported pursuing self-employment or owning their own business.

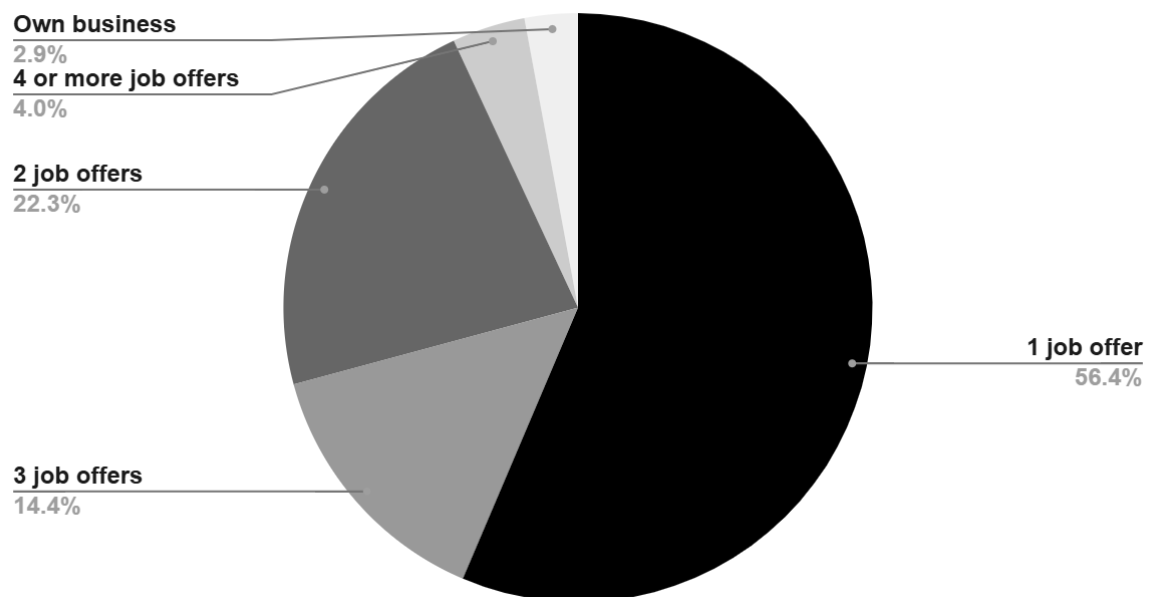


Figure 6: Number of job offers postgraduation (N = 548 respondents)

5.2.2 Job Expectations and Relation to Major

Continuing the series of questions on employment status, survey respondents were asked about the extent of the relationship between their major of study (engineering discipline) and their job offerings. The results are summarized in Table 1 below. The respondents who chose “does not apply” either did not have a secured job offer, were not seeking employment, or preferred not to share. 38.45% (N = 593) expressed a direct relationship between their job offerings and engineering major, and 38.28% chose the option “somewhat related”.

Table 1: The extent of the relationship between job offerings and engineering major of study (N = 2,490)

	Count	Percentage
Directly related	228	9.16%
Somewhat related	227	9.12%
Not related	138	5.54%
Does not apply	1897	76.18%

In the multiple-choice Question 9 in Appendix A, respondents were asked to select all options that applied from a given list of factors that they considered important when seeking employment. As the question allowed multiple responses, percentages represent the proportion of respondents selecting each option, and therefore do not sum to 100%. The results illustrated in Figure 7 show that most respondents emphasized salary and job benefits as the most important factors when seeking a job. Fast career advancement was the second most frequently selected factor, while challenging work was the least selected. More respondents found importance in the positive impact of their job on society than in having a job that is relevant to their field of study.

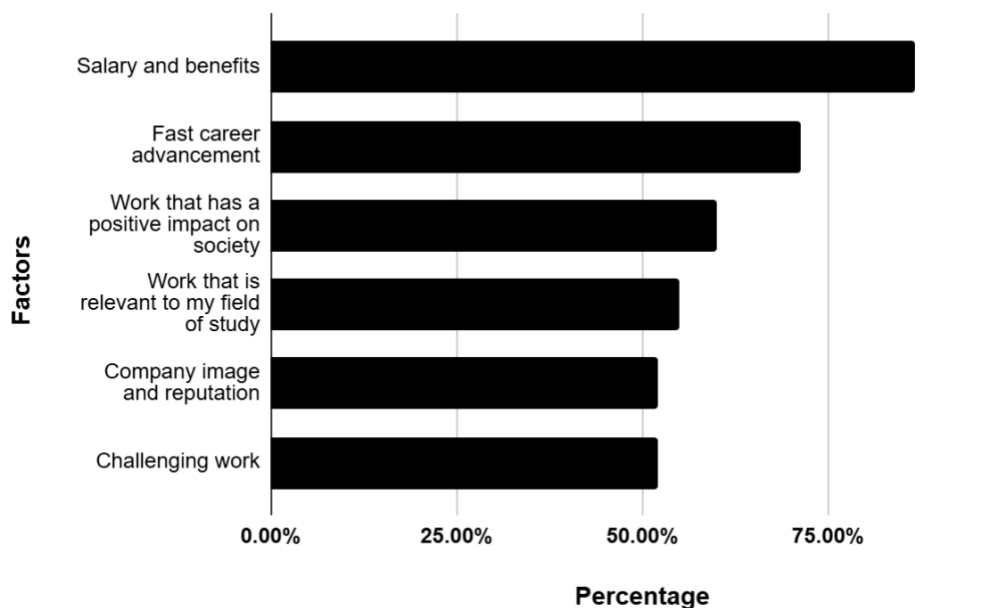


Figure 7: Factors considered important by respondents when seeking employment (N = 895)

Finally, respondents with secured job offers were asked if the job's basic salary matches their expectations (Question 14 in Appendix A). 74.55% (N = 554 respondents) of the respondents had salaries that met their expectations, while 25.45% did not. 1,936 of the respondents answered, "Does not apply".

5.2.3 Declining Job Offers

The immediate main career pathway for an engineering graduate, as shown in our findings, was securing a convenient job offer. Table 2 presents the distinct reasons shared by the respondents (N = 1,075) on the factors that would prompt or have already prompted them to decline job offers. The most frequently chosen reason, selected by 38.70% of respondents, was that the job was not relevant to their completed undergraduate engineering major. This highlights the importance of field alignment in career decisions and persistence in STEM. In contrast, the job title was the least influential factor in prompting respondents to decline an offer, suggesting that engineering graduates prioritize salary, location, and job description over assigned designations when securing a job relevant to their needs and interests.

Table 2: Factors influencing engineering graduates' decisions to decline job offers (N = 1,075)

Factor	Count	
Not relevant to my major	416	38.70%
Salary	254	23.63%
Location	192	17.86%
Job description	138	12.84%
Company reputation	51	4.74%
Job title	24	2.23%

5.3 Personal Interests Shaping Career Prospects and Outcomes

5.3.1 Personal Interests and Internships

Internships are an essential mandatory part of an engineering undergraduate degree at the American University of Beirut, and a primary experiential career component throughout the students' journey. Table 3 summarizes the main resources and networks through which the survey respondents secured their internship(s). 1,003 respondents shared their answers, while the remaining 1,487 (of the total N = 2,490) selected "Does not apply." The main source for the majority of the respondents (51.84%) was their personal contacts through their own or their family's circles, connections, and networks. The support of the university played an essential role in facilitating the securing of internships; 24.93% reported the use of the university's career services, and 13.36% utilized the support of the university's faculty internship program to secure their internships. 13.36% of the respondents used online job portals, mainly LinkedIn, to obtain their internships. Finally, job fairs were a source for 2.49% of the respondents.

Table 3: Sources of the internships completed by the survey respondents (N = 1,003).

Internship Sources	Count	Percentage
Personal contacts	520	51.84%
University's career services	250	24.93%
University's faculty internship program	134	13.36%
Online job portals	74	7.38%
University's job fair	25	2.49%

A deeper understanding of internship outcomes and their role as an experiential component of career development is important, given their influence on the career decisions of engineering graduates [25]. Table 4 shows career-related outcomes of the internships, if any, for the total sample size (N = 2,490). Only 16.79% of the respondents reported that their internships led to employment, while the majority (83.21%) did not secure a job offer through their internship. Despite that, 89.04% of the respondents indicated that their internships were beneficial in guiding their career decisions, suggesting that internships provide significant experiential value beyond immediate employment opportunities.

Table 4: Employment and career decision outcomes attributed to internship participation (N = 2,490)

Outcome	Yes (Count)	Yes (Percentage)	No (Count)	No (Percentage)
The internship led to employment.	418	16.79%	2072	83.21%
The internship helped in making better career decisions.	2217	89.04%	273	10.96%

Beyond immediate outcomes, respondents also shared the influence of their internships on their career decisions and personal interests in STEM. As an experiential component for career direction and decision-making, internships confirmed career choices, as Respondent #1431 expressed, “My internship allowed me to find my passion, and I decided straight away to continue my studies in that specific field.” On the other hand, some internships prompted shifts away from a chosen specialization field in STEM, as Respondent #1618 shared, “I decided that I did not like the field in which I interned [STEM field].” Internships have also led to discovering a preferred career field or sector. Respondent #1659 revealed, “My internship helped me discover my interest in aeronautics and aerospace engineering.” Moreover, internships allowed for the elimination of some career options as Respondent #1232 shared, “[Through my internship, I] realized that I did not like manufacturing and preferred theoretical engineering.”

Additionally, internships played an essential role in providing networking and professional opportunities for the graduates. Respondent #96 shared, “My internships were relevant to my degree and allowed me to create an efficient network and choose the right Master's program.” Respondent #747 also said, “[My internship] introduced me to many professionals in the industry, some of whom have become mentors.” Respondent #691 also shared, “I got offered

a job by the same company [I interned with]." Furthermore, Respondent #692 revealed, "[My internship] provided me with a full year of experience, since I continued [to work] part-time with the company after the internship."

Nevertheless, the internship experience of some graduates prompted them to shift from Engineering to a non-STEM career. Respondent #1470 shared, "I enjoyed the management field and wanted to pursue a Master's at IE Business School [after my internship]." Respondent #1392 answered, "I chose strategy consulting instead of engineering [because of my internship]." Finally, Respondent #774 expressed, "Before my internship, I was torn between consulting and engineering. After [the internship], I decided on consulting."

5.3.2 Personal Interests, Postgraduate Studies, and Skills Development

Personal interests were shown in our findings to play a key role in shaping engineering graduates' immediate postgraduation career pathways. In particular, some graduates choose to pursue postgraduate studies either prior to exploring the job market or in place of immediate employment. The data showed that 36.39% of the survey respondents (N = 2,490) had applied to one or more graduate or professional schools for postgraduate studies, while 54.62% did not, and 9% responded: "Does not apply". Out of those who applied (N = 906), 92.75% applied to Master's degrees (MA, MS, ME, MBA, etc.), and 7.25% to Doctor's degrees (MD, JD, PhD, etc.).

Respondents were further asked, through open-ended questions, to describe the factors influencing their decision to pursue postgraduate studies. Various answers reflected the distinct advantages of postgraduate studies and the effect of personal interests on career choices. First, seeking employability and better job opportunities, eventually in a career, was one of the prominent responses of a Civil Engineering graduate who pursued a non-STEM career. They shared, "[I am pursuing my postgraduate studies] to get better job positions in whatever firm I will be applying for." Another factor was gaining and advancing knowledge and specialization, as well as interdisciplinary knowledge related to the chosen field. This mainly showed among respondents persisting in STEM fields. An Industrial Engineering student who chose a STEM career reported, "[I am pursuing my postgraduate studies] to specialize in a specific field in the industry (energy/sustainability field)." Moreover, an Electrical Engineering graduate who pursued a STEM career expressed, "I am fascinated by the rapid growth of AI and Machine learning, thus further education would broaden my horizons." Finally, personal interest in the chosen field of study also stood out as a significantly influential factor in decisions to pursue postgraduate programs. A Civil Engineering student who decided on a non-STEM career shared, "[I am going to pursue my postgraduate studies] to specialize in the field that I am more interested in [than Engineering]". On the other hand, a Computer and Communications Engineering graduate who chose a STEM career shared, "[I am going to pursue my postgraduate studies because of my] interest in the [Engineering] field."

6. Discussion

This study examined the postgraduation career pathways of engineering graduates in Lebanon to understand the influencing factors that affect the graduates' persistence in or transition away from careers in STEM. Grounded in the Social Cognitive Career Theory (SCCT), the study's findings highlight the dynamic interplay between personal interests and job market conditions, in the context of Lebanon's economic instability and limited local opportunities.

6.1 Career Pathways postgraduation

The findings reveal diverse postgraduation pathways among engineering graduates in Lebanon, including immediate employment in STEM positions locally or abroad, enrollment in postgraduate studies, and transitions to non-STEM careers such as management consulting, business, or management-related fields. As shown in Figures 2 and 3, the majority of the graduates had accepted or were still seeking employment and aimed to move outside Lebanon. These pathways directly address the study's first research question by revealing that persistence in STEM in Lebanon is not a linear outcome of an engineering undergraduate degree, but rather a dynamic process shaped by both individual and contextual considerations, in line with relevant literature [1],[18].

Contextual factors, primarily salary expectations, geographic location, and the availability of relevant job opportunities to the major of study, played a central role in shaping career decisions, as shown in Figure 7. More graduates prioritized financial security and job stability over other factors, including personal interest in engineering, with many perceiving non-STEM job positions or employment outside Lebanon as an immediate career opportunity for more competitive compensation and clearer opportunities for career specialization and progression [1].

Satisfaction with postgraduation plans (presented in Figure 5) could therefore be closely tied to how well-chosen pathways aligned with both short-term economic needs and long-term career aspirations that are mainly shaped by personal interests as per the literature and SCCT [6],[19]. High satisfaction rates with postgraduate plans are positively impacted by mentorship and universities' career services [8]. Graduates who reported access to mentors or structured career guidance showed stronger clarity and confidence in early career decision-making [5]. This resonates with two SCCT values of personal interests and self-efficacy [20]. These findings suggest that while individual motivation remains important, institutional and contextual factors play a meaningful role in shaping early career satisfaction and direction.

6.2 Impact of the Job Market and Workplace Opportunities on Career Pathways

Findings related to the second research question indicate that conditions in the Lebanese job market and the broader economic context strongly influenced graduates' career pathways. Limited local engineering opportunities, combined with low wages, economic instability, and uncertain prospects for career advancement, constrained graduates' ability to persist in STEM roles within Lebanon [18]. As a result, the data showed that many graduates either sought employment abroad or transitioned to non-STEM fields.

Perceptions of limited advancement opportunities and a mismatch between salary expectations and current workplace opportunities were particularly notable in the reported data. Some graduates, despite their interest in engineering, decided to pursue a pragmatic career shift into non-STEM, mainly management consulting careers [12]. Such transitions do not necessarily reflect a loss of interest in engineering but potentially a reassessment of priorities in response to socioeconomic constraints. Within the SCCT framework, these findings emphasize the role of contextual factors in shaping outcome expectations and career choices [19]. Thus, when environmental barriers are prominent, personal interests alone may be insufficient to sustain the choice of STEM as an immediate career path directly after graduation. These results align with existing literature documenting how labor market constraints and economic instability influence STEM retention in developing economies [3],[9]. In the Lebanese context specifically, structural and contextual barriers often function

as decisive factors, reinforcing the dynamic interplay between individual agency and environmental conditions beyond intrinsic motivation.

6.3 Impact of Personal Interests on Career Paths Postgraduation

Personal interest remained a significant, though evolving, factor in shaping postgraduation pathways, addressing the third research question. Interests emerged as evolving constructs that were continuously shaped by academic experiences, internship exposure, and early encounters with the labor market. Those interests were not static; rather, they were continuously impacted by career experiential learning opportunities, particularly internship experiences as revealed in Section 5.3.1. Internship experiences strengthened technical knowledge, clarified career aspirations, and informed graduates' perceived alignment with engineering roles, often reinforcing decisions to pursue postgraduate studies or employment in STEM. This finding aligns with the SCCT, which conceptualizes developing interests through learning experiences that impact self-efficacy beliefs and outcome expectations over time [19].

Personal interests also shaped how graduates evaluated job opportunities during their post-graduation job search. Graduates did not assess offers solely based on financial compensation but considered broader criteria, including relevance to the field, job title, job description, and long-term career alignment [7]. Offers that failed to resonate with graduates' evolving interests or perceived career trajectories could be rejected based on the factors presented in Table 2. This highlights how interests interact with outcome expectations, a core value of the SCCT, to guide decision-making [19].

The findings also show that personal interest alone did not guarantee persistence in STEM. For some graduates, shifting interests coincided with unmet outcome expectations, especially aspirational career growth and recognition. This corresponds to the literature proposing that interest is necessary but not sufficient for sustained STEM engagement, especially in constrained economies like Lebanon's [17].

Self-efficacy also emerged as a key mediating factor between personal interest and career persistence in STEM [1]. Graduates who developed strong self-efficacy, which was often made possible through experiential learning opportunities, project-based assignments, and mentorship, were more likely to pursue STEM careers despite structural challenges based on qualitative findings [7]. Confidence in their ability to perform engineering tasks and adapt to complex work environments enhanced a sustained engagement with the field. This confidence may have also been strengthened by the technical knowledge gained through their experiences.

6.4 Positioning and Contribution to the Literature

This study expands existing literature by providing empirical data from Lebanon, largely absent from existing literature, as Lebanon has witnessed a prolonged economic crisis, worsening labor market constraints, and a brain drain phenomenon. The findings are consistent with research in other MENA countries facing similar socioeconomic challenges, such as high rates of youth unemployment, limited private-sector engineering opportunities, pivots to non-STEM careers, and reliance on employment abroad [10], [13], [14], [15], [16]. Thus, the consistency between the findings of this study and broader structural conditions revealed in the literature suggests that student decision-making is not merely individual but deeply shaped by systemic constraints and opportunities.

This research identified and analyzed key factors, primarily job market conditions, contextual constraints, personal interests, and self-efficacy, for their specific impact on postgraduation outcomes. It is worth noting that this study does not offer an exhaustive account of all factors influencing career pathways in Lebanon and the broader MENA region. Career decisions are inherently multidimensional, shaped by institutional practices, labor market structures, family expectations, and personal interests. This study's results were situated within a single institutional context, yet their relevance extends beyond the considered institution. The factors influencing persistence in STEM fields, such as perceptions of career stability, economic uncertainty, access to opportunities, and shifting aspirations, reflect structural dynamics that are widely experienced by engineering students across Lebanon. Given the institution's diverse student population and its integration within national, regional, and international labor markets, the patterns observed are likely indicative of broader trends shaping engineering career trajectories in the country.

6.5. Limitations and Future Work

This study is subject to some limitations that should be acknowledged. First, the analysis is based on data from a single academic institution, which may limit the generalizability of the findings to other universities within Lebanon or the broader MENA region. Second, the study did not have access to students' academic performance data, such as grades or cumulative averages, as they were beyond the scope of the study. This constrained the ability to examine potential relationships between academic achievement and the observed trends. Third, the dataset was available only in aggregated form, preventing the tracking of individual students over time and limiting the ability to conduct longitudinal analyses of educational and career trajectories.

Future research can build on this work by expanding data collection across multiple universities to enhance representativeness and enable comparative analyses across institutional contexts. Access to additional variables, including academic performance indicators, would allow for more refined assessments of student outcomes and goals. Adopting a longitudinal study design would further strengthen the analysis by enabling the tracking of individuals at different stages of their academic and professional journeys. Moreover, future studies can explore more in-depth a broader set of institutional, social, and personal factors, such as institutional support structures, mentorship availability, financial constraints, socio-economic background, geographic location, cultural norms, and exposure to industry opportunities, across diverse Lebanese and MENA contexts. Incorporating more in-depth qualitative approaches, including interviews and focus groups, would also provide richer insights into the lived experiences of students and graduates across different academic institutions. Building on the present study, the authors are currently developing and have published gender-specific and gender-segregated analyses to further investigate the career pathways of women engineering students and graduates in Lebanon. These studies adopt mixed methods approaches to integrate quantitative findings with qualitative insights derived from interviews with the target population.

7. Conclusion

This study examined the postgraduation pathways of engineering graduates in Lebanon to understand the factors influencing their persistence in STEM fields amid prolonged economic instability. Grounded in Social Cognitive Career Theory (SCCT), the findings pinpoint the dynamic interplay between personal preferences, perceived self-efficacy, outcome

expectations, and contextual institutional and infrastructural factors in shaping career decisions.

The findings reveal that engineering graduates in Lebanon follow diverse postgraduation pathways, including local employment, employment abroad, postgraduate studies, and transitions to non-STEM fields. Across the study period, approximately half of the respondents pursued STEM-aligned early career pathways, underscoring both the continued appeal of engineering and the substantial transition into non-STEM fields. Job market conditions and the broader economic context play a significant role in shaping these pathways. Limited local opportunities, salaries, and economic instability reduce persistence in STEM within Lebanon and encourage graduates to pursue employment or postgraduate study abroad as alternative strategies for immediate career advancement after graduation from engineering. Personal interests, career expectations, and graduates' self-perceived alignment with engineering further influence career decisions. Experiential learning opportunities, specifically internships and postgraduate studies, support informed career decision-making and strengthen persistence in STEM fields, with a large majority of graduates reporting that internships contributed meaningfully to their career choices. Internships contributed to career decision-making for 89% of respondents, although only 16.8% reported that an internship directly led to employment.

This study contributes to engineering education literature by offering context-specific evidence from Lebanon, where economic and political volatility impact traditional career pathways. Researchers and policymakers exploring STEM persistence in Lebanon and comparable MENA contexts may benefit from these findings when designing interventions to improve career decisions, enhance experiential learning, and strengthen pathways for sustained STEM employment.

References

- [1] Y. Zhou and S. Shirazi, "Factors influencing young people's STEM career aspirations and career choices: A systematic literature review - international journal of science and mathematics education," SpringerLink, <https://link.springer.com/article/10.1007/s10763-025-10552-z>.
- [2] T. Li and Y. Liu, "Stem fever but hesitate to choose? The contextual factors influencing the STEM career choice of female undergraduate students in China - Research in Science Education," SpringerLink, <https://link.springer.com/article/10.1007/s11165-025-10257-x>.
- [3] Y. J. Xu, Career outcomes of STEM and non-STEM college graduates: Persistence in majored-field and influential factors in career choices | request PDF, https://www.researchgate.net/publication/257658077_Career_Outcomes_of_STEM_and_Non-STEM_College_Graduates_Persistence_in_Majored-Field_and_Influential_Factors_in_Career_Choices.
- [4] S. M. R. Jelks and A. M. Crain, Sticking with stem: Understanding stem career persistence among STEM Bachelor's Degree Holders: The Journal of Higher Education: Vol 91, no 5, <https://www.tandfonline.com/doi/abs/10.1080/00221546.2019.1700477>.

- [5] L. Zhou, D. H. Stratton, and X. Li, "Retention in STEM: Factors influencing student persistence and employment," arXiv.org, <https://arxiv.org/abs/2311.14142>.
- [6] E. Q. Rosenzweig et al., "Beyond stem attrition: Changing career plans within STEM fields in college is associated with lower motivation, certainty, and satisfaction about one's career - International Journal of STEM Education," SpringerLink, <https://link.springer.com/article/10.1186/s40594-024-00475-6>.
- [7] H. Jiang, L. Zhang, and W. Zhang, "Influence of career awareness on STEM career interests: Examining the roles of self-efficacy, outcome expectations, and gender - international journal of STEM education," SpringerLink, <https://link.springer.com/article/10.1186/s40594-024-00482-7>.
- [8] D. Smith et al., "The role of mentorship and research experiences in shaping STEM careers: A quantitative analysis," American Journal of STEM Education, <https://ojed.org/STEM/article/view/7873>.
- [9] W. Luwei and M. Huimin, "From jobs to careers: Drivers and barriers to career development in emerging Labor Markets," Frontiers in sociology, <https://pmc.ncbi.nlm.nih.gov/articles/PMC11576451/>.
- [10] Y. Chen, W. W. M. So, J. Zhu, and S. W. K. Chiu, (PDF) stem learning opportunities and career aspirations: The interactive effect of students' self-concept and perceptions of stem professionals, https://www.researchgate.net/publication/377468341_STEM_learning_opportunities_and_career_aspirations_the_interactive_effect_of_students'_self-concept_and_perceptions_of_STEM_professionals.
- [11] M. Bone, E. Ehlinger, and F. Stephany, "Skills or degree? the rise of skill-based hiring for AI and Green Jobs," arXiv.org, <https://arxiv.org/abs/2312.11942>.
- [12] R. Mellors-Bourne, H. Connor, and C. Jackson, BIS research paper number 30 stem graduates in non STEM Jobs , <https://assets.publishing.service.gov.uk/media/5a78d36140f0b6324769a757/11-771-stem-graduates-in-non-stem-jobs.pdf>.
- [13] S. Sabarwal, S. Melhem, and M. M. Abusalem, "Level up mena: How digital education and skills are powering the next generation of Jobs," World Bank Blogs, <https://blogs.worldbank.org/en/arabvoices/level-up-mena-how-digital-education-and-skills-are-powering-the-the-next-generation-of-jobs>.
- [14] T. Reuters , "Ai will be 'transformational', say professionals in Middle East & North Africa," TR - Legal Insight MENA, <https://insight.thomsonreuters.com/mena/legal/posts/ai-will-be-transformational-middle-east-north-africa>.
- [15] H. EL-Deghaidy, Z. Almasabi, A. Elkholy, and N. Mansour, "Mapping stem gender disparities: A scoping review of the MENA region - journal for STEM education research," SpringerLink, <https://link.springer.com/article/10.1007/s41979-025-00149-0>.

- [16] A. T. Rahma et al., "Factors affecting women scientists' retention and progress in STEM fields in the UAE: A cross-sectional study," F1000Research, <https://pubmed.ncbi.nlm.nih.gov/41510220/>.
- [17] S. Habibian, A. Elzir, and A. Jaber, "Lebanon: Survey reveals gaps between education and the job market," World Bank Blogs, <https://blogs.worldbank.org/en/arabvoices/lebanon-survey-reveals-gaps-between-education-and-job-market>.
- [18] M. Tarazi, "Skills gap and training needs: Challenging workplace requirements and implications for the MENA region," IEMed, <https://www.iemed.org/publication/skills-gap-and-training-needs-challenging-workplace-requirements-and-implications-for-the-mena-region/>.
- [19] R. W. Lent, S. D. Brown, and G. Hackett, "Toward a unifying social cognitive theory of career and academic interest, choice, and performance" - sciencedirect, <https://www.sciencedirect.com/science/article/abs/pii/S000187918471027X>.
- [20] R. W. Lent, S. D. Brown, and G. Hackett, "Contextual supports and barriers to career choice: A social cognitive analysis", <http://nsfengineerstudy.org/webdocs/scct.pdf>.
- [21] Y. J. Dori, H. Refaeli-Mishkin, N. Wengrowicz, S. R. Yoel, and D. Dori, "Exploring career choice and retention among engineering undergraduate students and systems engineers: A gender perspective," Eurasia Journal of Mathematics, Science and Technology Education, <https://doi.org/10.29333/ejmste/15483>.
- [22] Y. J. Xu, Career outcomes of STEM and non-STEM college graduates: Persistence in majored-field and influential factors in career choices | request PDF, https://www.researchgate.net/publication/257658077_Career_Outcomes_of_STEM_and_Non-STEM_College_Graduates_Persistence_in_Majored-Field_and_Influential_Factors_in_Career_Choices.
- [23] T. B. Hassen, "A study on Lebanon's competitive knowledge-based economy, relative strengths, and shortcomings - journal of the knowledge economy," SpringerLink, <https://link.springer.com/article/10.1007/s13132-023-01644-8>.
- [24] A. R. Takieddine , (PDF) Labor Market and education in Lebanon: The missing link, https://www.researchgate.net/publication/335817065_Labor_Market_and_Education_in_Lebanon_The_Missing_Link.
- [25] N. S. Ayon, Y. Abu Adla, and R. Zarafa, "To what extent the educational engineering program at a private Lebanese University prepares students for the Workplace," Creative Education, https://file.scirp.org/Html/18-6304480_93919.htm.
- [26] B. Hedge, "Persistence of STEM majors in Higher Education," Journal of Research in Science, Mathematics and Technology Education, <https://jrsmte.com/article/persistence-of-stem-majors-in-higher-education-14650>.
- [27] American University of Beirut. (n.d.). *American University of Beirut. Fact Book*. <https://www.aub.edu.lb/ieds/FactBook/Pages/default.aspx>

- [28] J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, CA: SAGE Publications, Inc, 2018.
- [29] S. J. Tracy, "Qualitative quality: Eight 'big-tent' criteria for excellent qualitative research," *Qualitative Inquiry*, vol. 16, no. 10, pp. 837–851, Oct. 2010.
doi:10.1177/1077800410383121

Appendix A

Excerpts of Alumni Exit Survey Questions

1. Gender: ☐ Female ☐ Male
2. Major Description:
 - ☐ Chemical Engineering
 - ☐ Civil Engineering
 - ☐ Computer and Communications Engineering
 - ☐ Construction Engineering
 - ☐ Electrical and Computer Engineering
 - ☐ Industrial Engineering
 - ☐ Mechanical Engineering
3. Which of the following will become your main activity after graduation?
 - ☐ I am enrolled in a program of further education other than graduate or professional school
 - ☐ I am not currently seeking employment and do not plan to attend school next year
 - ☐ I am still seeking employment
 - ☐ I have accepted a job
 - ☐ I plan to continue in my current position/job
 - ☐ I will be going to a graduate or professional school full-time next year
 - ☐ I will be self-employed
 - ☐ I will be going to a graduate or professional school part-time next year and working part-time
 - ☐ I will be participating in a volunteer or service program
 - ☐ I do not know yet
 - ☐ Other:
4. Have you applied to any graduate or professional schools? ☐ Yes ☐ No
5. For the main activity you mentioned, please indicate the location where you intend to pursue this activity:
 - ☐ Arab countries (Gulf States)
 - ☐ Arab countries (Non-Gulf)
 - ☐ Europe
 - ☐ Lebanon
 - ☐ North America
 - ☐ Other

6. If your main activity will be working or seeking work, in which field will it be?
7. Have you been accepted for study at any of the graduate or professional schools to which you applied? In which field?
8. Why are you planning to continue further education?
9. If you are currently seeking employment, how important are the following factors? Check all that apply.
- ☐ Fast career advancement
 - ☐ Salary and benefits
 - ☐ Challenging work
 - ☐ Work that has a positive impact on society
 - ☐ Work that is relevant to my field of study
 - ☐ Company image and reputation
10. If you declined any job offer(s), specify the reasons: Check all that apply.
- ☐ Not relevant to my major
 - ☐ Salary
 - ☐ Job description
 - ☐ Location
 - ☐ Company reputation
 - ☐ Job title
 - ☐ Other
11. When did you obtain your job position?
- ☐ Immediately upon or before graduation
 - ☐ 3 months after graduation
 - ☐ 6 months after graduation
 - ☐ 1 year or more after graduation
 - ☐ Other
12. Since you have accepted a job, please specify the employment type
- ☐ Employed full-time (on average 30 hours or more per week)
 - ☐ Employed part-time (on average, less than 30 hours per week)
 - ☐ Does not apply
13. If currently employed, was this your only job offer for post-graduation employment?
- ☐ Yes - this was my only job offer
 - ☐ No - I had 1 other job offer
 - ☐ No - I had 2 other job offers
 - ☐ No - I had 3 other job offers
 - ☐ No - I had 4 or more other job offers
 - ☐ Does not apply

14. Does this basic salary match your expectations?

☐ Yes

☐ No

☐ D/A

15. Did your internship help you in making better career decisions? ☐ Yes ☐ No .

16. Please explain [Follow up on # 15]

17. How satisfied are you with your post-graduate plans?