PEDAGOGICAL INNOVATION IN MILITARY HIGHER EDUCATION: THE PERSPECTIVE OF CADETS AT THE MILITARY ACADEMY

Paulo Gomes, Academia Militar, gomes.pja@exercito.pt
Renato Pessoa dos Santos, Academia Militar, santos.recp@exercito.pt
Sandra Almeida, Academia Militar, almeida.sleo@academiamilitar.pt

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ABSTRACT

This study examines the contribution of pedagogical innovation to the development of command and leadership competencies in military higher education, emphasising the role of active learning methodologies, student-centred approaches, and the pedagogical integration of digital technologies in officer training. Using an exploratory-confirmatory quantitative design and Structural Equation Modeling, data were collected from 398 cadets of the Portuguese Military Academy through the Innovative Pedagogical Practices Perception Scale. The findings revealed a robust three-factor structure comprising Active and Experiential Learning, Perceived Pedagogical Innovation, and Pedagogical Integration of Technology. The structural model showed that Active and Experiential Learning has a positive and significant effect on the development of command and leadership competencies and on perceptions of teaching effectiveness. In contrast, Perceived Pedagogical Innovation and Pedagogical Integration of Technology did not demonstrate significant direct effects. The results suggest that leadership competency development in military higher education is primarily enhanced through contextualised, practice-oriented learning experiences based on problem-solving and realistic operational scenarios.

Keywords: Pedagogical innovation; military leadership; experiential learning; military higher education.

RESUMO

O presente estudo analisa o contributo da inovação pedagógica para o desenvolvimento de competências de comando e liderança no ensino superior militar, destacando o papel das metodologias de aprendizagem ativa, das abordagens centradas no estudante e da integração pedagógica das tecnologias digitais na formação de oficiais. Recorrendo a um desenho quantitativo exploratório-confirmatório e à Modelação de Equações Estruturais, foram recolhidos dados junto de 398 cadetes da Academia Militar Portuguesa através da Escala de Perceção das Práticas Pedagógicas Inovadoras. Os resultados evidenciaram uma estrutura trifatorial robusta, composta pelas dimensões Aprendizagem Ativa e Experiencial, Inovação Pedagógica Percebida e Integração Pedagógica da Tecnologia. O modelo estrutural demonstrou que a Aprendizagem Ativa e Experiencial exerce um efeito positivo e significativo no desenvolvimento de competências de comando e liderança, bem como na perceção de eficácia docente. Em contrapartida, a Inovação Pedagógica Percebida e a Integração Pedagógica da Tecnologia não evidenciaram efeitos diretos significativos. Os resultados sugerem que o desenvolvimento de competências de liderança no ensino superior militar é promovido sobretudo através de experiências de aprendizagem contextualizadas e orientadas para a prática, assentes na resolução de problemas e na utilização de cenários operacionais realistas.

Palavras-chave: Inovação pedagógica; liderança militar; aprendizagem experiencial; ensino superior militar.

1. INTRODUCTION

Contemporary strategic, technological, and operational transformations have imposed new challenges on military education institutions, requiring more flexible training models oriented towards the development of complex competencies. The unpredictability of modern environments, combined with technological advancement, digitalisation, Artificial Intelligence (AI), and multidomain operations, demands officers capable of critical thinking, decision-making under pressure, leading multidisciplinary teams, and adapting rapidly to uncertainty (Vandergriff, 2006; Santos et al., 2019).

Within this context, pedagogical innovation assumes a strategic role by promoting more participatory, reflective, and experiential approaches, in contrast to traditional teaching models centred on content transmission. Military education requires not only technical and doctrinal expertise but also cognitive, behavioural, and interpersonal competencies that enable effective responses to current operational demands (Johansen, 2021).

Pedagogical modernisation in military education is associated with the adoption of student-centred methodologies, active learning approaches, and the integration of emerging technologies. In this context, students assume an active role in the construction of knowledge, developing autonomy, critical thinking, self-regulated learning, and adaptive leadership skills (Biggs & Tang, 2011; Zimmerman, 2002). Simultaneously, the use of digital environments, operational simulation, AI, and immersive learning contexts brings educational processes closer to contemporary operational realities (Garrison & Kanuka, 2004; Holmes et al., 2019; Radianti et al., 2020).

Accordingly, this study analyses the role of pedagogical innovation in the development of command and leadership competencies, addressing the relevance of student-centred learning, the need for pedagogical innovation within the military context, and the contribution of emerging technologies to the modernisation of officer education and the development of competencies aligned with contemporary operational challenges.

2. STUDENT-CENTRED LEARNING

Traditionally, the dominant educational model was based on a transmissive approach in which the instructor acted as the primary holder of knowledge and the student assumed an essentially passive role. This paradigm primarily emphasised memorisation, content reproduction, and summative assessment.

In contrast, constructivist approaches argue that learning results from an active process of knowledge construction in which the student participates in a reflective and autonomous manner (Vygotsky, 1978; Piaget, 1972). Consequently, student-centred learning has gained prominence in higher education, including military education, by emphasising active participation, autonomy, critical thinking, reflection, and collaborative learning, as opposed to the traditional teacher-centred model characterised by the unidirectional transmission of knowledge.

According to Biggs and Tang (2011), learning becomes more meaningful when students actively participate in knowledge construction, while instructors assume the role of facilitators and pedagogical mediators through constructive alignment. In this regard, Parenteau (2021) argues that the development of critical thinking and intellectual autonomy is essential in military education and should coexist with discipline while being fostered from the earliest stages of military training.

Zimmerman (2002) highlights that the most effective learners are those capable of monitoring, regulating, and adjusting their own cognitive and motivational processes. Self-regulated learning therefore plays a central role in the education of future military leaders, contributing to the development of individual responsibility, critical reflection, and the capacity for lifelong learning throughout their careers. The active participation of cadets in debates, problem-solving activities, practical exercises, and scenario analysis promotes essential competencies for command and leadership. Khachadoorian et al. (2020) emphasise that metacognition and critical reflection are fundamental components of military education, contributing to improved decision-making capabilities and strategic performance among officers. Furthermore, student-centred learning fosters more collaborative and interactive learning environments. The European Students' Union (Todorovski et al., 2015) argues that this paradigm promotes not only knowledge acquisition but also the development of transferable competencies such as communication, cooperation, and complex problem-solving.

In the Portuguese context, the Military University Institute (MUI) has been developing pedagogical modernisation strategies aligned with the principles of student-centred learning, seeking to strengthen active methodologies, collaborative environments, and technological integration in military higher education (Instituto Universitário Militar, 2025). Nevertheless, the adoption of innovative pedagogical methodologies may encounter institutional resistance due to the persistence of traditional teaching models and knowledge reproduction practices (Hargreaves & Fullan, 2012). Many cadets continue to favour memorisation strategies oriented towards summative assessment, while some instructors maintain content-centred teaching practices, thereby hindering the consolidation of more participatory methodologies (Instituto Universitário Militar, 2026).

3. THE NEED FOR PEDAGOGICAL INNOVATION

The increasing complexity of contemporary strategic and operational environments has highlighted the need to transform the pedagogical models employed by military education institutions (Parenteau, 2021). Within this context, pedagogical innovation plays a decisive role in preparing leaders capable of operating in uncertain, ambiguous, and technologically complex environments.

Historically, military education has been based on hierarchical models centred on knowledge transmission and the repetition of procedures. In this framework, active learning methodologies, such as Problem-Based Learning (PBL), are particularly relevant as they promote autonomous learning, critical thinking, and decision-making through the resolution of real and complex problems (Barrows, 1986; Hmelo-Silver, 2004; Makin, 2016). In military education, these approaches bring pedagogical contexts closer to operational realities, fostering the development of command and leadership competencies (Makin, 2016; Vandergriff, 2006). At the same time, changes in student profiles and the emergence of a digital society require more participatory and technology-enhanced educational models capable of increasing engagement and improving learning outcomes (Biggs & Tang, 2011; Freeman et al., 2014; Garrison & Kanuka, 2004; Radianti et al., 2020).

In Portugal, the MUI has undertaken efforts to modernise its pedagogical practices in line with these international trends. Among these initiatives is the Pedagogical Innovation Laboratory-MUI (PIL-MUI), a structure dedicated to pedagogical experimentation, immersive learning environments, multimedia production, and technological integration in military higher education (Instituto Universitário Militar, 2025).

4. THE ROLE OF TECHNOLOGY

Digital transformation has profoundly reshaped teaching and learning models in higher education and has become particularly relevant within the military context (Garrison & Kanuka, 2004; Santos et al., 2019). The concept of blended learning represents one of the most significant expressions of this transformation.

According to Garrison and Kanuka (2004), this approach combines face-to-face instruction and digital learning within an integrated framework, promoting greater flexibility, active participation, and collaborative learning. In military education, the use of digital technologies makes it possible to align training processes more closely with operational realities. Salas et al. (2009) argue that simulation environments facilitate the development of leadership, communication, coordination, and stress-management competencies by allowing students to experience different scenarios within a safe and controlled environment.

Artificial Intelligence (AI) constitutes a central dimension of technological transformation in education, enabling the development of adaptive learning systems that provide personalised content, performance monitoring, and real-time feedback (Holmes et al., 2019). According to Park (2024), the integration of AI into blended learning models enhances student engagement and improves learning outcomes.

Nevertheless, technological integration in military education requires investment in both faculty development and existing infrastructure. Technology should therefore be regarded as complementary to, rather than a substitute for, pedagogical interaction and critical reflection (Garrison & Kanuka, 2004; Holmes et al., 2019; Santos et al., 2019; Johansen, 2021). In this context, pedagogical innovation laboratories and simulation centres are becoming increasingly important in preparing officers for complex, digital, and multidomain operational environments (Vandergriff, 2006; Santos et al., 2019).

5. INNOVATIVE PEDAGOGICAL PRACTICES

Teaching models centred on standardised examinations tend to privilege memorisation at the expense of critical thinking and the autonomous construction of knowledge (Bao, 2025). In contrast, active learning methodologies promote greater cognitive engagement, information retention, and the development of analytical and reflective competencies (Prince, 2004).

Recent studies further demonstrate that student-centred approaches enhance critical thinking (Gogoberidze et al., 2024) and support knowledge retention through active participation, collaborative learning, and problem-solving activities (Chen et al., 2025).

5.1. TECHNOLOGY AND INNOVATIVE LEARNING ENVIRONMENTS

The integration of technology demonstrates that active learning models supported by digital technologies enhance knowledge retention and learning outcomes (Bingol & Ozyaprak, 2025). However, pedagogical innovation involves student-centred methodologies that promote active participation and the meaningful integration of technology (Biggs & Tang, 2011; Garrison & Kanuka, 2004; Dias-Trindade et al., 2021). In this context, Zimmerman (2002) highlights the role of educational technologies in fostering deeper learning, which is particularly relevant in military education.

5.2. ACTIVE LEARNING METHODOLOGIES

The integration of digital technologies supports the development of more dynamic and collaborative learning environments, requiring continuous pedagogical updating by educators (Rocha et al., 2024). In specialised contexts such as military training, simulations, case studies, and experiential learning have proven particularly effective in bridging theory and practice (Salas et al., 2009).

Table 1 summarises the main active learning methodologies identified in the literature, highlighting their pedagogical characteristics, contributions to critical thinking and decision-making, as well as the principal authors associated with each approach.

Methodology	Objectives	Characteristics	Authors
Problem-Based Learning	Solving real-world and complex problems; developing critical thinking and decision-making skills.	Self-directed and collaborative learning; multidisciplinary integration; adaptive leadership development.	Barrows (1996); Hmelo-Silver (2004); Bishop and Verleger (2013); Salas et al. (2009); Vandergriff (2006)
Case-Based Learning	Practical application of knowledge; scenario analysis; knowledge retention.	Use of real or simulated cases; decision-making under pressure; teamwork.	Esbaei et al. (2024); Chen et al. (2025); Choudhury et al. (2025); Salas and Cannon-Bowers (2001)
Flipped Classroom	Greater learner autonomy; optimisation of face-to-face instructional time; practice-oriented learning.	Learning materials studied before class; emphasis on discussion and problem-solving during class sessions.	Crimmins and Midkiff (2017)
Gamification	Increased motivation and engagement; immediate feedback.	Use of game elements; challenges; cooperation and competition; interactive learning.	Deterding et al. (2011); Kapp (2012)

Table 1. Active learning methodologies in education.
Source. Authors' own elaboration based on the referenced literature.

6. METHODOLOGY

This study adopts a quantitative exploratory-confirmatory research design, using Structural Equation Modeling (SEM) to analyse complex relationships among latent variables and to simultaneously assess both measurement and structural models (Hair et al., 2017).

Given the absence of a previously validated instrument for the specific context of Portuguese military higher education, a reflective measurement model was selected, as it is particularly suitable for the initial stages of instrument development and validation (Marôco, 2014). In this regard, a two-stage sequential analytical strategy was followed, as proposed by Anderson and Gerbing (1988), integrating an initial exploratory phase followed by a subsequent confirmatory phase.

6.1. SAMPLE

The sample comprised 398 cadets from the Portuguese Military Academy, aged between 18 and 35 years (M = 21.96; SD = 2.48). Regarding biological sex, 344 participants (86.4%) were male and 54 (13.6%) were female. Concerning the branch of training, 249 cadets (62.6%) were enrolled in programmes leading to service in the Portuguese Army, whereas 149 (37.4%) were enrolled in programmes preparing officers for the National Republican Guard (GNR).

Table 2 presents the distribution of participants according to academic year and study cycle.

	Academic Year					
Study Cycle	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
Military Sciences – Arms	19	57	51	54	5	0
Military Sciences – Administration (Army & GNR)	16	15	18	18	3	0
Military Sciences – Security	13	23	28	24	0	0
Engineering Programmes (Army and GNR)	4	14	10	4	11	11
Total	**52**	**109**	**107**	**100**	**19**	**11**

Table 2. Number of participants by study cycle and academic year.

6.2. INSTRUMENTS

Sociodemographic Questionnaire: A sociodemographic questionnaire was developed to collect personal and academic information relevant to the characterisation of the sample. The instrument included questions concerning participants' age, biological sex, branch of training, and academic year/study cycle.

Perceived Innovative Pedagogical Practices Scale (PIPPS): The PIPPS is a self-report questionnaire developed by the authors to assess cadets' perceptions of innovative pedagogical practices within the context of military higher education. The instrument encompassed several dimensions related to teaching effectiveness, active pedagogical practices, cadet-centred learning methodologies, simulations and operational scenarios, pedagogical use of technology, formative assessment and feedback, the development of command and leadership competencies, and perceived pedagogical innovation. The items were organised using five-point Likert-type scales ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), enabling the assessment of participants' level of agreement with the statements presented. The instrument also included open-ended questions designed to gather participants' suggestions and perceptions regarding teaching strategies, practical activities, and the use of technology in the learning process.

6.3. PROCEDURES

Following authorisation from the Cadet Corps chain of command, the questionnaire was administered online to cadets. Participation was voluntary and anonymous. Prior to completing the questionnaire, participants were provided with an informed consent form outlining the objectives of the study, the confidentiality and anonymity of responses, and their right to withdraw from the study at any time without any negative consequences. Only after reading and accepting the informed consent form did participants proceed to complete the questionnaire. Data processing and analysis were conducted using Jamovi (Version 2.7.30). Both exploratory and confirmatory factor analyses were performed. To ensure independence between the exploratory and confirmatory phases of the analysis, the total sample (N = 398) was randomly divided into two equivalent subsamples (n = 199) following the split-sample approach recommended by Hair et al. (2019). The first subsample was used for the Exploratory Factor Analysis (EFA), whereas the second was reserved for estimating the SEM. This approach separates the exploratory and confirmatory phases, reducing the risk of post hoc model adjustments and increasing the methodological robustness of the proposed model (Hair et al., 2019).

The internal consistency of the instrument dimensions was assessed using Cronbach's alpha coefficient, with values equal to or greater than .70 considered indicative of adequate reliability (Hair et al., 2005). Furthermore, descriptive and inferential analyses were conducted according to participants' sex and branch of training. Additionally, the responses to the open-ended questions were analysed to identify participants' suggestions and perceptions regarding teaching strategies, practical activities, and the use of technology in the learning process.

7. RESULTS

7.1. EXPLORATORY FACTOR ANALYSIS (EFA)

Prior to conducting the EFA, the adequacy of the correlation matrix was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. The results indicated excellent sampling adequacy (KMO = .924) and a statistically significant Bartlett's test, $\chi^2(351) = 3906.334$, $p < .001$, confirming the existence of sufficient correlations among the items to justify the application of EFA. The EFA was conducted using the Principal Axis Factoring (PAF) extraction method with Direct Oblimin oblique rotation, given the theoretical assumption that the underlying factors would be correlated. Extracted communalities were satisfactory, ranging from .452 to .766, indicating that the retained factors adequately explained the variance of the analysed items.

The three-factor solution accounted for 58.29% of the total variance. The first factor explained 41.32%, the second factor 13.97%, and the third factor 3.01% of the variance. Factor 1 comprised items related to Active and Experiential Learning. Factor 2 included items associated with Perceived Pedagogical Innovation, displaying very high factor loadings and demonstrating strong conceptual consistency within this dimension. Factor 3 consisted primarily of items related to the Pedagogical Integration of Technology, presenting moderate to high negative factor loadings. This pattern is expected in oblique rotations and does not affect the substantive interpretation of the factor structure (Table 3).

The factor correlation matrix revealed moderate associations among the factors, particularly between the first and third factors ($r = -.593$), supporting the appropriateness of using an oblique rotation method. Overall, the results indicate a consistent and theoretically coherent factor structure, providing empirical support for the dimensions underlying innovative pedagogical practices within the context of military higher education.

Item	F1	F2	F3
21. Assessment values the innovative learning process and not only the final outcome.	**.914**		
20. I receive regular feedback that helps me improve my performance.	**.827**		
14. The scenarios used help me apply knowledge to real-life situations.	**.766**		
13. Classes incorporate simulations that closely resemble military/professional reality.	**.753**		
12. There are opportunities to learn through experimentation and error.	**.713**		
16. Technology is used to support learning rather than merely to present content.	**.691**		
9. Classes frequently employ active learning methodologies.	**.617**		
22. The feedback received contributes to the development of competencies and improvement of future performance.	**.583**		
8. Instructors adapt classes based on cadets' feedback.	**.661**		
15. Practical exercises and/or simulations contribute to decision-making and future performance.	**.641**		
11. Instructors prioritise problem-solving rather than prolonged lecturing.	**.575**		
10. I am encouraged to take an active role in constructing my own knowledge.	**.529**		
1. Instructors promote active participation during classes.	**.503**		
4. Group problem-solving is encouraged.	**.451**		
2. Case studies related to military/professional contexts are used.	**.427**		
7. Technology is used to support learning.	**,423**		
25. I would prefer methods centred on solving real-world problems.		**.909**	
27. Teaching should include a stronger practical component.		**.820**	
24. Learning should integrate more operational/professional scenarios.		**.815**	
23. I would like to have more activities based on realistic simulations.		**.758**	
26. The use of technology could be further explored.		**.738**	
5. Applied projects or practical assignments are used.			**-.641**
17. Digital tools help me better understand complex situations.			**-.585**
3. Simulations or practical exercises are conducted.			**-.578**
6. Instructors encourage critical reflection.			**-.548**
19. I feel more engaged when educational technologies are used.			**-.546**
18. Technology facilitates the simulation and understanding of operational/professional scenarios.			**-.525**

Table 3. Rotated Pattern Matrix of the EFA of Innovative Pedagogical Practices in Military Higher Education (n = 199).

The dimensional structure of the remaining scales was further examined through two additional EFA, both employing the PAF extraction method. For the Perceived Teaching Effectiveness scale, the results indicated excellent adequacy of the correlation matrix, with a KMO index of .873 and a statistically significant Bartlett's test of sphericity, $\chi^2(15) = 683.061$, $p < .001$. Extracted communalities ranged from .518 to .690, indicating satisfactory representation of the items by the latent factor. The analysis supported a unidimensional structure, which explained 60.62% of the total variance. Factor loadings ranged from .720 to .831, demonstrating strong item saturation on the identified factor.

For the Command and Leadership Competency Development scale, the results likewise demonstrated adequate psychometric quality of the correlation matrix, with a KMO value of .877 and a statistically significant Bartlett's test, $\chi^2(15) = 630.319$, $p < .001$. Extracted communalities ranged from .499 to .675, indicating adequate representation of the items by the extracted factor. The resulting one-factor solution explained 58.19% of the total variance. Factor loadings varied between .706 and .821, providing evidence of the structural consistency of the scale.

Regarding the internal consistency of the dimensions identified through the EFAs, all scales demonstrated high levels of reliability. The Active and Experiential Learning factor presented a Cronbach's alpha of .945, Perceived Pedagogical Innovation yielded an alpha of .910, and Pedagogical Integration of Technology showed an alpha of .862. The Perceived Teaching Effectiveness scale also demonstrated high internal consistency (α = .901), as did the Command and Leadership Competency Development scale (α = .892).

7.3. DESCRIPTIVE AND INFERENTIAL ANALYSES

The descriptive analysis revealed only minor differences between participants according to sex, with broadly similar mean scores across the dimensions under study. Male participants reported slightly higher scores in Perceived Teaching Effectiveness and Active and Experiential Learning, whereas female participants obtained higher mean scores in Perceived Pedagogical Innovation, Pedagogical Integration of Technology, and Command and Leadership Competency Development (Table 4).

Variable	**Male** ***M*** **(*SD*)**	**Female** ***M*** **(*SD*)**
Perceived Teaching Effectiveness	19.86 (4.03)	19.33 (4.29)
Command and Leadership Competency Development	19.68 (4.35)	20.17 (5.11)
F1 – Active and Experiential Learning	54.12 (9.57)	53.96 (9.48)
F2 – Perceived Pedagogical Innovation	19.56 (3.28)	20.28 (2.86)
F3 – Pedagogical Integration of Technology	21.71 (3.31)	22.28 (2.73)

Table 4. Descriptive statistics (means and standard deviations) of the study variables by sex.
Note. M = Mean; SD = Standard Deviation.

An independent-samples *t*-test was conducted to examine sex differences across the study variables. The results indicated that there were no statistically significant differences between male and female participants regarding Perceived

Teaching Effectiveness, $t(396) = 0.885$, $p = .377$; Command and Leadership Competency Development, $t(396) = -0.745$, $p = .457$; Active and Experiential Learning, $t(396) = 0.112$, $p = .911$; Perceived Pedagogical Innovation, $t(396) = -1.530$, $p = .127$; and Pedagogical Integration of Technology, $t(396) = -1.206$, $p = .229$.

Female participants reported slightly higher mean scores in Command and Leadership Competency Development, Perceived Pedagogical Innovation, and Pedagogical Integration of Technology, whereas male participants obtained marginally higher scores in Perceived Teaching Effectiveness and Active and Experiential Learning. However, none of these differences reached statistical significance, suggesting broadly similar perceptions among male and female participants.

With regard to branch affiliation, participants enrolled in programmes leading to service in the National Republican Guard (GNR) reported higher mean scores across all variables when compared with participants enrolled in programmes leading to service in the Portuguese Army. The most pronounced differences were observed for Active and Experiential Learning and Perceived Teaching Effectiveness (Table 5).

Variable	Male *M* (*SD*)	Female *M* (*SD*)
Perceived Teaching Effectiveness	19.43 (4.21)	20.39 (3.76)
Command and Leadership Competency Development	19.54 (4.52)	20.09 (4.35)
F1 – Active and Experiential Learning	53.18 (10.15)	55.62 (8.25)
F2 – Perceived Pedagogical Innovation	19.41 (3.41)	20.07 (2.88)
F3 – Pedagogical Integration of Technology	21.52 (3.53)	22.22 (2.64)

Table 5. Descriptive statistics (means and standard deviations) of the study variables by branch affiliation.
Note. M = Mean; SD = Standard Deviation.

An independent-samples *t*-test was also conducted to examine differences according to participants' branch of training. The results revealed statistically significant differences in Perceived Teaching Effectiveness, $t(396) = -2.289$, $p = .023$; Active and Experiential Learning (F1), $t(396) = -2.484$, $p = .013$; Perceived Pedagogical Innovation (F2), $t(396) = -1.984$, $p = .048$; and Pedagogical Integration of Technology (F3), $t(396) = -2.094$, $p = .037$. Across all these dimensions, participants enrolled in programmes leading to service in the GNR reported higher mean scores than those enrolled in programmes leading to service in the Portuguese Army.

For Perceived Teaching Effectiveness, GNR participants reported a mean score of 20.39 (*SD* = 3.76), compared with 19.43 (*SD* = 4.21) among Army participants. Similarly, for Active and Experiential Learning, GNR participants obtained higher scores (*M* = 55.62, *SD* = 8.25) than Army participants (*M* = 53.18, *SD* = 10.15). Comparable results were observed for Perceived Pedagogical

Innovation (GNR: M = 20.07, SD = 2.88; Army: M = 19.41, SD = 3.41) and Pedagogical Integration of Technology (GNR: M = 22.22, SD = 2.64; Army: M = 21.52, SD = 3.53).

In contrast, no statistically significant differences were found for Command and Leadership Competency Development, $t(396) = -1.180$, $p = .239$, although GNR participants reported a slightly higher mean score (M = 20.09, SD = 4.35) than Army participants (M = 19.54, SD = 4.52).

Overall, the findings suggest that GNR participants tend to hold more favourable perceptions of innovative pedagogical practices, particularly with regard to active learning, pedagogical innovation, and the integration of technology in teaching and learning.

7.4. STRUCTURAL EQUATION MODELING

In a second stage, a SEM was estimated using the Partial Least Squares (PLS-SEM) approach in order to test the relationships among the identified latent variables. Model assessment included indicators of internal consistency reliability and convergent validity, namely Cronbach's alpha, rho_A, composite reliability, and average variance extracted (AVE), following the criteria recommended by Hair et al. (2017, 2019).

Based on the literature review, an exploratory conceptual model integrating both latent and observed variables was developed to analyse the impact of innovative pedagogical methodologies on the development of command competencies. Drawing upon the dimensions identified through the EFA, the SEM specified in this study is presented in Figure 1.

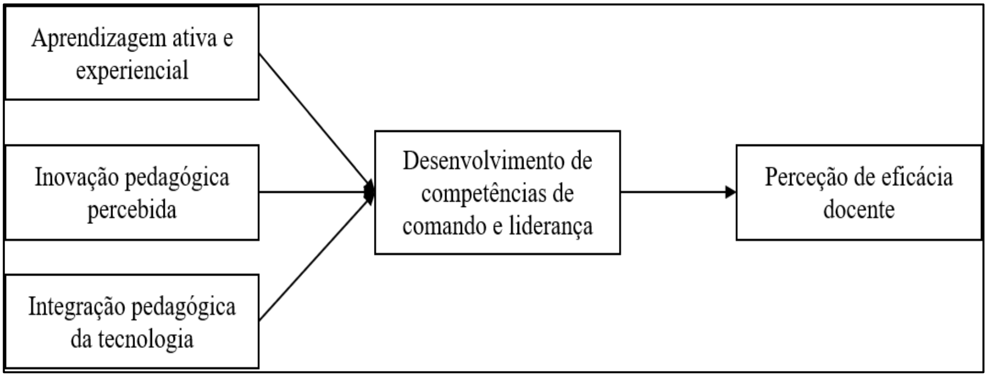

Figure 1. Structural Equation Model.

Based on the proposed model, the following hypotheses were formulated:

H1: Active and Experiential Learning has a positive and significant impact on the Development of Command and Leadership Competencies among cadets of the Portuguese Military Academy.

H2: Perceived Pedagogical Innovation has a positive and significant impact on the Development of Command and Leadership Competencies among cadets of the Portuguese Military Academy.

H3: Pedagogical Integration of Technology has a positive and significant impact on the Development of Command and Leadership Competencies among cadets of the Portuguese Military Academy.

H4: Development of Command and Leadership Competencies has a positive and significant impact on Perceived Teaching Effectiveness among cadets of the Portuguese Military Academy.

Regarding hypothesis testing, the results partially support the proposed theoretical model. Active and Experiential Learning exerted a positive and statistically significant effect on Development of Command and Leadership Competencies ($\beta = 0.737$, $z = 6.972$, $p < .001$), thereby supporting H1. In turn, Development of Command and Leadership Competencies had a positive and significant effect on Perceived Teaching Effectiveness ($\beta = 0.716$, $z = 9.781$, $p < .001$), thus supporting H4.

Contrary to expectations, neither Perceived Pedagogical Innovation ($\beta = 0.066$, $p = .354$) nor Pedagogical Integration of Technology ($\beta = 0.064$, $p = .567$) demonstrated significant effects on Development of Command and Leadership Competencies (DCLC). Consequently, H2 and H3 were not supported. This finding may be partially explained by the multicollinearity detected between Active and Experiential Learning and Pedagogical Integration of Technology ($r = .738$), which may have suppressed the independent effect of Pedagogical Integration of Technology.

The assessment of reliability and convergent validity for the SEM revealed satisfactory to excellent indicators across all constructs. Cronbach's alpha values ranged from .865 (Pedagogical Integration of Technology) to .945 (Active and Experiential Learning), while McDonald's omega (ω_1) yielded identical values, confirming the internal consistency of all dimensions above the recommended threshold of .70 (Hair et al., 2019). Convergent validity was likewise supported, with AVE values ranging from .532 to .710, all exceeding the recommended criterion of .50 (Fornell & Larcker, 1981; Hair et al., 2019), indicating that each construct adequately explained the variance of its indicators.

7.5. ANALYSIS OF OPEN-ENDED RESPONSES

The analysis of the open-ended responses revealed consistent patterns regarding participants' perceptions of pedagogical innovation, teaching methodologies, and the use of technology in military higher education. Overall, participants expressed strong support for more practical, interactive, and technology-enhanced learning approaches.

Technology use in the learning process emerged as the most prominent theme, being mentioned by approximately 65% of participants. Responses highlighted the importance of simulators, digital platforms, multimedia resources, artificial intelligence, and interactive digital environments as means of making learning more dynamic, realistic, and aligned with contemporary operational demands.

Practical activities also represented one of the most highly valued dimensions, being mentioned by approximately 51% of participants. Frequently suggested approaches included field exercises, operational simulations, laboratory activities, case studies, and training in contexts closely resembling professional practice, underscoring the importance attributed to experiential learning and the practical application of knowledge.

Active learning methodologies were referred to by approximately 46% of participants. Common suggestions included debates, problem-solving activities, group work, active classroom participation, and collaborative learning strategies. Participants demonstrated a clear preference for pedagogical approaches that are less lecture-based and more learner-centred.

Furthermore, simulations and operational scenarios were mentioned by approximately 32% of participants and were frequently associated with the development of decision-making, leadership, and adaptability in complex environments. Responses suggest that participants perceive substantial pedagogical value in methodologies based on realistic scenarios and immersive exercises.

Overall, the findings from the open-ended responses reinforce the quantitative results, revealing favourable perceptions regarding pedagogical modernisation, technology integration, and the use of active learning methodologies within the context of military education and training.

8. CONCLUSION

The literature review demonstrates that pedagogical innovation is a complex phenomenon requiring a coherent integration of teaching methods, technologies, and assessment systems. The transition towards a student-centred model, supported by realistic simulations and active learning methodologies, represents a promising pathway to ensure that military higher education continues to develop leaders capable of responding effectively to contemporary challenges characterised by uncertainty and volatility.

The results of the SEM indicate that, among the three pedagogical dimensions examined, only Active and Experiential Learning (AEL) exerts a direct, positive, and statistically significant effect on the Development of Command and Leadership Competencies (DCLC) among cadets of the Portuguese Military Academy ($\beta = 0.737$, $p < .001$). In turn, DCLC significantly influences Perceived Teaching Effectiveness (PTE) ($\beta = 0.716$, $p < .001$), explaining 65.3% and 51.3% of the variance in each construct, respectively. In contrast, Perceived Pedagogical Innovation (PPI) and Pedagogical Integration of Technology (PIT) did not demonstrate significant direct effects on competency development. This finding may be partially attributed to the high correlation observed between Active and Experiential Learning and Pedagogical Integration of Technology (r = .738), suggesting the presence of multicollinearity between these constructs.

Future research should consider alternative modelling approaches to mitigate this effect, particularly the possibility of combining Active and Experiential Learning and Pedagogical Integration of Technology into a single higher-order construct. Furthermore, replication of the study using larger and more diverse samples, including other military academies or higher education institutions with similar educational profiles, would contribute to assessing the stability and generalisability of the findings reported here.

The results obtained demonstrate both theoretical and empirical coherence, allowing relevant conclusions to be drawn for the pedagogical management of military higher education while also constituting an original and meaningful scientific contribution. The findings suggest that the development of command and leadership competencies is primarily fostered through pedagogical methodologies that place cadets at the centre of the learning process—encouraging them to experiment, solve problems, receive feedback, and apply knowledge in contexts that closely resemble military reality. When cadets perceive that these competencies are being effectively developed, they are also more likely to evaluate their instructors as effective educators.

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