

# The influence of training, subjective norms, and self-efficacy on entrepreneurial passion and intention of engineering students

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## ABSTRACT

Entrepreneurial passion and intention are critical drivers of innovation and economic development. However, empirical studies have primarily focused on business and social science students and have not yet extensively studied engineering students. This study examines how entrepreneurship training influences entrepreneurial passion and intention among engineering students, focusing on the mediating roles of subjective norms and entrepreneurial self-efficacy (ESE). Using a cross-sectional survey design, data were collected from 368 final-year engineering students at the Industrial University of Ho Chi Minh City, Vietnam, and analyzed with partial least-squares structural equation modeling (PLS-SEM). Importance–performance map analysis (IPMA) was also employed to identify the most influential predictors. Results reveal that entrepreneurship training enhances both subjective norms and ESE, which significantly fosters entrepreneurial passion, while entrepreneurial passion strongly predicts entrepreneurial intention. Mediation analyses confirmed that subjective norms and ESE partially mediate the effect of entrepreneurship training on entrepreneurial passion. Theoretically, the study extends social cognitive theory (SCT) by demonstrating how personal and contextual factors jointly shape entrepreneurial passion and intention. Practically, the findings highlight the need for entrepreneurship programs in engineering education to emphasize experiential learning, confidence building, and supportive social environments that strengthen entrepreneurial mindsets.

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## 1. INTRODUCTION

Entrepreneurial passion has gained significant attention in the field of entrepreneurship due to its critical role in fostering innovation, venture creation, and business success [1]. Scholars have extensively examined the factors that drive entrepreneurial passion, broadly categorizing them into personal and contextual dimensions [2]. Personal factors such as education, entrepreneurial self-efficacy (ESE), cognitive adaptability [3], and prior entrepreneurial experience have been shown to significantly influence entrepreneurial passion [4]. Among these, ESE is particularly important, as it strengthens individuals' confidence in their entrepreneurial capabilities, thereby enhancing their passion [5]. Contextual factors such as social support, competitive environments, and institutional backing also play pivotal roles in shaping entrepreneurial passion. For example, support from family, peers, or educational institutions fosters emotional engagement and passion for entrepreneurship [6]. Additionally, entrepreneurial passion has been

shown to positively affect entrepreneurial outcomes such as innovative behavior, persistence, and business performance [7]. Building on this foundation, it is important to recognize how these factors have been studied across different student populations.

Despite increasing research interest, most studies focus on business and social science students, leaving engineering and technology students relatively understudied. However, while much of the existing literature emphasizes business and social science students, relatively little attention has been paid to engineering and technology students. This is a significant gap because modern engineering education increasingly emphasizes entrepreneurial competencies alongside technical skills to address societal and economic challenges [8]. This lack of attention creates a critical research gap, particularly in understanding how entrepreneurship training shapes entrepreneurial passion among engineering students. Some studies have examined the impact of entrepreneurship training on engineering students' attitudes, intentions, and self-efficacy [9]. These studies highlight the potential of entrepreneurship training to shape students' career aspirations and entrepreneurial competencies. However, limited attention has been given to how entrepreneurship training specifically influences entrepreneurial passion in this group, particularly through psychological mechanisms such as subjective norms and ESE. In the same manner, the mechanisms through which it fosters entrepreneurial passion remain underexplored, particularly among engineering students [10]. This gap limits the development of effective programs tailored to their unique needs. In light of this gap, it becomes necessary to conduct an investigation that connects entrepreneurship training with passion and intention in the engineering context.

To address these issues, this study investigates how entrepreneurship training affects entrepreneurial passion and intention among engineering students, focusing on the mediating roles of subjective norms and ESE. By integrating insights from the theory of planned behavior (TPB) and social cognitive theory (SCT), this research aims to uncover the mechanisms by which entrepreneurship training fosters passion and intention for entrepreneurship in engineering students. In doing so, this study contributes to advancing research on entrepreneurship training and offers practical implications for enhancing entrepreneurial mindsets within engineering training.

## **2. HYPOTHESIS DEVELOPMENT**

### **2.1. Hypothesis development for entrepreneurial passion**

Prior research has consistently demonstrated a positive relationship between entrepreneurial passion and entrepreneurial intention [11]. As a key driving force, entrepreneurial passion motivates individuals to pursue new ventures by helping them overcome the challenges of starting a business [12]. Since entrepreneurial intention represents the first step toward business creation, a strong passion for entrepreneurship is likely to foster this intention. Based on the TPB, which posits that intentions are shaped by motivation, entrepreneurial passion is expected to play a central role in intention formation among engineering students. Accordingly, we propose the following hypothesis: for engineering students, passion in entrepreneurship is positively correlated with intention for entrepreneurship (H1).

### **2.2. Hypothesis development for subjective norms**

Subjective norms refer to an individual's perception of how significant others view their behavior [13]. According to the TPB, subjective norms are positively linked to entrepreneurial intention, as family, friends, and colleagues often influence one's decision to start a business [14]. However, subjective norms generally exert a weaker effect compared to attitudes or perceived behavioral control [13]. To explain how entrepreneurship training or education fosters entrepreneurial passion, we propose a mediation model where entrepreneurship training shapes subjective norms, which in turn affect entrepreneurial passion. Thus, we propose the following hypothesis: for engineering students, subjective norms mediate the relationship between entrepreneurial training and entrepreneurial passion (H2).

### **2.3. Hypothesis development for ESE**

Entrepreneurship training has been widely shown to enhance ESE among students [15], a relationship grounded in SCT. SCT suggests that entrepreneurship training fosters ESE through vicarious learning, practical experiences, and skill development [13]. In this study, interviews revealed that entrepreneurship programs at Industrial University of Ho Chi Minh City include various experiential activities, such as case competitions, guest talks, and business projects, which enhance students' entrepreneurial skills and confidence. Since higher ESE strengthens individuals' belief in their ability to overcome startup challenges, it is also expected to promote entrepreneurial passion. Accordingly, we propose the following hypothesis: for engineering students, ESE mediates the relationship between entrepreneurial training and entrepreneurial passion (H3).

### 3. METHOD

#### 3.1. Participants and sampling method

Data were collected from final-year mechanical engineering students at Industrial University of Ho Chi Minh City (IUH), a large public university in southern Vietnam [16]. Specifically, participants were drawn from the Faculty of Mechanical Engineering (FME). Between the second semester of 2022 and two semesters of 2023, lecturers distributed structured questionnaires during students' graduation thesis defenses. A total of 380 usable questionnaires were returned, yielding a high response rate of 97.7%. This response rate is acceptable compared to those of similar research [13], [17]. After removing 12 incomplete responses, the final sample included 368 students for analysis. Sample characteristics are shown in Table 1. This sample is considered representative of mechanical engineering students at IUH due to the high participation rate. However, we acknowledge that the current scope may not fully capture the diversity of students across other engineering departments or institutions in Vietnam. Future research could therefore extend the study to multiple departments and universities to enhance the generalizability of the results.

Table 1. Characteristics of collected samples in this study

Characteristics	Rank	Quantity	Percentage (%)
Age	18-20	153	41.58
	21-23	165	44.83
	24-26	18	4.89
	Above 26	32	8.69
Gender	Female	13	3.53
	Male	355	96.47
Hometown	Middle	150	40.76
	North	16	4.34
	South	202	54.89

#### 3.2. Tool and measures

This study employed seven-point Likert scales, ranging from 1 (strongly disagree) to 7 (strongly agree), known for their high reliability [18]. Entrepreneurial training was measured on a scale from 1 (completely impossible) to 7 (totally possible). The measurement scales for entrepreneurial training, ESE, subjective norms, entrepreneurial passion, and entrepreneurial intention were adapted from well-established prior studies to fit the Vietnamese higher education context. Entrepreneurial training was assessed using scales from Nguyen [13] and Liñán *et al.* [19], widely used in prior studies. Entrepreneurial intention (six items,  $\alpha=0.943$ ) was adapted from Liñán *et al.* [19]. Entrepreneurial passion (five items,  $\alpha=0.72$ ), focused on the "founding" domain, was adapted from Ahsan *et al.* [7]. Subjective norms (three items,  $\alpha=0.904$ ) were based on Liao *et al.* [20]. ESE (six items,  $\alpha=0.82$ ) was measured using established scales from Nguyen [13]. Reliability and validity were examined through Cronbach's alpha (CA), composite reliability (CR), average variance extracted (AVE), and discriminant validity, with results confirming that the adapted scales were valid and reliable for this context, as shown in Table 2. To ensure linguistic and cultural appropriateness, the original English items were translated into Vietnamese and then back-translated into English by bilingual experts. Details of all measures and their validity are shown in Table 3.

Table 2. Summary of constructs, measurement items, scale anchors, and sources

Construct	No. of items	Sample measurement items	Scale anchors	Reliability and validity	Source
Entrepreneurship training	5	Understanding of the entrepreneurial landscape; inclination to pursue a startup; essential skills needed to become a startup	1=completely impossible to 7=totally possible	CR=0.949; CA=0.933; AVE=0.788	[13], [19]
Entrepreneurial intention	6	My career objective is to become an entrepreneur; I am committed to starting a business in the future	1=strongly disagree to 7=strongly agree	CR=0.950; CA=0.936; AVE=0.759	[19]
Subjective norms	3	My closest family would support my decision to start a business; My closest friends would approve	1=strongly disagree to 7=strongly agree	CR=0.933; CA=0.893; AVE=0.824	[20], [21]
ESE	6	Ability to solve problems; managing money; being creative; making decisions	1=strongly disagree to 7=strongly agree	CR=0.928; CA=0.906; AVE=0.681	[13], [22]
Entrepreneurial passion	5	Starting a new business is thrilling; Becoming a business founder could become a significant aspect of my identity	1=strongly disagree to 7=strongly agree	CR=0.940; CA=0.920; AVE=0.757	[7], [23]

Table 3. Assessment of measures

Criteria	Standardized factor loadings
Subjective norms (adopted from [21]) CR=0.933; CA=0.893; AVE=0.824	
How strongly do you agree or disagree with the following declarations, using a scale from 1 (strongly disagree) to 7 (strongly agree)?	0.907
If I were to decide to start a business, my closest family would support that decision	
If I decide to start a business, my closest friends will approve of that decision	0.924
If I decide to start a business, my colleagues and associates would support that decision	0.892
Education for entrepreneurship (adopted from [19]) CR=0.949; CA=0.933; AVE=0.788	
How much do you think startup education programs can enhance the following features?	0.884
Please rate on a scale from 1 (completely impossible) to 7 (totally possible).	
Understanding of the entrepreneurial landscape	
Greater recognition of the figure of the startup	0.895
The inclination to pursue startup	0.900
The essential skills needed to become a startup	0.862
The desire to become a startup	0.897
ESE (adopted from [22]) CR=0.928; CA=0.906; AVE=0.681	
To assess your abilities, how strongly do you agree or disagree with the following statements on a scale from 1 (strongly disagree) to 7 (strongly agree)?	0.819
The ability to solve problems	
Managing money	0.784
Being creative	0.811
Getting people to agree with you	0.856
Being a leader	0.833
Making decisions	0.848
Entrepreneurial passion (adopted from [23]) CR=0.940; CA=0.920; AVE=0.757	
How much do you agree or disagree with the following statements, using a scale from 1 (strongly disagree) to 7 (strongly agree)?	0.896
Starting a new business is thrilling	
Guiding a new business toward success will be fulfilling	0.895
I am driven to find ways to improve existing products or services	0.870
I find it exciting to explore the environment for new opportunities	0.854
Becoming a business founder could become a significant aspect of my identity	0.834
Entrepreneurial intention (adopted from [19]) CR=0.950; CA=0.936; AVE=0.759	
How strongly do you agree or disagree with the following statements, using a scale from 1 (strongly disagree) to 7 (strongly agree)?	0.809
I am willing to do whatever it takes to become an entrepreneur	
My career objective is to become an entrepreneur	0.874
I will put in every effort to establish and manage my own business	0.867
I am committed to starting a business in the future	0.906
I have given serious consideration to starting a business	0.896
I am strongly committed to starting a business someday	0.873

### 3.3. Avoiding common method variance (CMV)

Common method variance (CMV) refers to potential bias arising from using the same survey method for all variables [13]. To minimize CMV, this study applied an ex-ante approach by simplifying the survey and ensuring respondent anonymity. Additionally, no high correlations among constructs ( $r > 0.90$ ) were found, showing no CMV concerns [24]. Variance inflation factor (VIF) values ranged from 1 to 1.694, well below the 3.30 threshold, further confirming the absence of CMV issues. Furthermore, Harman's single-factor test was conducted to further assess potential CMV [25]. The results indicated that the first factor accounted for 36.5% of the total variance, which is below the recommended 50% threshold. These findings suggest that CMV is unlikely to pose a significant threat in this study.

### 3.4. Data analysis methods

Partial-least squares structural equation modeling (PLS-SEM) was used due to its suitability for analyzing complex models and its tolerance for non-normal data [26]. PLS-SEM is preferred over covariance-based methods for complex models, small samples, and unexplored relationships. It also performs well with the sample size of 368 used in this study. Within the PLS-SEM framework, reliability and validity of the measurement model were confirmed through confirmatory factor analysis (CFA). Specifically, standardized factor loadings, CA, and CR were assessed to establish internal consistency, while convergent validity was confirmed by ensuring that AVE values exceeded 0.5. Discriminant validity was further verified using both the Fornell–Larcker criterion and heterotrait–monotrait (HTMT) ratios [27]. These steps ensured that the measurement model met the accepted standards of reliability and validity prior to testing the structural relationships.

4. RESULTS

Table 4 illustrates that all the constructions can be considered importantly connected ( $p < 0.01$ ), with the most important relationship observed between intention for entrepreneurship and startup passion (0.74). The VIFs indicate that multicollinearity bias did not occur in the study. The VIF values range from 1 to 1.402, well below the cut-off point of 5 [27].

On the diagonal, the square roots of the AVE estimates are highlighted in bold, SD denotes standard deviation. In the lower-left section, the numbers represent the connections between constructs. While in the upper-right section, the numbers represent the HTMT values. At the same time, F denotes formative construct. HTMT is not computed for formative constructs. As shown in Table 5, all HTMT values are below the threshold of 0.85, indicating satisfactory discriminant validity [24].

Table 4. Assessment of measures

No.	Variable	Mean	SD	1	2	3	4	5	6	7	8	9
1	ET	4.81	1.31	<b>0.89</b>					F	F	F	F
2	ESE	4.80	1.07	0.477**	<b>0.83</b>				F	F	F	F
3	EI	4.90	1.35	0.547**	0.591**	<b>0.87</b>			F	F	F	F
4	EP	5.15	1.21	0.492**	0.629**	0.74**	<b>0.87</b>		F	F	F	F
5	SN	5.11	1.23	0.430**	0.562**	0.60**	0.649**	<b>0.91</b>	F	F	F	F
6	Gender	0.64	0.48	-0.02	0.144**	0.01	-0.01	-0.03	NA	F	F	F
7	Age1820	0.45	0.50	0.164**	-0.06	0.08	0.10	0.04	-0.76**	NA	F	F
8	Age2123	0.49	0.50	-0.05	0.10	-0.02	-0.06	-0.02	0.68**	-0.89**	NA	F
9	Age2426	0.05	0.23	-0.20**	-0.09	-0.15**	-0.129*	-0.06	0.18**	-0.22**	-0.23**	NA

\*\* At the 0.01 level (2-tailed), the correlation can be considered statistically significant.

\* At the 0.05 level (2-tailed), the correlation can be considered statistically significant.

Note: ET=Entrepreneurial training; ESE=Entrepreneurial self-efficacy; EI=Entrepreneurial intention; EP=Entrepreneurial passion; SN=Subjective norms.

Table 5. HTMT ratios

Construct pair	ET-ESE	ET-EI	ET-EP	ET-SN	ESE-EI	ESE-EP	ESE-SN	EI-EP	EI-SN	EP-EI
HTMT	0.521	0.590	0.531	0.470	0.636	0.690	0.617	0.797	0.654	0.714

4.1. The evaluation of the measurement models

Table 2 shows that all constructions met the reliability thresholds, with CR and CA exceeding 0.7. AVE values were above 0.5, confirming convergent validity [27]. Discriminant validity was supported as the square root of AVE exceeded inter-construct correlations, and HTMT ratios were below 0.85, as shown in Table 5 [27].

4.2. The structural model of this study

Both the determination coefficient ( $R^2$ ) and the  $Q^2$  values were used to evaluate the structural model. Figure 1 illustrates the  $Q^2$  values, the determination coefficient ( $R^2$ ), and the path coefficients. In this study, all  $R^2$  values are higher than 0.10, at the same time, all  $Q^2$  values are above zero, thereby confirming the adequate predictive relevance and satisfactory explanatory power of the model [28].

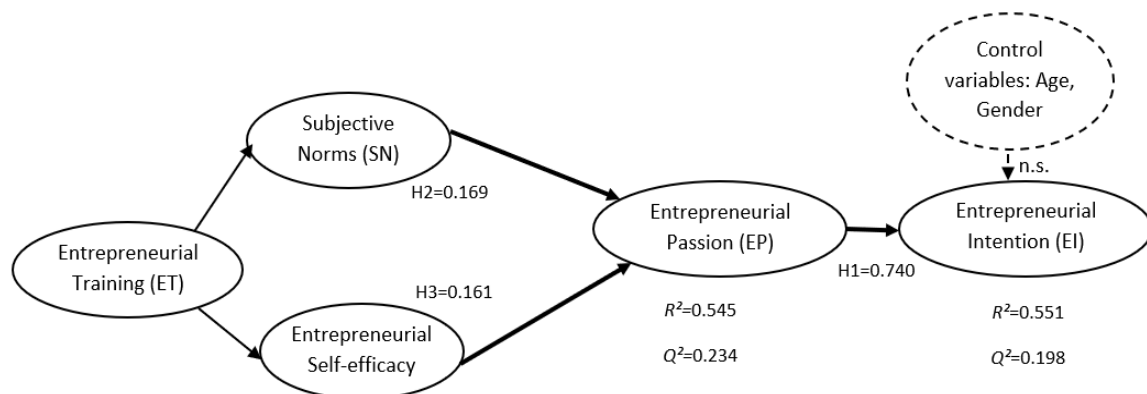


Figure 1. Structural model path estimates in this study

### 4.3. Hypothesis testing for the current study

Path coefficients were tested using bootstrapping with 5,000 samples and 368 cases. As shown in Figure 1, entrepreneurial passion had a strong positive influence on entrepreneurial intention (with  $\beta=0.74$ ,  $p<0.001$ ), supporting H1. In Figure 1, the statistical significance is at the 0.001 level. Following Hair *et al.* [27] mediation analysis showed that subjective norms partially mediated the influence of entrepreneurship training on entrepreneurial passion. Both the indirect effect ( $\beta=0.169$ ,  $p<0.001$ ) and direct effect ( $\beta=0.163$ ,  $p<0.01$ ) were significant, with a variance accounted for (VAF) of 0.34, indicating moderate mediation, thus supporting H2. Similarly, ESE also partially mediated this relationship. The indirect effect ( $\beta=0.161$ ,  $p<0.001$ ) and direct effect ( $\beta=0.163$ ,  $p<0.01$ ) were significant, with a VAF of 0.327, confirming moderate mediation and supporting H3.

### 4.4. Results of post-hoc analysis

An importance-performance map analysis (IPMA) was conducted to identify key factors affecting entrepreneurial passion [13]. The most significant predictors were entrepreneurial training (0.493), subjective norms (0.391), and ESE (0.336), as shown in Table 6. Subjective norms showed the highest performance (68.570), followed by entrepreneurial training (63.541) and ESE (63.360). Although entrepreneurial training had the greatest effect, its performance remained relatively low, suggesting it has not been sufficiently emphasized in this engineering university.

Table 6. Results of the IPMA for entrepreneurial passion

Variable	Total influences	Performance
Entrepreneurial training	0.493	63.541
ESE	0.336	63.360
Subjective norms	0.391	68.570

The results in Table 6 show that entrepreneurial training (0.493) had a greater impact on entrepreneurial passion than ESE (0.336) and subjective norms (0.391). However, its performance was low (63.541) compared to subjective norms (68.570). This clearly showed that entrepreneurial training has not received adequate attention at this engineering university. This indicates that while entrepreneurship training strongly influences entrepreneurial passion, its current delivery is suboptimal, underscoring the need for curriculum redesign and greater emphasis on experiential learning.

## 5. DISCUSSION

Drawing on SCT, this study examined how environmental and personal factors shape entrepreneurial passion and intention. Subjective norms were found to positively influence entrepreneurial passion, consistent with prior research [13]. However, this finding contradicts studies reporting a weak or negligible impact of subjective norms on entrepreneurial outcomes [19], [21], particularly in student samples, where attitude or self-confidence dominates intention formation. A possible explanation for this discrepancy lies in the technical context of the current study, where career decisions are often strongly influenced by family expectations and peer approval, especially in the context of an emerging economy like Vietnam. Support from family, friends, and peers fosters emotional engagement, encouraging participation in entrepreneurial activities, which in turn builds passion for entrepreneurship.

In this study, subjective norms were found to have a strong and positive influence on entrepreneurial passion ( $\beta=0.391$ ,  $p<0.001$ ), highlighting the significant role of social approval in shaping students' emotional commitment to entrepreneurship. This finding implies that entrepreneurial training practices could be strengthened by explicitly involving family and peer networks, for example through joint workshops, mentorship initiatives, or community-based projects that reinforce the social support of entrepreneurial behavior. By integrating these social elements, educators may create environments that not only build skills but also develop passion through perceived support.

The study also confirmed that subjective norms mediate the relationship between entrepreneurship training and entrepreneurial passion, aligning with previous findings [29]. However, this finding contradicts previous studies suggesting that subjective norms often have a weaker or inconsistent impact on business outcomes compared to other antecedent factors such as attitude or cognitive behavioral control [21]. Entrepreneurship training can shift students' perceptions of how others view their entrepreneurial involvement, thus enhancing passion. This may be due to the inspirational aspects of entrepreneurship training, which helps students perceive entrepreneurial behavior as socially valued and acceptable.

Additionally, ESE was found to mediate the effect of entrepreneurship training on entrepreneurial passion, supporting earlier studies on engineering students [13]. Programs including case studies, guest talks, and startup competitions likely enhance students' skills and confidence, thereby increasing both ESE and entrepreneurial passion. Therefore, entrepreneurship programs for engineering students should include practical activities such as hackathons, mentorship from industry professionals, and workshops involving family or peers to help students build confidence and feel supported in pursuing entrepreneurial careers. This result differs from some previous studies [30], which found that ESE had only a direct impact or no significant mediating role, especially for non-engineering student samples. The strong mediating effect observed here suggests that within engineering education, entrepreneurial training is more likely to translate into passion when it succeeds in enhancing students' confidence in applying engineering knowledge to entrepreneurial problem-solving.

This study extends SCT by demonstrating how entrepreneurship training functions as an environmental input that shapes entrepreneurial passion indirectly through ESE, highlighting a process-based mechanism within engineering education. By integrating the TPB, the findings show that subjective norms play a more critical mediating role in translating training into entrepreneurial passion among engineering students than previously assumed, thereby refining TPB's explanatory power in technical education contexts. It should also be noted that the sample was drawn exclusively from final-year students in the FME at IUH, which provides strong insights for this group but may not fully represent engineering students from other departments or universities in Vietnam. Future studies could use long-term data and compare students from different universities or countries to test whether these findings hold beyond one university and cultural context.

## 6. CONCLUSION

This study contributes to both theory and practice by highlighting the roles of entrepreneurial training, ESE, and entrepreneurial passion as key drivers of entrepreneurial intention among engineering students. Using PLS-SEM and IPMA analyses, the findings demonstrate that entrepreneurship training significantly enhances both ESE and subjective norms, which in turn foster entrepreneurial passion and, ultimately, entrepreneurial intention. These results provide one of the first pieces of empirical evidence that ESE and subjective norms serve as important mediating mechanisms in this context. From a theoretical perspective, the study extends the application of SCT by showing how both personal ESE and environmental (subjective norms) factors jointly influence entrepreneurial passion and intention. It also adds to entrepreneurship training literature by shifting the focus toward engineering students, a group often overlooked in prior research. Importantly, the study offers novel evidence on the mediating role of ESE, underscoring its originality in demonstrating how self-efficacy functions as a psychological bridge between entrepreneurship training and entrepreneurial passion in engineering education.

Practically, the findings suggest that entrepreneurship programs in engineering should place greater emphasis on developing students' self-efficacy and cultivating supportive social environments. Integrating entrepreneurship training with technical curricula, offering experiential activities, and strengthening peer and family support systems may help foster stronger entrepreneurial passion and intention among engineering graduates. Despite these contributions, the study has limitations. Data set was collected from a single institution, which may restrict the generalizability of the results. Future research should expand the sample to other universities and examine how emerging digital technologies and AI-enabled educational practices reshape entrepreneurship training, self-efficacy, and entrepreneurial intention.

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## AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualizationM : **M**ethodologySo : **S**oftwareVa : **V**alidationFo : **F**ormal analysisI : **I**nvestigationR : **R**esourcesD : **D**ata CurationO : **O**riginal DraftE : **E**ditingVi : **V**isualizationSu : **S**upervisionP : **P**roject administrationFu : **F**unding acquisition

## CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

## DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [TKN], upon reasonable request.




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