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Sustainable Approaches in Professional Higher Education: The Role of Distance Learning, Integrity of Teaching Methodology, and Classroom Innovation

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Abstract

The rapid digital transformation of higher education creates opportunities and challenges, particularly in professional programmes where students must balance academic learning with preparation for operational duties, such as in medicine, engineering, and defence. While digital technologies are widely used in higher education, their sustainable integration into professional contexts, especially security and defence education, remains underexplored. This study investigates the determinants of perceived e-learning usefulness among undergraduates (cadets) at the Lithuanian Military Academy, applying an adapted technology acceptance model framework. A structured questionnaire was used to measure constructs related to distance learning effectiveness, classroom innovation, security, sustainability of digital systems, and individual learning preferences, with hypotheses tested through mediation and moderated mediation models. The results indicate that the effectiveness of distance learning is the strongest factor influencing intention to use it, supported by the roles of classroom innovation and system security. Perceived usefulness further emerges as both a direct predictor of adoption and a conditional factor shaping the impact of pedagogical and infrastructural design on acceptance. These findings extend traditional technology acceptance frameworks and provide new insights into how sustainable digital teaching can be fostered in higher professional education, where academic quality and operational readiness must be aligned.

Keywords: distance learning; higher education; professional higher education; technology acceptance model (TAM/UTAUT); teaching and learning methodologies; classroom innovation

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1. Introduction

Higher education institutions play a critical role in preparing future leaders capable of addressing complex societal, environmental, and operational challenges. At universities that educate security and defence professionals, students complete higher education curricula and engage in mission-oriented training under strict operational and security requirements. This dual role creates unique demands for instructional design, particularly when integrating sustainability principles into education. In this context, sustainable higher education means balancing high-quality academic learning with the operational readiness

required of future officers, while also supporting long-term skill retention and efficient use of resources.

In recent years, the digital transformation of higher education has accelerated, with distance learning (DL) emerging as a critical enabler of flexibility, accessibility, and innovation [1–7]. DL has the potential to support students' academic and professional training by overcoming geographical constraints during deployments, reducing travel-related carbon footprints, and enabling continuous access to specialized resources regardless of location. From a sustainability perspective, such digital delivery methods align with the objectives of minimizing environmental impact while ensuring educational continuity and inclusivity [7–10].

However, research also shows that DL in security and defence education faces persistent challenges: reduced learner engagement, limited social presence, uneven digital competence among students and teachers/instructors, and difficulties in integrating theoretical modules with hands-on professional training [11,12]. Furthermore, effective DL adoption depends on its interplay with established teaching and learning methodologies, the promotion of classroom innovation, and the alignment with individual learning styles—all of which remain underexplored in the literature on professional education for security and defence.

Existing frameworks such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) offer valuable tools for understanding technology adoption [13,14]. Yet, prior studies applying these models have largely focused on general higher education or corporate training contexts, with limited attention to the specificities of military and security education [3,14,15]. In particular, they rarely address how technology acceptance interacts with pedagogical innovation, operational discipline, and sustainability imperatives within mission-driven academic environments. This gap highlights the need for a more context-sensitive application of technology acceptance theories that accounts for the dual academic–operational nature of professional military training. Although distance learning has been widely studied, little research has examined how it interacts with teaching and learning methodologies, its role in fostering classroom innovation, or how it aligns with diverse learning styles in professional security and defence education, especially from a sustainability perspective. Previous studies have tended to treat DL as a technical or logistical solution rather than a pedagogical ecosystem shaped by institutional culture, professional norms, and operational constraints. As a result, there is limited empirical evidence on how DL can simultaneously enhance academic quality, operational readiness, and sustainability within such specialized educational settings.

This study addresses these limitations by offering an integrative, context-specific analysis of DL adoption in military higher education. It examines the determinants of perceived e-learning usefulness among undergraduates (cadets) at the Lithuanian Military Academy, focusing on:

- The synergy between distance learning and teaching/learning methodologies in a blended security and defence curriculum;
- The role of distance learning in fostering classroom innovation while maintaining discipline and operational standards;
- The alignment of distance learning with undergraduates' learning styles to ensure inclusive and equitable education; and
- The moderating role of perceived usefulness in balancing rigorous academic learning with the operational needs of cadet training.

By linking these elements into a unified analytical model grounded in TAM/UTAUT, this research extends existing technology acceptance frameworks to a novel empirical domain—security and defence higher education—and introduces sustainability as an integrative dimension of pedagogical and technological innovation. The study thus contributes

to both theory and practice by producing a systematized, evidence-based understanding of sustainable DL integration in professional education, with implications for curriculum design, policy development, and institutional strategy.

2. Literature Review: Sustainable Distance Learning in Higher Professional Education

The rapid digital transformation of higher education has made distance learning (DL) central to advancing accessibility, inclusion, and equity [16,17]. However, most existing research has focused on civilian higher education, while DL in professional higher education—programmes preparing students for operational roles in defence, policing, healthcare, or engineering—remains comparatively underexplored [18,19]. In such mission-oriented settings, DL serves a dual purpose: it must deliver academically rigorous instruction while sustaining professional readiness. This duality demands systems that are pedagogically sound, operationally feasible, and sustainable over time [20,21].

2.1. Challenges and Sustainability Considerations in DL for Professional Education

DL is widely recognized for enhancing flexibility, improving access, and complementing classroom-based instruction [22]. Yet, in security and defence education, it must be carefully integrated with field training and face-to-face instruction to preserve discipline, teamwork, and operational skill development [23,24]. Studies have noted that DL cannot replace experiential learning but can reinforce theoretical foundations and ensure continuity during deployments or emergencies. Moreover, DL must accommodate diverse learning styles, allowing students to control pacing, interact through multimedia formats, and engage in both individual and collaborative learning [25,26]. Research has shown that alignment between DL design and learning preferences enhances engagement and perceived usefulness—two critical factors for sustainable adoption [27].

Sustainability in DL extends beyond environmental benefits such as reduced travel or energy use. It also encompasses institutional resilience, technological security, and alignment with operational schedules [20,21]. In security and defence education, DL systems must ensure confidentiality, data protection, and adaptability to constrained learning environments. Evaluating DL's sustainability and security fit is therefore essential for understanding its adoption potential.

2.2. Theoretical Frameworks for Technology Adoption

Technology adoption models, particularly the Technology Acceptance Model (TAM) [28,29] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [30], provide a foundation for understanding DL use. Both frameworks identify Perceived Usefulness (PU) and Intention to Use (IU) as key determinants of adoption. However, previous studies have largely examined these relationships in general higher education, overlooking the unique contextual constraints of professional and defence-oriented learning environments.

Recent extensions of these frameworks highlight that PU and IU can act not only as mediators but also as moderators of technology adoption processes [31,32]. For instance, research by Al-Adwan et al. [33] demonstrated that the effect of teaching design on technology use is stronger when learners perceive the system as useful. Similarly, Alshammari & Alkhwaldi [34] and Zhang & Wang [35] found that learning style compatibility and perceived innovation predict sustained DL engagement, particularly in structured professional programmes. These insights inform the conceptualization of PU in this study as a *contextual boundary condition* that influences how DL factors translate into IU.

2.3. Conceptual Model and Hypotheses Development

Building on prior research, this study integrates sustainability and professional education considerations into established technology adoption frameworks. It proposes a model where Distance Learning Effectiveness (DLE) acts as an overarching predictor influencing undergraduates' Intention to Use (IU) DL through four mediating mechanisms:

- Teaching Methodology Integration (TM): Prior studies indicate that when DL is effectively aligned with pedagogical methods, student motivation and perceived usefulness increase [36].
- Learning Style Alignment (LS): Alignment with learners' cognitive and sensory preferences enhances perceived engagement and learning outcomes [37,38].
- Classroom Innovation (CI): Innovative DL practices promote interaction, creativity, and adaptability in professional learning settings [39].
- Security and Sustainability Fit (SSF): Secure, reliable, and resource-efficient platforms encourage trust and long-term adoption, especially in security-sensitive environments [40,41].

The model further posits that Perceived Usefulness (PU) moderates these relationships, amplifying the positive effects of DL dimensions on IU when usefulness perceptions are high. This conditional process reflects how individual attitudes shape the translation of instructional and sustainability features into behavioural intentions.

2.4. Summary of Hypotheses

To test these relationships, the study assumes a two-stage conditional process model [32] (see Figure 1).

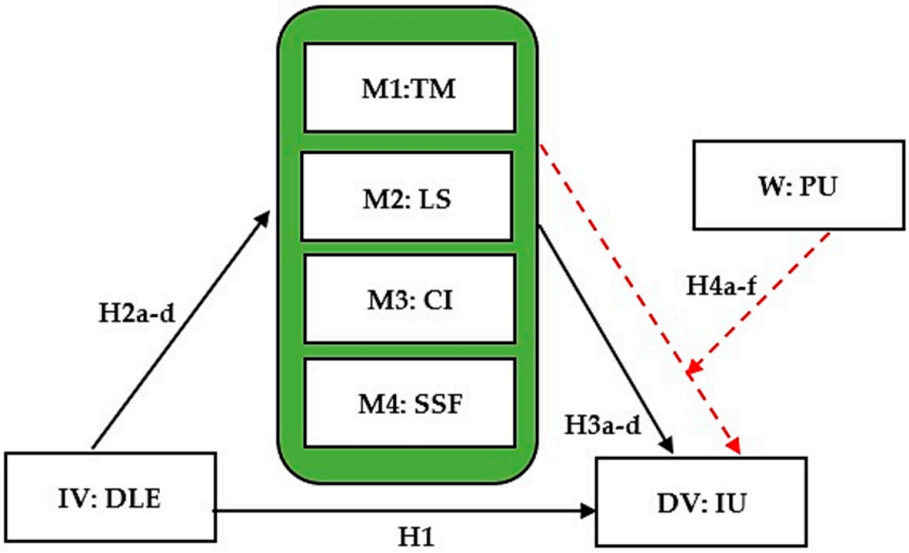


Figure 1. The conceptual research model.

The first set of hypotheses (H1 and H2a–d) addresses the direct associations between DLE, its main dimensions, and undergraduates' IU:

H1. *Distance Learning Effectiveness (DLE) directly predicts undergraduates' intention to use distance learning (IU).*

H2a–d. *Distance Learning Effectiveness (DLE) has direct effect to four dimensions teaching methodology integration (H2a: TM), learning style alignment (H2b: LS), classroom innovation (H2c: CI), and security and sustainability fit (H2d: SSF).*

The second set of hypotheses (H3a–d) examines whether the four dimensions (TM, LS, CI, and SSF) function as mediating mechanisms that explain *how* Distance Learning Effectiveness (DLE) explains undergraduates' Intention to Use distance learning (IU):

H3a. *Teaching methodology integration (TM) mediates the effect of DLE on IU.*

H3b. *Learning style alignment (LS) mediates the effect of DLE on IU.*

H3c. *Classroom innovation (CI) mediates the effect of DLE on IU.*

H3d. *Security and sustainability fit (SSF) mediates the effect of DLE on IU.*

In the final step, Perceived Usefulness (PU) is hypothesized as a second-stage moderator that conditions the strength of the relationships between the four dimensions and undergraduates' IU. This enables testing how PU moderates the effect of each dimension on IU. The set of hypotheses (H4a–d) examines impact of the importance of PU:

H4a. *DLE improves TM integration, which increases IU when PU is high.*

H4b. *DLE enhances LS alignment, which increases IU when PU is high.*

H4c. *DLE fosters CI, which increases IU when PU is high.*

H4d. *DLE improves SSF, which increases IU when PU is high.*

H4e. *PU strengthens the indirect effects of TM, LS, CI, and SSF on IU.*

H4f. *Undergraduates' IU is explained by conditional indirect effects of DLE via TM, LS, CI, and SSF, moderated by PU.*

The structure of conceptual research model (see Figure 1) responds to the gap in professional higher education research by systematizing DL's contributing factors under a sustainability outlining and testing their implementation dynamics in a security-sensitive context.

3. Methodology

3.1. Participants

This study employed a systematic random sampling approach to secure a representative dataset. Data collection was conducted in February 2025 at the Lithuanian Military Academy (LMA), where undergraduates (cadets) were invited to complete a self-administered digital questionnaire distributed via the Google Forms platform. Prior to beginning the survey, participants were thoroughly informed about the ethical principles guiding the research, with a clear emphasis on maintaining anonymity and safeguarding the confidentiality of all responses. Participation was strictly voluntary, and no external incentives or compensation were provided. The study was conducted in accordance with the Declaration of Helsinki and approved by the General Jonas Žemaitis Military Academy of Lithuania (Approval No. V-814, issued on 14 December 2020).

The final sample included 155 undergraduates enrolled in the 2nd, 3rd, and 4th years of study. Each participant received a detailed explanation of the study's purpose and procedures, and informed consent was obtained before data collection commenced. This ensured that undergraduates participated with full awareness of their rights and protections, while their identities remained fully anonymous throughout the research process.

3.2. Sudy Instrument

The study instrument was designed as a structured questionnaire consisting of seven thematic blocks: Distance Learning Effectiveness (DLE, Block 1), Teaching Methodology Integration (TM, Block 2), Learning Style Alignment (LS, Block 3), Classroom Innovation (CI, Block 4), Security & Sustainability Fit (SSF, Block 5), Perceived Usefulness (PU, Block 6), and Intention to Use (IU, Block 7), supplemented by a demographic section. The block structure was guided by theoretical frameworks of the Technology Acceptance Model (TAM) [36], the Unified Theory of Acceptance and Use of Technology (UTAUT) [37–39], and sustainability-oriented digital teaching research [40]. Each block was carefully adapted to the study programme context, where undergraduates simultaneously pursue higher education curricula and prepare for operational duties, creating unique demands on distance learning (DL).

Distance Learning and Teaching Methodologies (Block 1, H1). This block captures how DL interacts with face-to-face instruction and with modules that are specific to professional training. Items were adapted from UTAUT's "Effort Expectancy" and "Facilitating Conditions" [37], which emphasize the degree to which a system supports effective task completion. In sustainable education contexts, alignment of digital and traditional methods is considered a key determinant of adoption [40,41]. Therefore, this block evaluates whether DL enhances flexibility, efficiency, and complementarity across theoretical and practical components of higher professional education.

Teaching Methodology Integration (TM, Block 2). This block assessed the extent to which distance learning (DL) complements face-to-face instruction and specialized professional training modules, focusing on the degree of alignment between digital and traditional teaching methods. In the context of the Lithuanian Military Academy, undergraduates are simultaneously exposed to academic coursework and operational preparation; therefore, teaching effectiveness relies heavily on methodological integration rather than separation of formats. The items in this block (TM1–TM4) were designed to capture perceptions of methodological coherence by examining whether DL methods: (i) are embedded within face-to-face instruction, (ii) supplement professional training rather than replace it, (iii) improve flexibility in course delivery, and (iv) enhance the efficiency of theoretical instruction. These indicators were adapted from the Effort Expectancy and Facilitating Conditions constructs of UTAUT [37], which emphasize how system design supports task completion and reduces perceived barriers to learning. From a sustainability perspective, effective integration of DL and traditional methodologies has been identified as a critical determinant of adoption, as it allows institutions to optimize teaching resources, reduce logistical constraints, and ensure continuity of instruction [41]. In security and defence education, this integration acquires an additional layer of importance: DL platforms must support theoretical knowledge acquisition while preserving space and time for field-based exercises.

Learning Style Alignment (LS, Block 3). This block was designed to capture how distance learning (DL) systems accommodate undergraduates diverse learning preferences, recognizing that effective digital education depends not only on technological availability but also on its alignment with individual cognitive and behavioural styles. The block emphasizes adaptability in pacing, autonomy, collaboration, and format variety, as these dimensions are central to learner-centred approaches in both higher education and professional training. The items in this block (LS1–LS4) were developed from extensions of the Technology Acceptance Model (TAM) that incorporate personalization and learner autonomy as predictors of technology adoption [42,43]. In these models, user perceptions of flexibility and the ability to tailor instruction to individual needs have been shown to significantly increase perceived usefulness and behavioural intention to use digital platforms. In the security and defence education context, undergraduates often face competing

demands between academic progress and operational duties, meaning that DL must provide sufficient adaptability to different schedules, learning rhythms, and task intensities. Furthermore, DL can enhance inclusivity by offering differentiated pathways, allowing undergraduates with varying levels of prior knowledge, technological literacy, or operational experience to engage effectively with learning materials. From a sustainability and equity perspective, research emphasizes that DL's potential lies in enabling more personalized learning environments [44]. Thus, ensuring alignment with diverse learning styles contributes not only to individual learner satisfaction but also to the long-term resilience of the educational system.

Classroom Innovation (CI, Block 4). This block was designed to assess the role of distance learning (DL) as a driver of pedagogical innovation, particularly in environments where traditional instruction is complemented by digital modalities. The items in this block (CI1–CI4) measured the extent to which DL promotes the use of innovative teaching practices, including integration of multimedia, deployment of simulations, enhancement of interactivity, and stimulation of higher-order cognitive skills such as problem-solving and critical thinking. The conceptual grounding for this block draws on innovation and digital transformation frameworks in higher education [45,46], which highlight that technological adoption in teaching is most effective when it enables educators to experiment with novel pedagogical approaches. Innovation in this sense does not merely refer to the introduction of new tools but to the transformation of teaching and learning processes into more engaging, adaptive, and participatory experiences. In the security and defence education context, DL-mediated classroom innovation is particularly relevant because undergraduates must be prepared for complex, uncertain, and rapidly changing operational environments. Digital simulations, scenario-based training, and gamified learning modules allow undergraduates to rehearse decision-making under pressure, replicate combat or logistical situations, and explore tactical alternatives without the resource intensiveness of live training. Thus, DL innovation extends beyond convenience—it becomes a means of creating realistic, scalable, and cost-effective training environments that support both academic development and operational readiness. From a sustainability perspective, innovative DL practices also contribute to reducing reliance on resource-heavy physical training setups. For example, virtual simulations can substitute for costly field exercises in some contexts, while multimedia-enhanced instruction reduces dependency on printed materials. This aligns with broader sustainable education goals, where innovation is understood as a mechanism to achieve long-term efficiency and adaptability [40].

Security and Sustainability Fit (SSF, Block 5). This block was designed to capture the intersection of technological reliability, operational feasibility, and sustainability considerations that are specific to security and defence education. Unlike civilian higher education, where distance learning (DL) adoption primarily emphasizes accessibility and efficiency, the security and defence context introduces non-negotiable requirements for data security, mission compatibility, and resilience under constrained resources. The items in this block (SSF1–SSF4) were constructed by integrating UTAUT's "Facilitating Conditions" dimension [37] with insights from sustainability-oriented digital teaching [47] and security and defence e-learning research [48]. The security and defence education setting amplifies the relevance of these dimensions. For example, while security is a background concern in most higher education contexts, in security and defence it is an explicit and critical determinant of adoption. Similarly, sustainability extends beyond ecological concerns to include institutional resilience—the capacity to maintain effective teaching and training under conditions of resource scarcity, budgetary limitations, or operational disruptions.

Perceived Usefulness (PU, Block 6). Perceived Usefulness (PU) represents one of the core constructs of the Technology Acceptance Model (TAM) [33] and is widely regarded as the strongest predictor of technology adoption across educational and organizational contexts. In this study, PU was operationalized through items assessing the extent to which DL improves learning effectiveness, academic performance, and professional development opportunities (PU1–PU3). The construct was carefully adapted to the Lithuanian Military Academy context, where undergraduates evaluation of DL usefulness is shaped by the dual requirement to achieve higher education outcomes and to develop specific competencies. PU was modelled as a second-stage moderator in the study's conceptual framework, situated between the mediators (Blocks 2–5). The theoretical importance of PU as a moderator is supported by extensions of TAM and UTAUT [36,49], which highlight its role in bridging contextual determinants (such as usability, innovation, or security) with adoption behaviours. In sustainability-oriented digital education research, PU also functions as a mediating link between pedagogical innovation and durable technology uptake [50,51].

Intention to Use (IU, Block 7). Intention to Use (IU) represents the final dependent variable of the model and reflects undergraduates' behavioural commitment to adopting DL technologies in their academic and professional routines. IU was measured through three items (IU1–IU3) that captured undergraduates' willingness. The operationalization of IU follows UTAUT's behavioural intention construct [37], which has been consistently validated as a proximal predictor of actual system use. In the security and defence education, IU acquires particular significance because undergraduates' willingness to adopt DL not only influences their individual learning trajectories but also determines the institutional sustainability of digital teaching initiatives. If undergraduates embrace DL as a legitimate and effective complement to traditional training, this strengthens the Academy's capacity to integrate DL systematically across cohorts and programmes. Furthermore, IU serves as the end-point outcome of the study's theoretical model, synthesizing the influence of all prior determinants (Blocks 1–5) and the moderating role of PU (Block 6). A strong IU suggests that DL has successfully met the dual challenge of academic quality and professional applicability, while a weak IU would indicate resistance to adoption despite contextual facilitators. This aligns with broader research in technology adoption, where behavioural intention is widely regarded as the best predictor of future system sustainability and diffusion [52,53].

The detailed description of the questionnaire blocks and the measures included in this study are presented in Table 1. All questionnaire items were assessed using a 5-point Likert scale ranging from '1–strongly disagree' to '5–strongly agree'.

Demographic Section. To account for contextual factors, demographic data were collected, including undergraduates' year of study, access to secure technologies, and time availability. In sustainability enclosing, these variables capture structural inequalities in access to DL resources [40].

By uniting adoption theory, sustainability principles, and profession-specific adaptations, this instrument advances the field in two ways. Theoretically, it extends TAM/UTAUT by embedding sustainability and security-sensitive determinants into the adoption model. Practically, it generates actionable insights for educational decision-makers in professional training by identifying which DL factors enhance undergraduates' professional readiness while maintaining alignment with sustainability goals. Thus, the questionnaire serves as both a measurement tool and a knowledge production mechanism.

Table 1. Detailed description of used measures included into this study.

Questionnaire Block Items	M [1]	SD [1]	CA
INDEPENDENT VARIABLE (IV), Block 1: Distance Learning Effectiveness (DLE)			
DLE 1: DL is effective for my studies overall. **DLE 2**: DL provides reliable access to educational resources. **DLE 3**: DL enables smooth integration into the curriculum. **DLE 4**: DL supports both academic and professional education.	3.044	0.677	0.860
DEPENDENT VARIABLE (DV), Block 7: Intention to Use (IU)			
IU 1: I intend to continue using DL. **IU 2**: I would recommend DL to other undergraduates. **IU 3**: I will seek DL opportunities beyond the formal education.	3.029	0.701	0.846
MEDIATORS: Block 2, Block 3, Block 4, Block 5			
Block 2: Teaching Methodology Integration (TM): **TM 1**: DL methods are well-integrated with face-to-face teaching. **TM 2**: DL complements practical/professional training modules. **TM 3**: DL improves the flexibility of course delivery. **TM 4**: DL enhances the efficiency of instruction in theoretical modules.	3.019	0.777	0.880
Block 3: Learning Style Alignment (LS): **LS 1**: DL allows me to learn at my own pace. **LS 2**: DL accommodates my preferred learning style. **LS 3**: DL offers sufficient variety in learning formats. **LS 4**: DL supports independent learning while enabling collaboration.	3.047	0.762	0.861
Block 4: Classroom Innovation (CI): **CI 1**: DL encourages instructors to use innovative teaching techniques. **CI 2**: DL enables creative use of multimedia and simulations. **CI 3**: DL improves interactivity of sessions. **CI 4**: DL promotes problem-solving and critical thinking.	3.019	0.728	0.818
Block 5: Security and Sustainability Fit (SSF): **SSF 1**: DL platforms are secure for security and defense training. **SSF 2**: DL fits operational schedules. **SSF 3**: DL can be sustained with current resources. **SSF 4**: DL supports long-term skill retention.	3.585	0696	0.886
MODERATOR* of second-stage (TM/LS/CI/SSF → IU), *Block 6: Perceived Usefulness (PU)			
PU1: DL improves my learning effectiveness. **PU2**: DL enhances my academic performance. **PU3**: DL is useful for my professional development.	3.452	0.773	0.832

[1] Notes: N = 155 for all items; M—mean; DS—Standard deviation; CA—Cronbach's Alpha.

3.3. Methodology of Statistical Analyses

The statistical analyses were designed to rigorously test the hypothesized relationships within the conceptual model, which integrates the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) with sustainability perspectives in higher education.

The empirical research was conducted using IBM SPSS Statistics version 29 and the PROCESS macro version 3.5 [54], which together enabled a systematic and comprehensive evaluation of the proposed framework. Preliminary analyses included frequency analysis to assess the demographic characteristics of the sample, correlation analysis to explore the interrelationships among study constructs, confirmatory factor analysis to verify the validity of measurement variables, and reliability testing using Cronbach's alpha coefficients, all of which supported the robustness of the measurement model.

Hypothesis testing proceeded in three stages. First, PROCESS Model 4 was used to assess direct effects between Distance Learning Effectiveness (DLE), its four design dimensions: Teaching Methodology Integration (TM), Learning Style Alignment (LS), Classroom Innovation (CI), and Security and Sustainability Fit (SSF), and undergraduates' Intention to Use distance learning (IU). Second, the mediating roles of these dimensions were examined by decomposing total effects into direct and indirect paths, with mediation confirmed through bias-corrected bootstrapping with 5000 resamples to ensure robust confidence interval estimation. Finally, PROCESS Model 14 was employed to test whether Perceived Usefulness (PU) functioned as a second-stage moderator, evaluating interaction effects, conditional indirect effects at varying levels of PU. Following the scholars' recommendations [53–56], the regions of significance identified using the Johnson–Neyman technique. Statistical significance was set at $p < 0.05$, effect sizes were interpreted using standardized coefficients following Cohen's guidelines [57], explained variance was assessed through R^2 values, and conditional effects were visualized where interactions were significant.

This integrated strategy combined preliminary validation with a two-stage conditional process approach, thereby providing a rigorous and replicable examination of both the mechanisms and the boundary conditions through which DLE shapes undergraduates' adoption of distance learning.

4. Results

The results of this study are based on a quantitative survey based design conducted to examine the contributing factors of perceived e-learning usefulness among undergraduates of the Lithuanian Military Academy. The conceptual research model integrates the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) with sustainability perspectives in higher professional education in the field of security and defense. The findings demonstrate how distance learning (DL) interacts with teaching methodologies, classroom innovation, and individual learning styles, while simultaneously accounting for security requirements.

4.1. Preliminary Data Analysis Results

The demographic profile of the sample revealed that the majority of participants were male, accounting for 127 individuals (82%), while 28 participants (18%) were female. Age distribution showed that 50 respondents (32%) were younger than 19 years, 64 (41%) were between 20 and 21 years, 40 (26%) were in the 22–24 age group, and a single respondent (1%) was older than 25 years. With respect to educational attainment, nearly all participants (154; 99.4%) reported holding a secondary school diploma, while only one respondent (0.6%) indicated an alternative educational background. A more detailed breakdown of these demographic characteristics is provided in Table A1 of Appendix A.

Also, the descriptive data analysis and relationship assessment using Pearson's correlation was performed on study variables. The results are presented in Table 2.

The obtain results proved strong evidence for the reliability, validity, and discriminant adequacy of the study variables (see Table 2). The descriptive statistics show that the mean values of the constructs ranged between 3.019 and 3.585 on a five-point scale, indicating moderate to moderately high perceptions across all measured factors. The standard deviations, ranging from 0.677 to 0.773, suggest a reasonable spread of responses, reflecting sufficient variability for meaningful statistical testing. Construct reliability (CR) values exceeded the recommended threshold of 0.70 [58], with all constructs ranging between 0.859 and 0.919, which confirms internal consistency and measurement robustness. Similarly, the average variance extracted (AVE) values were all above the critical value of 0.50, ranging

between 0.603 and 0.740, demonstrating reasonable convergent validity and indicating that more than 50% of the variance in observed items was explained by the latent constructs.

Table 2. The preliminary analysis results on study variables.

Factor	Descriptive		Discriminant Validity		Correlations						
	M	±SD	CR	AVE	DLE	IU	PU	TM	IS	CI	SSF
DLE	3.044	0.677	0.859	0.603	**0.777**						
IU	3.029	0.701	0.867	0.621	0.884 **	**0.788**					
PU	3.452	0.773	0.873	0.696	0.547 **	0.612 **	**0.834**				
TM	3.019	0.777	0.907	0.709	0.665 **	0.721 **	0.688 **	**0.842**			
LS	3.047	0.762	0.919	0.740	0.706 **	0.737 **	0.662 **	0.860 **	**0.860**		
CI	3.019	0.728	0.892	0.675	0.763 **	0.790 **	0.433 **	0.657 **	0.680 **	**0.822**	
SSF	3.585	0696	0.908	0.712	0.612 **	0.710 **	0.670 **	0.673 **	0.656 **	0.603 **	**0.844**

Notes: Distance Learning Effectiveness (DLE), Teaching Methodology Integration (TM), Learning Style Alignment (LS), Classroom Innovation (CI), Security and Sustainability Fit (SSF), Intention to Use (IU), Perceived Usefulness (PU). ** Correlation is significant at the 0.01 level (2-tailed); on the diagonal are square roots of AVEs (black).

The discriminant validity was assessed using the Fornell–Larcker criterion, where the square roots of the AVEs (diagonal values) exceeded the corresponding inter-construct correlations, thereby confirming the distinctiveness of the constructs [59]. Correlation analysis revealed strong and significant associations among the variables, with coefficients ranging from 0.433 to 0.884 ($p < 0.01$). Notably, Distance Learning Effectiveness (DLE) was highly correlated with Classroom Innovation (DLE & CI, r = 0.763, $p < 0.01$) and Learning Style Alignment (DLE & LS, r = 0.706, $p < 0.01$), underscoring the centrality of these factors in shaping learners' perceptions of DL. Intention to Use (IU) also demonstrated particularly strong correlations with Classroom Innovation (IU & CI, r = 0.790, $p < 0.01$) and Learning Style Alignment (IU & LS, r = 0.737, $p < 0.01$), highlighting that innovative and learner-centred approaches significantly influence undergraduates' willingness to accept distance learning. Perceived Usefulness (PU) was most strongly associated with Teaching Methodology Integration (PU & TM, r = 0.688, $p < 0.01$) and Security and Sustainability Fit (PU & SSF, r = 0.670, $p < 0.01$), suggesting that undergraduates evaluate DL usefulness not only through pedagogical alignment but also through its compatibility with operational and sustainability demands.

Overall, these results confirm that the measurement model is psychometrically sound and that the study variables are appropriately distinct yet meaningfully interrelated. The strong correlations among DLE, the four design dimensions (TM, LS, CI, SSF), PU, and IU provide empirical support for the hypothesized mediation and moderation relationships tested in subsequent analyses, validating the theoretical integration of TAM, UTAUT, and sustainability perspectives in this study.

4.2. Hypotheses Testing Results

4.2.1. Direct Impacts on Distance Learning Effectiveness

Direct effects (H1 and H2a–d) were tested using the PROCESS v3.5 macro with a simple mediation model (Model 4), as recommended by Hayes [52]. Construct values were derived from the average scores of their respective measurement items, and bootstrapping with 5000 resamples was employed to obtain bias-corrected confidence intervals. The findings demonstrated that Distance Learning Effectiveness (DLE) is a robust and consistent predictor across all examined outcomes (see Table 3).

Table 3. Direct effects of Distance Learning Effectiveness (DLE) assessed by using the PROCESS v3.5 macro-Model 4.

Explanation			Coeff. β	SE	St. Coeff. β	t	*p*	LLCI	ULCI
H1	**Model 1**	constant	0.244	0.122		2.004	0.047	0.003	0.485
	DLE → IU	DLE	0.915	0.039	0.884	23.410	0.000	0.838	0.992
	Model 1 Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***	
		0.884	0.782	0.108	548.021	1.000	153.000	0.000	
			Coeff. β	**SE**	**St. Coeff. β**	**t**	***p***	**LLCI**	**ULCI**
H2a	**Model 2a**	constant	0.69	0.216		3.229	0.002	0.270	1.123
	DLE → TM	DLE	0.763	0.069	0.665	11.026	0.000	0.626	0.900
	Model 2a Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***	
		0.665	0.443	0.338	121.569	1.000	153.000	0.000	
			Coeff. β	**SE**	**St. Coeff. β**	**t**	***p***	**LLCI**	**ULCI**
H2b	**Model 2b**	constant	0.627	0.201		3.121	0.002	0.230	1.024
	DLE → LS	DLE	0.795	0.064	0.706	12.333	0.000	0.667	0.922
	Model 2b Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***	
		0.706	0.499	0.293	152.110	1.000	153.000	0.000	
			Coeff. β	**SE**	**St. Coeff. β**	**t**	***p***	**LLCI**	**ULCI**
H2c	**Model 2c**	constant	0.522	0.175		2.979	0.003	0.176	0.868
	DLE → CI	DLE	0.820	0.056	0.763	14.594	0.000	0.709	0.931
	Model 2c Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***	
		0.763	0.582	0.223	212.999	1.000	153.000	0.000	
			Coeff. β	**SE**	**St. Coeff. β**	**t**	***p***	**LLCI**	**ULCI**
H2d	**Model 2d**	constant	1.672	0.205		8.164	0.003	1.267	2.076
	DLE → SSF	DLE	0.629	0.066	0.612	9.572	0.000	0.499	0.758
	Model 2d Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***	
		0.612	0.375	0.305	91.618	1.000	153.000	0.000	

Notes: Model 1 = outcome variable IU (undergraduates 'intention to use DL); Model 2a = outcome variable TM (teaching methodology integration); Model 2b = outcome variable LS (learning style alignment); Model 2c = outcome variable CI (class-room innovation); Model 2d = outcome variable SSF (security and sustainability fit). R = correlation coefficient and R-sq = correlation coefficient in square. LLCI = lower bound of 95% CI; ULCI = upper bound of 95% CI. Bootstrap sample size = 5000.

H1: Direct Effect of DLE on Intention to Use DL. The analysis revealed a strong, positive, and highly significant direct effect of DLE on undergraduates' intention to use DL (IU), supporting Hypothesis 1. Specifically, DLE had a standardized effect (Model 1: DLE → IU, β = 0.915, $p < 0.001$, 95% CI [0.838, 0.992]). This indicates that improvements in undergraduates' perception of DL effectiveness substantially increase their likelihood of adopting DL platforms. The model accounted for 78.2% of the variance in IU ($R^2 = 0.782$), confirming that undergraduates' evaluations of DL functionality, accessibility, and integration are central determinants of adoption intentions.

H2a: DLE → TM (Teaching Methodology Integration). In support of Hypothesis 2a, DLE was found to have a significant direct effect on teaching methodology integration (Model 2a: DLE →TM, β = 0.763, SE = 0.069, t = 11.026, $p < 0.001$, 95% CI [0.626, 0.900]). The model explained 44.3% of the variance in TM ($R^2 = 0.443$). This suggests that the more effective undergraduates perceive DL, the more they recognize its potential for supporting structured teaching methodologies within higher education curricula. This reinforces the notion that perceived system effectiveness facilitates confidence in adapting instructional designs to DL contexts.

H2b: DLE → LS (Learning Style Alignment). Hypothesis 2b was also supported, with results showing a strong effect of DLE on learning style alignment (Model 2b: DLE → LS, β = 0.795, $p < 0.001$, 95% CI [0.667, 0.922]). The model accounted for 49.9% of the variance in LS ($R^2 = 0.499$). This indicates that undergraduates who perceive DL as effective are more likely to acknowledge that DL can flexibly accommodate diverse learning preferences and strategies. Although LS did not mediate IU in the indirect analysis, its strong association with DLE highlights its role in shaping user satisfaction and perceived pedagogical inclusiveness.

H2c: DLE → CI (Classroom Innovation). The analysis strongly supported Hypothesis 2c, showing that DLE positively influenced classroom innovation (Model 2c: DLE → CI, β = 0.820, $p < 0.001$, 95% CI [0.709, 0.931]). The model explained 58.2% of the variance in CI ($R^2 = 0.582$), the highest variance among the mediators. This indicates that effective DL environments encourage the integration of innovative instructional practices such as simulation-based training, digital collaboration, and interactive technologies. The magnitude of this effect highlights innovation as a key channel through which DL effectiveness drives undergraduates' engagement and eventual adoption.

H2d: DLE → SSF (Security and Sustainability Fit). Finally, Hypothesis 2d was supported. DLE demonstrated a significant effect on security and sustainability fit (Model 2d: DLE →SSF, β = 0.629, $p < 0.001$, 95% CI [0.499, 0.758]). The model explained 37.5% of the variance in SSF ($R^2 = 0.375$). This result underscores that undergraduates associate effective DL systems with greater alignment to institutional requirements for security, resilience, and sustainability, these factors particularly critical in security and defense education.

Collectively, these findings indicate that DLE exerts a powerful and multi-dimensional impact on both adoption intention and intermediate constructs relevant to pedagogical integration, learning personalization, classroom innovation, and systemic sustainability. While mediation analysis showed that only CI and SSF significantly transmitted this effect to IU, the direct pathways confirm that DLE serves as the foundational driver of undergraduates 'perceptions and intentions.

Thus, H1 and H2a–H2d are fully supported, and the results reinforce that strengthening DL effectiveness is central to fostering undergraduates' willingness to use DL, while simultaneously enhancing institutional teaching innovation and ensuring operational alignment.

4.2.2. Testing for Mediation Effect

In Hypotheses H3a–H3d, it was planned that four theoretically grounded dimensions—teaching methodology integration (TM), learning style alignment (LS), classroom innovation (CI), and security and sustainability fit (SSF)—would mediate the relationship between Distance Learning Effectiveness (DLE) and undergraduates' intention to use distance learning (IU). To test these indirect pathways, a mediation analysis was conducted using PROCESS v3.5 macro, Model 4 [52]. The bias-corrected bootstrap method (5000 resamples, 95% CI) was applied to enhance robustness against non-normality of sampling distributions [52](. The overall model explained 84.8% of the variance in IU ($R^2 = 0.848$, $F(5, 149) = 165.676$, $p < 0.001$), confirming strong explanatory power of the conceptual framework (see Table 4).

Table 4. The mediation effects assessed by using the PROCESS v3.5 macro-Model 4.

	Explanation		Coeff. β	SE	St. Coeff. β	t	*p*	LLCI	ULCI
Hypotheses H3a–d	**Model 3**	constant	−0.224	0.124		−1.808	0.073	−0.470	0.021
	DLE → IU	DLE	0.591	0.057	0.571	10.403	0.000	0.479	0.703
	TM → IU	TM	0.125	0.106	0.139	1.186	0.238	−0.084	0.334
	LS → IU	LS	−0.041	0.111	−0.045	−0.374	0.709	−0.260	0.177
	CI → IU	CI	0.173	0.051	0.179	3.402	0.001	0.072	0.273
	SSF → IU	SSF	0.190	0.046	0.188	4.100	0.000	0.098	0.281

Indirect Effect of Distance Learning Effectiveness				
	Effect	**Boot SE**	**Boot LLCI**	**Boot ULCI**
H3a: DLE → TM → IU	0.096	0.122	−0.181	0.291
H3b: DLE → LS → IU	−0.033	0.125	−0.1231	0.253
H3c: DLE → CI → IU	0.142	0.052	0.045	0.246
H3d: DLE → SSF → IU	0.119	0.051	0.019	0.218

Model 3 Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***
	0.921	0.848	0.077	165.676	5.000	149.000	0.000

Notes: Distance Learning Effectiveness (DLE), Teaching Methodology Integration (TM), Learning Style Alignment (LS), Classroom Innovation (CI), Security and Sustainability Fit (SSF), Intention to Use (IU).

The direct effect of DLE on IU remained significant (Model 3, DLE → IU, β = 0.591, $p < 0.001$), underscoring its central role as an exogenous predictor. However, mediation analysis revealed different outlines across the four proposed mediators.

H3a (TM as mediator). The indirect effect of DLE on IU through teaching methodology integration was not significant (Model 3 (H3a): DLE → TM → IU, β = 0.096, Boot CI [−0.181, 0.291]), indicating that TM did not explain improvements in DLE into higher IU. This suggests that while DL systems may support pedagogical integration, undergraduates do not perceive these adjustments as critical drivers of their intention to adopt DL.

H3b (LS as mediator). Similarly, learning style alignment did not appear as a significant mediator (Model 3 (H3b): DLE→ LS→ IU, β = −0.033, Boot CI [−0.123, 0.253]), suggesting that personalization of learning formats alone does not enhance undergraduates' implementation purposes. Given the regimented structure of education in security and defence, flexibility to accommodate individual preferences may be less influential than institutional or operational priorities.

H3c (CI as mediator). By contrast, classroom innovation was a significant mediator (Model 3 (H3c): DLE → CI → IU, β = 0.142, SE = 0.052, 95% CI = [0.045, 0.246]). The positive pathway indicates that effective DL promotes innovative pedagogical practices, which in turn significantly strengthen undergraduates' IU. This underscores the importance of leveraging DL not only for knowledge delivery but also for fostering interactive, simulation-based, and problem-oriented approaches that resonate with undergraduates' operational learning needs.

H3d (SSF as mediator). Security and sustainability fit also showed a significant mediating role (Model 3 (H3d): DLE → SSF → IU, β = 0.119, SE = 0.051, 95% CI = [0.019, 0.218]). This finding highlights that undergraduates are more willing to adopt DL when systems align with defence-sector requirements of confidentiality, resilience, and long-term sustainability. Thus, institutional assurances of operational security and infrastructural reliability act as strong enablers of intention.

Taken together, these results provide partial support for H3. While DLE uses a direct influence on IU, its indirect influence is controlled specifically through classroom innovation and security and sustainability fit, but not through teaching methodology integration or learning style alignment. This pattern suggests that in professional education, adoption intentions are driven less by pedagogical alignment or personalization,

and more by whether DL enables innovative training modalities and guarantees secure, sustainable infrastructures.

Thus, H3c and H3d are empirically supported, while H3a and H3b are not supported. These results contribute to the broader TAM/UTAUT-based sustainability literature by emphasizing that in security-sensitive professional education contexts, the drivers of perceived usefulness and IU extend beyond standard pedagogical or learner-centric considerations to include systemic and operationally aligned innovations.

4.2.3. Moderation Effects of Perceived Usefulness

The moderating role of Perceived Usefulness (PU) in the relationships between the four mediators: teaching methodology integration (TM), learning style alignment (LS), classroom innovation (CI), and security and sustainability fit (SSF), and undergraduates' intention to use distance learning (IU) was examined using the PROCESS v3.5 macro Model 14 (see Table 5).

Table 5. The moderation effects of perceived usefulness construct assessed by PROCESS v3.5 macro-Model 14.

	Explanation		Coeff. β	SE	t	*p*	LLCI	ULCI
Hypotheses H4a–d	**Model 4**	constant	1.166	0.175	6.650	0.000	0.819	1.512
	DLE → IU	DLE	0.610	0.057	10.755	0.000	0.498	0.722
	TM → IU	TM	0.058	0.107	0.539	0.591	−0.154	0.270
	LS → IU	LS	0.021	0.111	0.188	0.851	−0.198	0.239
	CI → IU	CI	0.158	0.051	3.075	0.003	0.056	0.259
	SSF → IU	SSF	0.137	0.050	2.719	0.007	0.037	0.236
	PU → IU	PU	0.077	0.044	1.750	0.082	−0.010	0.163
	H4a: TM × PU → IU	TM × PU	0.403	0.134	3.003	0.003	0.138	0.668
	H4b: LS × PU → IU	LS × PU	−0.305	0.138	−2.208	0.029	−0.578	−0.032
	H4c: CI × PU → IU	CI × PU	0.042	0.045	0.927	0.355	−0.047	0.131
	H4d: SSF × PU → IU	SSF × PU	−0.145	0.052	−2.764	0.006	−0.249	−0.041
	Model 4 Summary	**R**	**R-sq**	**MSE**	**F**	**df1**	**df2**	***p***
		0.929	0.863	0.072	91.069	10.000	144.000	0.000

This analysis tested whether PU strengthened or weakened the influence of these mediators on IU, as hypothesized in H4a–H4d. The inclusion of interaction terms (mediator × PU) allowed an assessment of conditional effects, while Model 4 fit statistics confirmed the robustness of the results (R^2 = 0.863; F = 91.069, $p < 0.001$), indicating that the model explained 86.3% of the variance in undergraduates' intention to use DL (IU).

Before considering interactions, the direct relationships indicated that DLE stayed a significant predictor of IU (DLE → IU, β = 0.610, $p < 0.001$). Among mediators, CI (CI → IU, β = 0.158, $p = 0.003$) and SSF (SSF → IU, β = 0.137, $p = 0.007$) significantly predicted IU, whereas TM (TM → IU, β = 0.058, $p = 0.591$) and LS (LS → IU, β = 0.021, $p = 0.851$) were non-significant. PU alone had a weak, non-significant effect on IU (PU → IU, β = 0.077, $p = 0.082$), suggesting that its role operates conditionally through moderation rather than as a direct driver of adoption.

Hypothesis H4a was focused on moderating effect of PU on TM → IU. The interaction between TM and PU was positive and significant (TM × PU, β = 0.403, $p = 0.003$, 95% CI [0.138, 0.668]), supporting hypothesis H4a. This indicates that PU increases the influence of teaching methodology integration on undergraduates' intention to use DL. In practical terms, when undergraduates perceive DL as highly useful, effective teaching methodology integration becomes a stronger determinant of their adoption intentions. Conversely, when PU is low, the pedagogical benefits of methodology integration alone may not be sufficient to enhance adoption (see Figure 2).

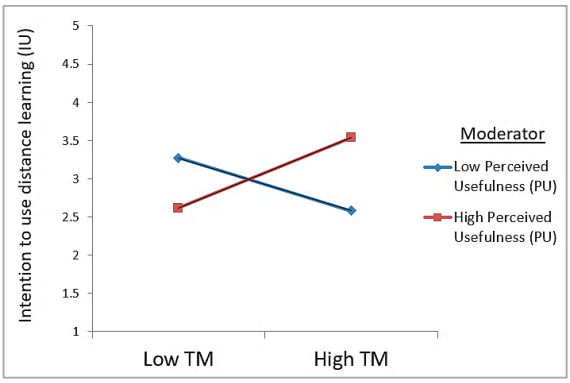


Figure 2. The graphical explanation how Perceived usefulness (PU) strengthens the positive relationship between teaching methodology integration (TM) and intention to use distance learning (IU).

Hypothesis H4b was focused on moderating effect of PU on LS → IU. In contrast, the interaction term between LS and PU was negative and significant (LS × PU β = −0.305, p = 0.029, 95% CI [−0.578, −0.032]), confirming hypothesis H4b but in an unexpected direction. This suggests that higher perceptions of usefulness weaken, rather than strengthen, the effect of learning style alignment on IU. One interpretation is that when undergraduates already consider DL highly useful, personalized learning style compatibility becomes less critical in shaping adoption intentions. Instead, perceived systemic benefits (e.g., efficiency, innovation, and sustainability) may outweigh individual learning preferences in influencing behavioural intentions (see Figure 3).

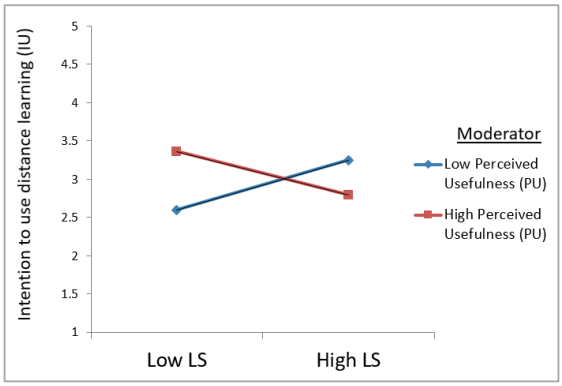


Figure 3. The graphical explanation how Perceived Usefulness (PU) reduces the positive relationship between learning style alignment (LS) and Intention to use distance learning (IU).

Hypothesis H4c was focused on moderating effect of PU on CI → IU. For classroom innovation, the interaction with PU was not significant (CI × PU β = 0.042, p = 0.355), leading to the rejection of hypothesis H4c. This indicates that regardless of undergraduates' perceived usefulness of DL, the positive influence of innovative classroom practices on IU remains stable. In other words, innovations such as simulations, collaborative platforms, and interactive technologies directly foster adoption intentions, without being contingent on PU levels.

Hypothesis H4d was focused on moderating effect of PU on SSF → IU. Finally, the interaction term between SSF and PU was negative and significant (SSF × PU β = −0.145, p = 0.006, 95% CI [−0.249, −0.041]), supporting hypothesis H4d. This suggests that PU reduces the positive effect of security and sustainability fit on IU. A believable explanation is that when undergraduates already regard DL as highly useful, institutional assurances regarding security and sustainability exert a weaker incremental effect on adoption decisions. Conversely, when PU is lower, these systemic assurances play a stronger role in motivating undergraduates to engage with DL systems (see Figure 4).

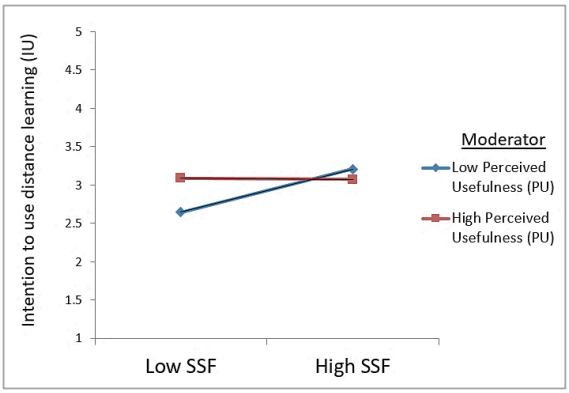


Figure 4. The graphical explanation how Perceived Usefulness (PU) reduces the positive relationship between security and sustainability fit (SSF) and Intention to use distance learning (IU).

Taken together, the results disclose a nuanced moderating role of PU. It strengthens the effect of teaching methodology integration (H4a), but weakens the influence of learning style alignment (H4b) and security and sustainability fit (H4d), while exerting no conditional influence on classroom innovation (H4c). This pattern suggests that perceived usefulness acts as a selective amplifier, magnifying the importance of structured pedagogical approaches but weakening dependence on personalization and institutional assurances when DL is already perceived as beneficial.

Overall, these findings highlight the critical yet complex role of PU in shaping adoption behaviours. PU does not act uniformly across all mediators but rather shifts the weight undergraduates place on different dimensions of DL experience, reflecting a dynamic interplay between individual perceptions and structural/systemic features.

5. Discussion

This study addresses a key gap in existing technology adoption frameworks by demonstrating how distance learning (DL) can be effectively integrated into higher professional education, particularly within defence-oriented programmes that must balance rigorous academic learning with operational training requirements. Specifically, the findings reveal that the effectiveness of distance learning (DLE) operates through four design-relevant mechanisms—integration with teaching methodologies (TM), learning-style alignment (LS), classroom innovation (CI), and security and sustainability fit (SSF)—and one boundary condition, perceived usefulness (PU). Together, these mechanisms shape undergraduates' (cadets') intention to use distance learning (IU).

5.1. Direct Effects of Distance Learning Effectiveness

The results confirm that DLE is the strongest predictor of cadets' intention to use DL, both directly and through indirect pathways. This aligns with extensive research in technology acceptance, which emphasizes that perceived system effectiveness and reliability are central to adoption [56]. Similarly to findings in TAM and UTAUT studies, when learners view DL as efficient and dependable, their behavioural intention to use it increases. In the context of defence education, this underscores that DL must not only function technically well but also support mission-specific competencies and training continuity during deployments—factors that heighten its perceived value among cadets.

5.2. Mediating Effects of Design Mechanisms

Among the four design mechanisms, classroom innovation (CI) and security and sustainability fit (SSF) emerged as the most influential mediators.

Classroom innovation (CI) showed a significant positive effect on intention and mediated the DLE–IU relationship (DLE → CI → IU). This finding supports prior evidence that technology-enabled pedagogical innovation enhances learner engagement and motivation [57,58]. In defence education, where standardized procedures and structured training often dominate, DL-supported innovation such as virtual simulations, scenario-based exercises, and blended teamwork can enhance adaptability and decision-making under operational constraints.

Security and sustainability fit (SSF) also exhibited a strong direct and indirect influence on intention (DLE → SSF → IU). This highlights that secure, resilient, and resource-efficient DL platforms are indispensable in military education, where confidentiality, reliability, and continuity are mission-critical. Consistent with prior findings that trust and perceived security influence technology acceptance [60], our results extend this logic to defence education, where sustainability also includes operational readiness and system resilience during crises or cyber incidents.

5.3. Moderating Role of Perceived Usefulness

Building on the TAM and UTAUT frameworks, the moderated mediation analysis (PROCESS Model 14) demonstrated that PU acts as a boundary condition that strengthens or weakens the effects of DLE components on IU.

Positive moderation (TM × PU → IU) was confirmed. Results indicated that when cadets perceive DL as highly useful, its alignment with traditional teaching methodologies, such as structured lesson plans, graded assessments, and instructor feedback, further increases their intention to use DL. This aligns with studies showing that perceived value amplifies the influence of pedagogical design on technology adoption [59,61].

Negative moderation (LS × PU → IU) was confirmed. Results point out that when PU is already high, the additional effect of tailoring DL to specific learning styles diminishes. This finding resonates with research questioning the efficacy of strict learning-style matching [62] and suggests that for cadets, usefulness and efficiency outweigh personalized content.

Negative moderation (SSF × PU → IU) was confirmed. Results indicated that at high levels of PU, the added impact of security and sustainability on intention weakens. This suggests a substitution effect—once DL is seen as valuable, robust security and sustainability become assumed baseline conditions rather than active motivators. This nuance refines previous findings [63], indicating that in military contexts, secure infrastructure operates as a hygiene factor—essential but not sufficient to drive behavioural intention on its own.

Null moderation (CI × PU → IU) was confirmed. Results showed that PU did not moderate the CI–IU relationship, indicating that innovation's effect on adoption remains consistent. This stability supports research showing that well-designed digital innovation benefits learners regardless of prior attitudes [64].

5.4. Theoretical and Practical Implications

Theoretically, these findings extend TAM and UTAUT by reframing PU not only as a direct determinant of intention but as a contextual moderator that conditions the effects of pedagogical and infrastructural features. This advances the understanding of technology acceptance in specialized, high-stakes educational settings such as defence and security.

Practically, the study offers several implications for instructional design and DL strategy in defence education:

- Enhance classroom innovation (CI) by integrating virtual simulations, interactive case studies, and adaptive learning tools that replicate operational scenarios while maintaining academic rigour.

- Strengthen security and sustainability fit (SSF) by implementing secure communication platforms, data protection protocols, and system resilience planning to ensure continuity during missions or crises.
- Align DL with teaching methodologies (TM) by designing courses that complement existing training structures and command hierarchies, maintaining discipline and standardized procedures.
- Focus on perceived usefulness (PU) by highlighting the tangible benefits of DL, such as flexibility during deployments and access to specialized resources, to strengthen acceptance and motivation.

5.5. Limitations and Future Research

While the study provides valuable insights, it has several limitations. The analysis is based on data from undergraduate (cadet) students at the Lithuanian Military Academy, which may limit generalizability to other security and defence institutions with different organizational structures or technological capabilities. Additionally, the study provides a cross-sectional snapshot rather than longitudinal evidence on the sustained impact of DL adoption and sustainability strategies. Future research should extend this analysis through cross-institutional and longitudinal designs to validate the model and explore long-term outcomes on learning effectiveness and operational performance.

6. Conclusions

This study examined the determinants of undergraduates' intention to use distance learning in higher professional education, focusing on the unique challenges of balancing academic and operational requirements. The findings extend traditional Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) models by showing that perceived usefulness (PU) functions as a moderator rather than solely as a predictor of technology acceptance.

The results highlight the role of distance learning effectiveness (DLE) as the strongest predictor of intention, complemented by classroom innovation (CI), security and sustainability fit (SSF), and the conditional influence of PU. Theoretically, this contributes to technology acceptance research by positioning perceived usefulness (PU) as a boundary condition that shapes how design features influence adoption.

In practice, the findings highlight the importance of developing sustainable digital teaching strategies for higher professional education in security and defence. Innovative teaching techniques, such as the creative use of multimedia and simulations, interactivity, problem-solving, and critical thinking, emerge as key drivers of engagement and learning. In addition, secure and resilient infrastructures must be integrated into institutional strategies because they are considered a basic requirement in security and defence study contexts.

The moderation results highlight that adapting distance learning to undergraduates' learning-style preferences adds little once they already see it as useful. Instead, more reliable strategies—such as clear course structure, retrieval practice, and adaptive speed—should guide instructional design. The findings also suggest that adoption should be gradual: in the early phase, institutions should emphasize visible effectiveness and create safe opportunities for innovation to build confidence. As perceptions of usefulness grow, integration with established teaching methodologies becomes more powerful.

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R.S.; project administration, A.V.V.; funding acquisition, A.V.V. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the General Jonas Zemaitis Military Academy (NoV-814, 14 December 2020).

Informed Consent Statement: This research did not involve the use of specific human materials. It was based on a questionnaire in which respondents simply expressed their opinions. Additionally, we strictly adhered to ethical requirements to ensure the anonymity of all respondents.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
LMA	Lithuanian Military Academy
CR	Construct Reliability
AVE	Average Variance Extracted
DLE	Distance Learning Effectiveness
TM	Teaching Methodology Integration
LS	Learning Style Alignment
CI	Classroom Innovation
SSF	Security and Sustainability Fit
IU	Intention to Use
PU	Perceived Usefulness

Appendix A

Table A1. The demographic and context characteristics of study participants.

Demographic and Context Characteristics	M (±SD) or N (%)
Gender	
1: Male (%)	127 (82%)
2: Female (%)	28 (18%)
Age (M ± SD)	19.6 (±1.54)
Year of study:	
1: 2nd study year	50 (32%)
2: 3rd study year	64 (41%)
3: 4th study year	41 (27%)
Frequency of e-learning use during term:	
1: Daily	37(24%)
2: Several times/week	95 (61%)
3: Weekly	23 (15%)
4: Monthly	0 (0%)
5: Rarely/Never	0 (0%)
Primary device used for e-learning:	
1: Laptop	79 (51%)
2: Desktop	67 (43%)
3: Smartphone	6 (4%)
4: Other	3 (2%)

Notes: N = 155 participants.

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