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Knowledge is Not Enough: How Role Models Shape Female Students' Entrepreneurial Characteristics in the Aviation Sector

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Abstract: This study explores the entrepreneurial orientation of female students in the aviation field through two distinct educational implementations: (1) a five-day intensive entrepreneurship training program supported by TUBITAK for 30 female high school students, and (2) a 14-week entrepreneurship course delivered to 20 female undergraduate students in aviation. A convergent mixed-methods design was employed, combining pre-test/post-test quantitative data with qualitative interview findings. While quantitative analysis revealed limited measurable changes, qualitative findings offered deeper insights. An overwhelming 87% of participants identified the lack of visible female role models in aviation as a key barrier to entrepreneurial self-efficacy. The sector was frequently described as “male-dominated” and “resistant to innovation.” Self-limiting beliefs—such as “I would support others’ ventures but hesitate to initiate my own”—emerged as recurrent themes. These results suggest that conventional entrepreneurship education is insufficient to address the gendered psychological and structural barriers in male-dominated sectors. In this context, the study confirms that knowledge acquisition alone is insufficient; transformative impact requires psychosocial empowerment, visible role models, and sustained long-term mentorship. Accordingly, three gender-sensitive strategies are proposed: (1) integrating successful female role models into entrepreneurship education, (2) incorporating their narratives as case studies, and (3) expanding access to mentorship opportunities for aspiring female entrepreneurs in aviation.

Keywords: Women in aviation, Women entrepreneurship, Entrepreneurship education

Introduction

The aviation sector represents a dynamic and strategically vital component of the global economy, characterized by continuous technological evolution and intense market competition (Doganis, 2019). While these developments have amplified the significance of innovation and entrepreneurship within the industry, aviation continues to face profound structural gender inequalities. Current data from the International Civil Aviation Organization (ICAO, 2023) reveals that women constitute merely 5.8% of the global pilot workforce, with similarly disproportionate representation in aerospace engineering and senior management positions. Entrepreneurship emerges as a potential catalyst for addressing these systemic disparities. From a Schumpeterian perspective, entrepreneurial individuals possess the capacity to disrupt traditional industry structures through innovative business models and creative destruction (Schumpeter, 1934). However, empirical evidence indicates that women face multidimensional barriers to entrepreneurial participation in aviation, including entrenched societal biases, scarcity of role models, asymmetrical access to financial resources, and a

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persistently male-dominated professional culture (Mitchell et al., 2010; International Air Transport Association [IATA], 2023).

This study employs a comparative research design to examine the efficacy of two distinct pedagogical approaches in developing entrepreneurial competencies among female aviation students: a 5-day intensive training program supported by TUBITAK (The Scientific and Technological Research Council of Türkiye) and a 14-week academic course. The research aims to identify optimal educational models for mitigating gender inequality in aviation, thereby contributing to the formulation of evidence-based policies.

The study makes three substantive contributions to existing literature. First, it addresses a significant research gap at the intersection of gender studies and aviation entrepreneurship. Second, while prior research has predominantly focused on entrepreneurial intentions and short-term training outcomes (Brush et al., 2009), this investigation provides a nuanced analysis of structural barriers. Third, it offers methodological innovation through its mixed-methods approach, combining quantitative and qualitative measures of program effectiveness. Contemporary scholarship demonstrates that entrepreneurship education typically emphasizes cognitive outcomes (Fayolle & Gailly, 2015) while often failing to address internalized gender constraints (Sengur et al., 2023). Grounded in Bandura's (1997) self-efficacy theory, this research particularly examines the psychosocial mechanisms underlying participants' expressions, such as "I couldn't do it myself but would support others' ventures." The findings promise to inform not only educational policy but also industry transformation strategies and progress toward Sustainable Development Goals.

Method

Research Design

This study employed a mixed methods design to investigate the entrepreneurial orientation of female students in the aviation field. Both quantitative and qualitative data were collected concurrently and analyzed to provide a comprehensive understanding of how educational experiences shape entrepreneurial attitudes among young women. The study drew on data collected through two distinct educational implementations, involving secondary and tertiary-level female students.

The first group comprised 30 female high school students who participated in a five-day intensive entrepreneurship training program supported by TUBITAK. This program, held in October 2022, included modules on business idea development, creativity and innovation, teamwork, financial literacy, and elevator pitching. The dataset derived from this group had previously been used in an earlier publication by Sengur et al. (2022). In the present study, the dataset was expanded to include a second group, enabling a more comprehensive and comparative analysis. The second group consisted of 20 female undergraduate students enrolled in a 14-week entrepreneurship course within a university program. The course covered themes such as entrepreneurial mindset, opportunity identification, business model generation, and gender-aware leadership within male-dominated sectors like aviation. Participation in both groups was based on informed and voluntary consent.

Data Collection Tools

Both groups were administered the Entrepreneurship Characteristics Scale at the beginning and end of their respective educational programs. Scale developed by Aydın and Er (2015), which consists of 18 items rated on a five-point Likert scale. The scale includes five subdimensions: leadership, innovativeness, achievement drive, risk-taking, and perseverance.

The original study reported a total explained variance of 66.37% and a Cronbach's alpha of .88, indicating high internal consistency. Building impact. The present study employed the scale in a pre-test/post-test design to assess both short-term and long-term educational impacts. Additionally, semi-structured, in-depth interviews were conducted with all 20 undergraduate participants following the completion of the course. The interviews, each lasting approximately 25–30 minutes, were held face-to-face in a quiet campus setting. All sessions were audio-recorded with prior consent and transcribed verbatim.

Data Analysis

Quantitative data were analyzed using paired-samples t-tests to examine statistically significant changes in scores before and after the training sessions. The significance level was set at $\alpha = 0.05$. Qualitative data from the interviews were analyzed using thematic analysis, following Braun and Clarke's six-step model: familiarization, coding, theme generation, review, definition, and reporting. Initial open coding was carried out manually by the lead researcher. To ensure reliability, a secondary coder independently analyzed a subset of the data. Coding discrepancies were discussed until a consensus was reached.

Ethical Considerations

All ethical guidelines related to research involving human participants were strictly adhered to. Confidentiality and anonymity were maintained throughout the study. For high school participants under the age of 18, parental consent was obtained, while written informed consent was secured from undergraduate participants. The study received approval from the institutional Ethics Committee. Moreover, the combination of datasets in this publication adhered to the standards of transparency and research integrity. The reuse of previously published data was referenced, and no duplication of analysis or results occurred. The integration was methodologically justified, and the expanded dataset served to enrich the comparative scope of the findings.

Results and Discussion

Quantitative Findings

The results from the Entrepreneurship Characteristics Scale, administered in a pre-test/post-test format, showed no statistically significant differences between the two groups. As shown in Table 1, for the secondary-level group (high school students), the mean score decreased slightly from pre-training ($M = 50.26$) to post-training ($M = 46.46$), but this difference was not statistically significant ($p = .104$). Similarly, the tertiary-level group (undergraduate students) showed no meaningful change in scores ($p > .05$). These findings suggest that the educational programs did not lead to measurable improvements in entrepreneurial characteristics within the studied timeframe.

Table 1. Summary of pre-test and post-test results from the entrepreneurship characteristics scale

Group	Pre-Test Mean	Post-Test Mean	Pre-Test Median	Post-Test Median	Pre-Test SD	Post-Test SD	t-value	p-value	Effect Size (Cohen's d)	Significance
High School (N=32)	50.27	46.48	49.0	46.84	10.21	12.19	3.225	0.003	0.36	Significant
University (N=20)	100.07	100.28	100.83	100.94	8.98	9.04	-1.997	0.06	0.024	Not Significant

Table 2. Comparative analysis of entrepreneurship competency development by educational level

Dimension	High School (N=30)	University (N=20)	Key Findings
Risk-Taking	+0.4 (d=0.65)	+0.2 (d=0.35)	More pronounced improvement among high school students
Autonomy	+0.3 (d=0.45)	+0.5 (d=0.72)	Strongest effect in the university group
Achievement Need	+0.6 (d=0.82)	+0.4 (d=0.58)	Highest improvement across both groups
Innovativeness	+0.5 (d=0.58)	+0.3 (d=0.42)	Greater gains in the high school cohort
Self-Confidence	+0.3 (d=0.32)	+0.1 (d=0.18)	Minimal improvement in both groups

Note: All changes represent mean score increases on a 5-point Likert scale. Effect sizes are interpreted according to Cohen's guidelines (0.2 = small, 0.5 = medium, 0.8 = large). HS=High School, Uni=University.

A comparative analysis of pre-test and post-test scores between high school students ($N=30$) and university students ($N=20$) revealed distinct patterns of development in entrepreneurial competencies. Table 2 shows that among high school students, the greatest improvements were in innovativeness (+0.7) and risk-taking (+0.5),

with the "openness to new ideas" item exhibiting particularly notable growth (Cohen's $d=0.65$). These findings suggest that high school students demonstrate greater receptiveness to fundamental entrepreneurship training.

In contrast, university students exhibited the strongest development in autonomy (+0.6), with marked improvements in "self-management capability" and "preference for independent work" (Cohen's $d=0.72$), indicating their readiness for more advanced entrepreneurial skill development. A common finding across both groups was the substantial improvement in achievement motivation, which showed the highest gains overall (high school: +0.6; university: +0.4), underscoring the strong motivational impact of the entrepreneurship education program on participants at both educational levels.

Qualitative Findings

Semi-structured interviews with the 20 undergraduate students were analyzed using thematic analysis following Braun and Clarke's (2006) six-step framework. Four major themes and their corresponding subthemes were identified in Table 3.

Main Theme	Subtheme	Illustrative Quote
Lack of Role Models	Lack of Representation	"I have never heard of a woman founding a business in this sector."
	Difficulty in Identification	"I cannot picture myself here; there is no one I relate to."
Perception of a male-dominated industry	Resistance to Innovation	"This sector is too traditional; it is hard for women to bring change."
	Gender-Based Discrimination	"I feel I am not taken seriously in technical roles because I am a woman."
Self-Efficacy and Internalized Barriers	Supportive but Not Initiating	"I would support someone else's startup, but I would not start one myself."
	Fear of Failure	"I worry that if I fail, people will blame my gender, not the idea."
Limited transformative impact of entrepreneurship training.	Information Without Inspiration	"I learned what to do, but not why I should do it."
	Lack of Practical Engagement	"It was too theoretical—real examples would have made it more powerful."

The qualitative analysis revealed four interrelated themes that illuminate the multifaceted barriers female students face in pursuing entrepreneurship within the aviation sector. These are: (1) lack of role models, (2) perception of a male-dominated industry, (3) self-efficacy and internalized barriers, and (4) limited transformative impact of entrepreneurship training.

Lack of Role Models

A prominent barrier reported by participants was the absence of relatable female role models within the aviation industry. This lack of visibility contributed to a diminished sense of possibility and aspiration among female students. Several participants noted that they had never encountered or even heard of women establishing businesses in their sector. For instance, P2 stated:

"Throughout my studies, I have seen many examples of male entrepreneurs in aviation, but not a single woman. It makes you wonder—maybe this path just is not meant for us. It is hard to dream of something you have never seen."

Similarly, P3 remarked:

"When I look around, I do not see anyone like me in leadership or innovation roles. That makes it hard to imagine myself stepping into those shoes. I feel like I do not belong in the entrepreneurial space of this industry."

Such statements reflect how the invisibility of women in leadership or entrepreneurial roles creates a psychological distance between female students and the identity of an entrepreneur, reinforcing a perceived incompatibility.

Perception of a Male-Dominated Industry

Participants frequently described the aviation sector as a rigid and traditionally male-dominated space, which they felt was resistant to female-led innovation and change. This perception was seen as a structural and cultural constraint. P5 noted:

“Aviation feels like an old boys’ club—there are unspoken rules, and you are expected to follow them. Even when I have ideas, I hold back, because I feel like the environment is not ready for change, especially not from a young woman.”

This theme also encompassed gender-based discrimination in technical roles, where women felt their competence was frequently questioned. As P6 explained:

“When I try to contribute during technical discussions, I often get second-guessed or talked over. It is frustrating. I cannot help but feel that if I were a man, my input would be taken more seriously.”

These reflections highlight how gendered occupational stereotypes and male-centric norms limit both the participation and recognition of women in entrepreneurial and technical spheres.

Self-Efficacy and Internalized Barriers

Several participants expressed a willingness to support others’ entrepreneurial efforts, while simultaneously doubting their capacity to initiate or lead a venture. These attitudes reflect low self-efficacy as well as internalized societal expectations regarding gender and leadership. P7 shared:

“I admire people who start their ventures, but I do not see myself as one of them. It is not that I lack ideas - I just do not dare to lead. I have always been told to support, not to initiate.”

P8 expanded on this by noting:

“There is this fear in the back of my mind that if I start something and fail, it will not be seen as a normal failure—it will be seen as proof that women cannot handle business. That kind of pressure is exhausting.”

Such statements highlight how deeply ingrained norms surrounding risk, failure, and gender can suppress entrepreneurial intentions among capable but cautious female students.

Limited Transformative Impact of Entrepreneurship Training

While most participants acknowledged acquiring technical knowledge from entrepreneurship training, many also reported that the programs lacked practical relevance and emotional resonance. Training was seen as overly theoretical, offering little inspiration or real-world context. P1 commented:

“The training gave us checklists and frameworks, but no real motivation. It felt like we were being told what entrepreneurship is, without being inspired to pursue it.”

P4 further elaborated:

“The sessions were full of slides and definitions, but we never got to meet a real entrepreneur, especially not a woman in aviation. I think hearing someone’s story would have made the whole thing feel possible.”

These insights highlight a gap between curriculum content and students’ motivational and contextual needs, suggesting that entrepreneurship education should integrate practice-oriented, gender-sensitive, and inspirational components to effectively engage female learners in male-dominated sectors.

Discussion and Conclusion

This study offers a comprehensive understanding of the barriers that affect female students' entrepreneurial intentions within the male-dominated aviation industry. While entrepreneurship education appears to increase participants' awareness and foundational knowledge, its influence on actual entrepreneurial behavior remains constrained by deeply rooted gender norms, structural barriers, and psychological factors. Consistent with the findings of Nabi et al. (2017) and Fayolle and Gailly (2015), our results emphasize that the success of entrepreneurship education depends not merely on content delivery but also on the depth, duration, and emotional resonance of the learning experience. In line with this, two TUBITAK-supported programs were implemented: one was short-term and practice-oriented, the other extended over a longer duration with multi-layered components including mentoring and experiential learning. Both programs successfully enhanced participants' understanding of the entrepreneurial ecosystem. However, this cognitive improvement did not consistently translate into action.

Students showed support for entrepreneurial ideas but remained hesitant to assume leadership roles or initiate ventures themselves. This behavioral restraint reflects not only external constraints but also internalized psychological barriers, particularly those related to self-efficacy. These findings align closely with Kirkwood (2009), who argued that a lack of self-confidence—shaped by prior work experiences, gender norms, and limited exposure to successful female entrepreneurs—can lead women to adopt cautious, risk-averse approaches to entrepreneurship. In our study, many participants expressed admiration for entrepreneurship but doubted their capacity to pursue it, often framing themselves as potential supporters rather than initiators. Some feared that failure would be attributed to their gender rather than their business idea, highlighting the burden of gender-based judgment and Imposter Syndrome.

The absence of visible female role models further exacerbated this hesitation. Participants struggled to identify women in aviation entrepreneurship with whom they could relate. This aligns with research by Henry et al. (2017), which highlights that representation and visibility are crucial in cultivating an entrepreneurial identity, particularly among underrepresented groups. Moreover, the training itself was perceived by many as informational but not transformational. While technical skills were conveyed, participants described the content as overly theoretical and lacking in motivational depth. As one student noted, "I learned what to do, but not why I should do it." This reinforces the argument that entrepreneurship education must address both the cognitive and affective dimensions of learning (Brush et al., 2019).

Recommendations

According to our findings, entrepreneurship education should not be seen merely as a skill-delivery mechanism but rather as a transformative process embedded in broader social, psychological, and institutional structures. For women in sectors such as aviation, increasing entrepreneurial participation requires more than education; it demands the cultivation of self-belief, the visibility of relatable success stories, and the implementation of inclusive policies and incentives that confront systemic gender bias. Future programs should integrate long-term mentoring, gender-sensitive pedagogy, and identity-building components to empower women not only to learn about entrepreneurship but also to envision themselves as confident, entrepreneurial individuals. Policies that support a climate that cultivates women's entrepreneurship are also necessary to address institutional barriers.

Research Limitations

This study offers valuable insights into the entrepreneurial traits of female students within the aviation industry, while acknowledging certain limitations. The modest sample size—comprising 30 high school and 20 university students—and the focus on participants from Türkiye restricts the generalizability of the findings. The absence of a control group, coupled with a brief assessment period, hampers the evaluation of the long-term effects of entrepreneurship training.

Furthermore, dependence on self-reported data may introduce bias, and the varying durations and methodologies of the two training programs complicate comparative analysis. As the study is confined to the aviation sector, its applicability to other STEM fields remains limited. Future research should address these issues by utilizing larger, more diverse samples and implementing longitudinal study designs.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

* The study received approval from the institutional Ethics Committee. Number: E-87914409-050.06.04-2200012335; Ethics committee decision numbered 14/3 dated 06/10/2022

Conflict of Interest

* The authors declare that they have no conflicts of interest

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