

Individual innovativeness and attitudes toward artificial intelligence among student pilots

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Abstract

This study examines the relationships among individual innovativeness, use of AI-based tools, and attitudes toward AI among student pilots. Drawing on technology acceptance and human–AI interaction perspectives, the study aims to identify how both dispositional and experiential factors shape AI attitudes in a high-technology domain. Data were collected from 204 student pilots in Türkiye using a convenience sampling method. The study employed validated scales to measure individual innovativeness and attitudes toward AI. The collected data were analyzed using descriptive statistics, correlation analysis, reliability tests, and path analysis. The results indicate that individual innovativeness has a positive and significant effect on attitudes toward AI, while the use of AI-based tools emerges as a stronger predictor. Additionally, a small but significant relationship was found between innovativeness and AI usage. These findings suggest that attitudes toward AI are shaped by both personal tendencies and direct interaction with AI technologies. The study contributes to the literature by integrating human–AI interaction and technology acceptance perspectives in the aviation context and highlights the importance of experiential learning and psychological readiness for effective AI integration.

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1. Introduction

The aviation industry is a prime example of a sociotechnical domain in which humans and technology operate in close coordination through highly automated operational systems [1, 2]. Advances in flight management systems, decision-support tools, and intelligent automation technologies have not only reshaped human–technology interaction in terms of operational efficiency, but also through cognitive and behavioural adaptation processes. This suggests that the role of humans in automation has evolved from passive users to integral components of joint cognitive systems [3]. With the growing implementation of artificial intelligence (AI)-based systems in aviation in recent years, traditional human–automation interaction has increasingly shifted toward a human–AI teaming perspective [4]. Human–AI teaming involves collaborative arrangements in which humans and AI systems work together through information sharing, shared situation awareness, joint decision-making, and coordinated task execution [5]. This perspective is particularly relevant in high-reliability aviation operations, where the integration of human expertise and intelligent systems is increasingly recognized as a new operational paradigm that supports safety, resilience, and performance [6].

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Human–AI teaming is increasingly viewed in high-reliability domains, such as aviation, not merely as a technological advancement, but as a transformation that requires examination through a human factors lens. In this regard, the Artificial Intelligence Roadmap 2.0 published by the European Union Aviation Safety Agency (EASA), together with emerging regulatory AI frameworks, indicates that AI is expected to be progressively integrated into pilot operations through applications ranging from cockpit support systems and intelligent decision aids to virtual co-pilot solutions and advanced task-sharing architectures [7]. These developments reinforce the notion that AI is not intended to replace pilots, but rather to increasingly function as a “teammate” within future flight operations.

Recent literature further supports this transformation. AI-enabled virtual co-pilot systems, explainable decision-support mechanisms, intelligent cockpit interfaces, and discussions surrounding extended minimum crew operations suggest that future pilots will be evaluated not only in terms of manual and cognitive competencies but also in terms of their ability to collaborate effectively with intelligent systems [8, 9, 10]. Particularly in debates surrounding single-pilot operations and advanced automation, human–AI collaboration is increasingly considered a critical component for maintaining safety and operational resilience [11, 12]. In this context, the pilot’s role is evolving from that of a traditional “aircraft operator” toward that of a “human–AI team member” capable of coordinating with AI-supported systems [8, 9].

This transformation also raises important questions regarding pilot education and the individual characteristics that may shape the profile of future aviators. In this respect, student pilots represent a particularly critical population. As future operators expected to work in increasingly digitalized and AI-intensive flight environments, they constitute key stakeholders in this transition. Moreover, the global pilot shortage, ongoing digital transformation in aviation training, and the growing use of intelligent training technologies suggest that student pilots should be evaluated not only in terms of technical competence but also in terms of their adaptability to emerging technologies and openness to innovation [13, 14].

Despite the growing body of literature on AI in aviation, existing research has predominantly focused on technological capabilities, acceptance of automation, trust in intelligent systems, and the operational implications of human–AI collaboration. Relatively little attention has been given to the personal traits that could influence future pilots’ attitudes toward AI, particularly among student pilots. In this regard, individual innovativeness may be a critical yet under-explored factor, as it reflects an individual’s openness to new ideas, their willingness to adopt emerging technologies, and their tendency to embrace change. All of these factors may be particularly relevant in AI-enabled aviation environments. At the same time, attitudes toward AI are likely to play a significant role in shaping how future pilots perceive, accept, and collaborate with intelligent systems. Against this backdrop, investigating the relationship between student pilots’ individual innovativeness and their attitudes toward AI may contribute to a deeper understanding of human readiness for future AI-supported flight operations. Accordingly, the present study aims to investigate this relationship. Addressing this relationship will contribute to the emerging literature on human–AI teaming from an aviation psychology perspective and offer practical implications for pilot selection, training, and developing future-oriented competencies in increasingly intelligent aviation systems.

2. Literature Review and Hypothesis Development

2.1. Individual Innovativeness

Individual innovativeness is commonly conceptualized as a relatively stable personal tendency to embrace, generate, and adopt new ideas or technologies earlier than others. The concept originates from the Diffusion of Innovations theory, which defines innovativeness as “the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas” [15, 16]. At the behavioral level, innovativeness reflects how quickly an individual adopts new ideas compared with others within a social system [17]. Beyond early adoption, individual innovativeness is closely

linked to cognitive and motivational characteristics such as curiosity, openness to experience, and a tendency toward exploration. These attributes facilitate individuals' engagement with novel technologies and uncertain environments. In organizational contexts, particularly in high-reliability sectors such as aviation, such characteristics are critical for adapting to rapidly evolving technological systems. Empirical evidence suggests that curiosity-driven exploration enhances innovative work behavior, with work engagement acting as an important mediating mechanism [18]. Similarly, positive psychological capital, comprising hope, optimism, resilience, and self-efficacy, has been shown to foster both work engagement and innovative behavior, further reinforcing individuals' capacity to adopt and utilize new technologies effectively [19]. Within aviation, where advanced automation and AI-supported decision-making systems are increasingly integrated into operational processes, individual innovativeness plays a critical role in shaping how professionals respond to technological change. Individuals who are more innovative are more inclined to explore, adopt, and develop favorable evaluations of AI-based tools, thereby forming more positive attitudes toward such systems.

2.2. Attitudes Toward AI

Attitudes toward AI refer to individuals' overall evaluative orientations toward AI systems, encompassing cognitive (beliefs), affective (emotions), and behavioral (intentions and usage tendencies) components [20, 21, 22]. Within the broader technology acceptance literature, attitudes are considered a central determinant of individuals' willingness to adopt and interact with emerging technologies, shaping both intention and actual usage behaviors. In the context of AI, attitudes are influenced by a complex interplay of perceived benefits and risks. While AI systems offer increased efficiency, decision support, and performance enhancement, they also introduce concerns related to trust, transparency, autonomy, and control. Recent studies emphasize that individuals' evaluations of AI are strongly shaped by their perceptions of uncertainty and system opacity, particularly in high-stakes environments [23, 24]. Accordingly, trust in AI and perceptions of system reliability play a critical role in fostering positive attitudes. This issue becomes especially salient in aviation, where AI is increasingly integrated into cockpit decision-support systems and operational processes. Research on AI-supported co-pilot systems and reduced crew operations highlights that AI is expected to function as an assistive tool rather than a replacement for human operators, with human oversight remaining essential for judgment, safety, and complex decision-making [24, 25]. This human-centric perspective is further reinforced by regulatory frameworks such as the European Union Aviation Safety Agency's (EASA) (2024) AI Roadmap 2.0, which emphasizes safe, transparent, and human-centered integration of AI into aviation systems. Empirical findings within aviation contexts also demonstrate that attitudes toward AI are shaped by psychological factors such as anxiety, trust, and adaptation capabilities. For instance, Çeken et al. [26] show that AI-related anxiety particularly sociotechnical concerns regarding system complexity and unintended consequences significantly influences general attitudes toward AI among student pilots. Similarly, Tuncal [27] identified moderate overall AI anxiety among aviation professionals peaking specifically in the sociotechnical sub-dimension and noted that these psychological responses can be further nuanced by demographic factors such as educational background. These findings highlight that individuals' perceptions of AI are not solely driven by technical evaluations but are also deeply embedded in their psychological responses and adaptation processes.

2.3. Relationship between Individual Innovativeness, Use of AI-Based Tools, and Attitudes Toward AI

Individual innovativeness has long been conceptualized as a fundamental personal trait shaping individuals' openness to new technologies and their willingness to experiment with novel systems. Building on the diffusion framework of Rogers [15], individual innovativeness reflects a tendency to adopt innovations earlier than others and to perceive technological change as an opportunity rather than a threat. This trait plays a particularly critical role in the context of AI, where uncertainty, perceived risk, and complexity often influence user perceptions and acceptance.

Recent empirical studies provide strong support for the role of individual innovativeness in shaping attitudes toward AI. For instance, Erciyas et al. [28] demonstrated that individual

innovativeness significantly predicts positive attitudes toward AI among healthcare students, indicating that individuals with higher innovativeness levels tend to evaluate AI technologies more favorably. Similarly, Park and Woo [29] found that personal innovativeness in information technology is associated with more positive emotional and cognitive responses to AI, including higher perceived functionality and lower negative affect. These findings are further supported by Hering et al. [30], who showed that personal technological innovativeness and attitudes toward AI jointly predict AI usage behaviors, with innovativeness acting as a foundational driver of technology engagement.

In the aviation context, recent research on student pilots further highlights the importance of attitudes toward AI and related psychological factors. Ceken et al. [26] found that student pilots exhibit varying attitudes toward AI depending on factors such as AI-related anxiety and adaptation processes, emphasizing the critical role of human-centered AI integration in aviation training environments. The study demonstrated that attitudes toward AI are closely linked to how individuals perceive uncertainty and adapt to emerging technologies, reinforcing the idea that personal dispositions such as innovativeness can play a crucial role in shaping these attitudes.

Beyond direct effects, emerging research also highlights the indirect mechanisms through which innovativeness shapes AI attitudes. Usanmaz et al. [31] found that individual innovativeness mediates the relationship between employment anxiety and attitudes toward AI, suggesting that individuals who perceive themselves as more innovative are more likely to transform uncertainty into positive evaluations of AI technologies. Likewise, Ülkü et al. [32] reported that AI-related anxiety can positively influence innovative behavior through future-oriented concerns, indicating that individuals' adaptive and innovative tendencies play a crucial role in how they respond to AI-related challenges. These findings collectively suggest that innovativeness not only directly enhances positive attitudes toward AI but also functions as a psychological mechanism that transforms uncertainty into opportunity.

Another important pathway linking individual innovativeness to attitudes toward AI is the actual use of AI-based tools. According to technology acceptance perspectives, individuals who are more innovative are more likely to experiment with and adopt emerging technologies, which in turn shapes their perceptions and evaluations. Lan et al. [33] demonstrated that personal innovativeness significantly increases perceived usefulness and ease of use of AI tools, which subsequently drives behavioral intentions. In a similar vein, Marocco et al. [34] emphasized that perceived performance improvements through AI usage lead to more positive attitudes, including reduced anxiety and higher perceived utility. These findings indicate that usage experiences play a critical role in reinforcing favorable attitudes toward AI.

Within this framework, the use of AI-based tools can be conceptualized as a behavioral mechanism through which individual innovativeness translates into more positive attitudes toward AI. Individuals high in innovativeness are more likely to engage with AI tools, gain direct experience, and develop more informed and favorable evaluations. This is particularly relevant in high-stakes domains such as aviation, where exposure to AI-supported systems (e.g., decision-support tools, automation interfaces) can significantly shape trust, acceptance, and overall attitudes toward AI integration.

Taken together, the literature suggests a dual pathway: individual innovativeness directly influences attitudes toward AI, while also indirectly shaping these attitudes through increased engagement with AI-based tools. This perspective aligns with contemporary views on human-AI interaction, which emphasize the importance of both personal predispositions and experiential factors in technology acceptance.

Although previous studies have examined attitudes toward AI and related psychological factors across different populations, existing evidence remains fragmented in several respects. First, prior research has largely focused on general technology acceptance variables, AI anxiety, trust, or usage intentions, while comparatively limited attention has been given to the role of individual innovativeness as a personal characteristic shaping attitudes toward AI. Second, although several studies have explored AI perceptions in educational or healthcare contexts, empirical evidence within aviation training environments remains relatively scarce. In particular, research involving

student pilots has predominantly focused on AI-related anxiety and adaptation issues rather than examining how personal characteristics and technology engagement jointly influence attitudes toward AI. Third, previous studies have generally investigated direct relationships between technological factors and AI perceptions, whereas the combined role of individual innovativeness and actual AI-based tool usage has received limited empirical attention. Addressing these gaps, the present study contributes to the literature by examining the direct effects of individual innovativeness and AI-based tool use on attitudes toward AI among student pilots, thereby extending current understanding of human-centered AI integration in aviation contexts.

Based on the theoretical arguments and empirical findings discussed above, the following hypotheses are proposed:

H1: Individual innovativeness has a positive and significant effect on attitudes toward AI.

H2: Use of AI-based tools has a positive and significant effect on attitudes toward AI.

3. Methodology

3.1. Measures

Demographic Information: A demographic information form was used to collect participants' background characteristics, including gender, age, and education level. In addition, participants' attitudes toward AI-based decision support systems in the cockpit, perceptions of AI-supported single-pilot operations, and their use of AI-based tools were assessed to provide contextual information about their experience and perceptions of AI.

Individual Innovativeness Scale: Individual innovativeness was assessed using the Individual Innovativeness Scale, developed by Hurt et al. [35] and adapted into Turkish by Kılıçer and Odabaşı [36]. The scale consists of 20 items, which are rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

General Attitudes toward AI Scale: General attitudes toward artificial intelligence were assessed using the General Attitudes toward AI Scale, developed by Schepman and Rodway [20] and adapted into Turkish by Kaya et al. [37]. The scale consists of 20 items, which are rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.2. Sample

The sample of the study consisted of student pilots receiving aviation training in Türkiye. Data were collected using a convenience sampling method through an online questionnaire. The survey was distributed via digital platforms accessible to student pilots enrolled in university aviation programs and flight training institutions. A total of 204 valid responses were obtained and included in the analysis.

3.3. Data Analysis

Data analyses were conducted using Jamovi (version 2.7.6), which is based on the lavaan package implemented in R [38]. Initially, data screening procedures were performed to examine missing values and the distributional properties of the variables. Descriptive statistics, including means, standard deviations, skewness, and kurtosis values, were calculated to assess normality. Pearson correlation analyses were conducted to explore the relationships among the study variables. The internal consistency reliability of the scales was evaluated using Cronbach's alpha coefficients, and composite scores were computed in accordance with the scale guidelines. To test the proposed research model, path analysis based on observed variables was performed. In the model, individual innovativeness was specified as the independent variable and attitudes toward artificial intelligence as the dependent variable. The use of AI-based tools was included as a control variable to account for participants' prior experience with AI technologies. Because the proposed model is just-identified ($df = 0$), global model fit indices were not interpreted, and the evaluation of the model was based on the significance and magnitude of the estimated path coefficients.

3.4. Ethical approval

The study was approved for ethical suitability by the International Science and Technology University Ethics Committee (Approval Date and Number: 17.07.2025/202507-02). Participation was voluntary and anonymous, and respondents were informed that their responses would be used solely for scientific purposes and treated with strict confidentiality.

4. Results

4.1. Demographic Characteristics

The demographic characteristics of the participants are presented in Table 1. The sample consisted of 204 student pilots, the majority of whom were male (78.9%), while females represented 21.1% of the sample. In terms of age distribution, participants were predominantly between 30–39 years (35.8%), followed by those aged ≤22 (27.5%) and 23–29 (26.0%), whereas a smaller proportion was aged 40 and above (10.7%). Regarding educational background, most participants held a bachelor’s degree (57.8%), followed by high school or below (19.1%), postgraduate degrees (15.3%), and associate degrees (7.8%). Participants’ attitudes toward AI-based decision support in the cockpit indicated a generally positive tendency, with 33.3% reporting that they support and 11.3% strongly support such systems, while 27.5% remained neutral. A smaller proportion expressed negative views (10.3% do not support; 0.5% strongly do not support). In contrast, attitudes toward AI-supported single-pilot operations were more cautious, with the majority of participants (61.3%) considering such operations not feasible, whereas 19.6% were undecided and 19.1% perceived them as feasible. Finally, the use of AI-based tools varied across the sample. While 41.2% reported occasional use and 24.5% frequent use, a notable proportion had limited or no experience with such tools (20.1% tried but rarely use; 12.3% never used; 2.0% no intention to use).

The age distribution observed in the sample reflects the heterogeneous structure of pilot training pathways rather than a conventional undergraduate student profile. Participants were recruited from both university aviation programs and authorized flight training organizations. While younger individuals often enter pilot training at the beginning of their professional careers, flight training institutions may also include older participants pursuing aviation as a second career path, engaging in late-career transitions, or undertaking private/commercial pilot conversion training. Therefore, the present sample represents a broader population of student pilots with diverse educational and training backgrounds. This characteristic should be considered when interpreting the generalizability of the findings.

Table 1. Demographic characteristics and ai-related perceptions of participants

Variables	Category	n	%
Gender	Female	43	21.1
	Male	61	78.9
Age	≤ 22	56	27.5
	23–29	53	26.0
	30–39	73	35.8
	≥ 40	22	10.7
Education Level	High school or below	39	19.1
	Associate degree	16	7.8
	Bachelor’s degree	118	57.8
	Postgraduate degree	31	15.3
Attitude Toward AI-Based Decision Support in Cockpit	Strongly do not support	1	0.5
	Do not support	21	10.3
	Neutral	56	27.5
	Support	68	33.3
	Strongly support	23	11.3
Attitude Toward AI-Supported Single-Pilot Operations	Feasible	39	19.1
	Undecided	40	19.6

	Not feasible	125	61.3
Use of AI-Based Tools	Strongly no (no intention to use)	4	2.0
	No, never used	25	12.3
	Tried but rarely use	41	20.1
	Yes, occasionally use	84	41.2
	Yes, frequently use	50	24.5
Total		204	100.00

4.2. Statistical Findings

Table 2 presents the descriptive statistics, reliability coefficients, and Pearson correlation results for the study variables. The findings indicate that participants reported a moderate to high level of attitudes toward AI (AIA) (M = 64.42, SD = 11.50) and individual innovativeness (II) (M = 74.74, SD = 8.77). The distributional properties of the variables suggest acceptable normality, as skewness and kurtosis values fall within commonly recommended thresholds ($|\text{skewness}| < 1$, $|\text{kurtosis}| < 1$) [39]. Specifically, AIA exhibited slight negative skewness (-0.325) and low kurtosis (0.281), while II showed near-normal distribution characteristics (skewness = -0.024; kurtosis = 0.218). In terms of internal consistency, both scales demonstrated good reliability. The Cronbach’s alpha coefficient was .875 for AIA and .820 for II, indicating satisfactory levels of internal consistency for both constructs. Pearson correlation analysis revealed a positive and statistically significant relationship between individual innovativeness and attitudes toward AI ($r = .226$, $p < .01$). This finding suggests that individuals with higher levels of innovativeness tend to exhibit more favorable attitudes toward AI.

Table 2. Descriptive statistics, skewness and kurtosis, reliability, and pearson’s correlation results

Variables	AIA	II	M	SD	Skewness	Kurtosis	Cronbach’s α
AIA	-	.226**	64.42	11.50	-0.325	0.281	.875
II	.226**	-	74.74	8.77	-0.024	0.218	.820

N = 204, **p < .01 (2-tailed). AIA=Artificial Intelligence Attitude; II= Individual Innovativeness

The structural model was tested using path analysis, and the results are presented in Table 3 and Figure 1. Because the proposed model is just-identified ($df = 0$), model fit indices are not interpreted. As shown in Table 3 and illustrated in Figure 1, both hypothesized relationships were found to be statistically significant. First, individual innovativeness had a positive and significant effect on attitudes toward AI ($\beta = 0.182$, $z = 2.82$, $p = .005$), supporting H1 [40]. Second, the use of AI-based tools also showed a positive and significant effect on attitudes toward AI ($\beta = 0.334$, $z = 5.16$, $p < .001$), supporting H2. The magnitude of this coefficient suggests a relatively stronger predictive contribution compared to individual innovativeness.

Table 3. Path analysis results

Hypothesis	Path	β	z	p	Decision
H1	Individual Innovativeness → Attitudes Toward AI	0.182	2.82	.005	Supported
H2	Use of AI-Based Tools → Attitudes Toward AI	0.334	5.16	< .001	Supported

In addition, a small yet statistically significant positive association was observed between individual innovativeness and the use of AI-based tools ($r = .13$, $p < .05$), as illustrated in Figure 1. The model explained 16% of the variance in attitudes toward AI ($R^2 = .160$), indicating a modest but meaningful level of explanatory power [39].

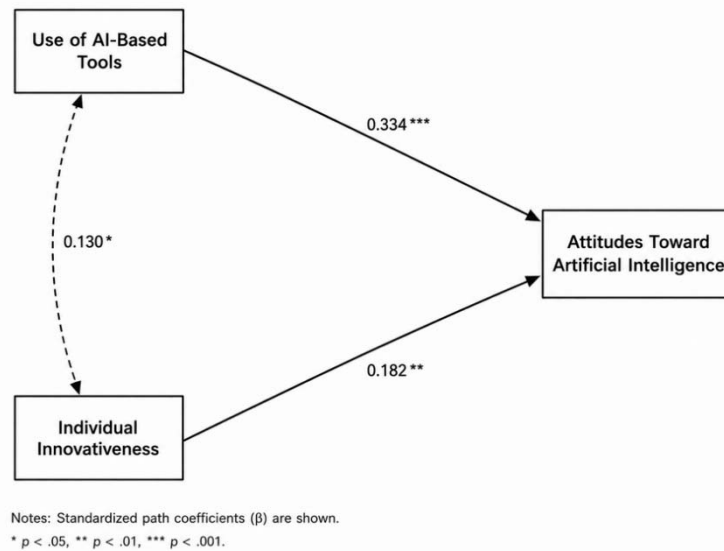


Fig 1. Path diagram

4. Discussion

The present study aimed to examine the relationships among individual innovativeness, use of AI-based tools, and attitudes toward AI within the context of student pilots. The findings provide empirical support for the proposed model and offer important insights into how both dispositional and experiential factors shape attitudes toward AI in a high-technology and safety-critical domain.

Consistent with the first hypothesis, individual innovativeness was found to have a positive and significant effect on attitudes toward AI. This finding aligns with classical innovation and technology adoption theories, which emphasize innovativeness as a key determinant of openness to new technologies [15]. More recent evidence further supports this relationship, indicating that personal technological innovativeness and attitudes toward AI jointly act as key predictors of AI usage behavior, suggesting that both general and technology-specific factors shape AI adoption [30]. In this sense, individual innovativeness can be interpreted as a foundational predisposition that enables individuals to approach AI systems with greater openness and reduced resistance.

From a human–AI interaction perspective, this finding suggests that individual differences play a critical role in shaping how users cognitively and affectively respond to intelligent systems. As highlighted in recent research, the successful integration of AI systems depends not only on interface design but also on how users perceive operational complexity and system behavior [41]. Individuals with higher innovativeness may be better equipped to cope with such complexities, thereby facilitating more effective human–AI collaboration.

The results also revealed that the use of AI-based tools has a stronger effect on attitudes toward AI than individual innovativeness. This finding highlights the importance of experiential learning in shaping AI perceptions. In line with the Technology Acceptance Model, perceived usefulness and ease of use play a critical role in shaping attitudes toward AI systems [42]. However, recent findings in the aviation context also indicate that trust in AI is not solely determined by perceived usefulness. Rather, it is influenced by factors such as transparency, explainability, and perceived system fairness. This suggests that experience with AI tools may simultaneously increase familiarity and reveal system limitations, leading to more nuanced attitudes.

The stronger impact of AI usage observed in this study is also consistent with recent research demonstrating that both innovativeness and attitudes toward AI predict actual AI usage behavior, with usage itself acting as a reinforcing mechanism that shapes future attitudes [30]. This cyclical

relationship suggests that exposure to AI technologies not only reflects prior attitudes but also actively contributes to their development.

Another important dimension of the findings relates to AI-related anxiety. Prior research in aviation contexts indicates that the impact of AI anxiety on outcomes such as perceived employability may be limited, reflecting the structured and human-centered nature of the aviation sector [43]. This is consistent with the current findings, which suggest that despite potential concerns regarding AI, both innovativeness and usage contribute to more positive attitudes. Similarly, broader research indicates that anxiety related to AI can, under certain conditions, motivate adaptive and innovative responses rather than purely negative reactions [32]. This highlights the complex role of psychological factors in AI acceptance, where anxiety does not necessarily translate into resistance but may instead coexist with curiosity and openness.

The relationship between individual innovativeness and AI usage, although modest, further supports the idea that innovative individuals are more likely to engage with new technologies. This finding is consistent with research conducted in the aviation education context, which shows that aviation professionals and academics tend to exhibit openness to innovation and willingness to engage with technological change [44]. Such tendencies are particularly important in sectors characterized by rapid technological advancement.

From a broader aviation and mobility perspective, attitudes toward emerging technologies are known to vary across individuals and groups, with distinct clusters ranging from early adopters to skeptics [45]. This diversity in attitudes suggests that AI acceptance cannot be treated as a uniform phenomenon and highlights the importance of considering individual differences such as innovativeness and experience when examining technology adoption.

In addition, the findings should be interpreted in light of ongoing transformations in aviation systems and training environments. Despite the increasing emphasis on AI integration in aviation operations, recent studies indicate that current educational programs may not sufficiently equip students with the necessary AI-related competencies [46]. This gap underscores the importance of not only developing technical skills but also fostering positive attitudes and readiness for human-AI collaboration among future aviation professionals.

5. Conclusion

This study provides empirical evidence that both individual innovativeness and the use of AI-based tools play significant roles in shaping attitudes toward artificial intelligence among student pilots. The findings indicate that while individual innovativeness contributes to a general openness and predisposition toward emerging technologies, direct interaction with AI systems emerges as a relatively stronger determinant of positive attitudes. This highlights the critical role of experiential learning and hands-on engagement in fostering favorable perceptions of AI. Within the aviation context, where human-AI collaboration is rapidly evolving and becoming integral to operational environments, these findings carry important implications. The increasing integration of AI-driven decision-support systems, automation interfaces, and intelligent cockpit technologies necessitates not only technical proficiency but also psychological readiness, trust, and adaptability among future aviation professionals. In this regard, the results emphasize that exposure to AI applications during training processes can enhance familiarity, reduce uncertainty, and ultimately facilitate acceptance. From a theoretical perspective, the study contributes to the growing body of literature on technology acceptance by integrating both dispositional (individual innovativeness) and behavioral (technology use) dimensions within a human-centered AI framework. This dual perspective offers a more comprehensive understanding of how attitudes toward AI are formed, particularly in high-reliability domains such as aviation, where safety, trust, and decision-making are paramount. The findings suggest that successful AI adoption is not solely driven by individual characteristics or system features, but rather by the dynamic interaction between users and technologies. Accordingly, fostering positive attitudes toward AI requires not only selecting

individuals with higher innovative tendencies but also designing training environments that promote meaningful engagement with AI systems. Furthermore, these results highlight the importance of embedding AI literacy, transparency, and trust-building mechanisms into aviation education and training programs to support the long-term sustainability of human-AI collaboration. These insights underline the importance of aligning technological development with human-centered design principles to ensure the effective and sustainable integration of AI in aviation and beyond.

Practical Implications and Limitations: The findings suggest several practical implications for aviation training institutions and industry stakeholders aiming to enhance human-AI integration. Given that the use of AI-based tools emerged as a stronger predictor of attitudes than individual innovativeness, training programs should prioritize hands-on, scenario-based AI applications to foster familiarity, perceived usefulness, and acceptance consistent with both classical and recent technology acceptance research [47, 48, 49, 50]. Additionally, integrating elements of trust, transparency, and explainability into training environments is essential, as these factors play a critical role in shaping user acceptance in safety-critical domains [42]. Educational practices should also support the development of individual innovativeness and address AI-related anxiety through structured exposure and guided interaction [15, 20, 43]. Finally, given the growing gap between industry needs and current training content, incorporating AI literacy and human-AI collaboration skills into aviation curricula is crucial for preparing future professionals for technology-intensive operational environments [46]. This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design limits the ability to draw causal conclusions, as the relationships reflect associations at a single point in time. Second, the use of a convenience sample consisting of student pilots in Türkiye may restrict the generalizability of the results to other populations and aviation contexts. Third, the reliance on self-reported data introduces the possibility of common method bias and response-related biases. Finally, although validated scales were employed, the analysis was conducted using composite scores rather than latent constructs, which does not account for measurement error at the item level.

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