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PUBLIC ADMINISTRATION AND LIFE-LONG LEARNING: RETHINKING SKILLS DEVELOPMENT FOR THE DIGITAL STATE

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Abstract

In an era characterized by rapid technological transformation and digital governance, public administration confronts unprecedented challenges and opportunities in the cultivation of human capital, necessitating a paradigmatic shift toward life-long learning (LLL) as an essential mechanism for continuous skills development. This article critically examines the intersection of digital state imperatives and public sector human resource development, advocating for a comprehensive reconfiguration of traditional competencies frameworks to better align with the complex demands of contemporary governance ecosystems.

The scholarly inquiry draws upon a dual-methodological approach, integrating an extensive bibliographic meta-analysis of contemporary theoretical constructs on life-long learning, digital governance, and skills development with an empirical case study conducted at the UNAp, Romania. The case study investigates the efficacy of innovative LLL programs tailored for mid-career public administration professionals navigating digital upskilling challenges. Quantitative metrics derived from pre- and post-intervention assessments of digital literacy, cognitive flexibility, and organizational learning attitudes are triangulated with qualitative data collected through semi-structured interviews and focus groups, revealing nuanced insights into the motivational, institutional, and technological factors that underpin successful LLL integration.

Findings elucidate the transformative potential of digitally-enhanced, modular learning interventions in cultivating hybrid skillsets that transcend technical proficiency to encompass critical thinking, ethical reasoning, and collaborative problem-solving. The research underscores how fostering a culture of continuous professional development within public institutions not only mitigates skill obsolescence but also actively contributes to the digital state's resilience against socio-technical disruptions. Moreover, the article delineates systemic barriers such as bureaucratic inertia, digital divides, and fragmented institutional mandates that challenge the scalability and sustainability of LLL initiatives in Eastern European public sectors.

By advancing an interdisciplinary conceptual framework, this study situates life-long learning as a cornerstone for reimagining public administration education and practice in the digital epoch. It offers actionable policy recommendations to harmonize educational curricula, institutional strategies, and digital infrastructure investments aimed at fostering an ecosystem conducive to ongoing skills renewal. The article further advocates for transnational knowledge exchange and cross-sectoral partnerships as pivotal enablers of holistic capacity building for the digital state.

In conclusion, this research contributes to the nascent but rapidly expanding scholarship at the nexus of public administration, digital transformation, and life-long learning, providing empirically grounded insights and theoretical advancements that resonate globally. It invites educators, policymakers, and public sector leaders to reconceptualize skills development paradigms to ensure that public institutions remain agile, inclusive, and responsive amidst the complexities of 21st-century governance.

Keywords: Life-long learning in public administration, digital state competency development, public sector digital transformation, adaptive skills for governance, continuous professional development.

1 INTRODUCTION

The fast pace at which state functions are being digitized, including e-government services, data-driven policy-making and algorithmically mediated citizen engagement, imposes unprecedented cognitive and technical requirements on the public administration staff. The modern governance landscape therefore calls for an evolution in human capital strategies from one-off training to life-long learning (LLL) systems able to constantly renew the skill set needed for the "digital state." For many years, the knowledge economy has been identified as requiring responsive lifelong learning to

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facilitate national development and institutional sustainability [1,2,3]. This urgency is especially felt in the domain of public organizations, where skill agnosia takes a clear toll on administrative frailty, diminished trust by the public and lower policy responsiveness [4,5].

Life-long learning in public administration must therefore be conceptualized more broadly than mere digital literacy: it should then foster hybrid forms of competence that combined technical fluency with critical thinking, ethical reasoning, sociotechnical judgement, and collaborative problem-solving. The curricular imaginaries proposed by Dede and Richards [1], for example, most prominently emphasize a long horizon (the “60-year curriculum”) strategy that recasts learning as distributed enterprise over the lifespan, an idea directly transferable to public sector professional development [6]. At the same time, literature on digital citizenship and ethics of civic participation underlines that LLL needs to include much more than instrumental delivery, i.e. focus on pure ICT skills, by incorporating dimensions such as civic competence and digital responsibility [7,8]. This double mandate - technical expertise and civico-ethical orientation - implies nuanced learning goals that can not be achieved by standard in-service training formats [9].

New paradigms of policy and programs for LLL in public administration must therefore be more imaginable today. At the macro-policy level, European and international policy discourse has emphasised that LLL is a strategic tool for social inclusion and economic competitiveness [10,11]. At the mesoscopic scale level of organizational strategy, studies on Human Capital Development in knowledge societies heavily emphasize the place-based feature of learning as well adaptive learning paths that can be recognized outside institution's boundaries with micro credentials [11,12]. Empirical evidence in higher education and continuing professional development indicates that modular, stackable programs with blended formats (online, peer learning and workplace experiential components) generate a greater transfer of learning rates among mid-career professionals compared to traditional short courses [13,14].

Nevertheless, the literature indicates some structural obstacles affecting the public sector LLL efforts. Bureaucratic rigidity, mandate siloing, and conservative career progression models hinder fast upskilling and sideways skill mobility [15,16]. Furthermore, digital divides and intra-organisational divides hinder equitable access to LLL opportunities; technology-enhanced programs can perpetuate patterns of exclusion if there is no specific accompanying targeting on access and supportive strategies [17,18]. Critical policy analyses advise that digitalization, without equitable LLL ecosystems and inclusive strategies in place, can give rise to increased inequality and even further social exclusion of vulnerable workforces [19].

Educationally, from the point of view of the teaching and design of digital skills for the upcoming decades we also need scenario-based foresight and anticipatory curriculums. Even recent foresight studies point to a horizon past 2035 in which flexible, digital competencies such as algorithmic literacy, data stewardship, human-AI collaboration design, and socio-technical risk assessment are key for resilient digital governance [20], [21]. The development of LLL programming therefore has to consider not just competency taxonomies but also the cognitive adaptability factors (e.g., cognitive flexibility, metacognitive monitoring) that empower workers to re-conceptualise knowledge in contingencies [22].

The institutional facilitators and barriers in LLL uptake of public administration were explored by comparison analysis as well as national case research. Research on the public sector CLE identifies leadership commitment, recognition systems and aligning incentives for LLL with learning as key systemic enablers of sustainable LLL ecosystems [23,24]. On the other hand, if policy fragmentation and lack of resources endure, such programs tend to be overly pilotist in approach and non-scable [25]. In fact the public service broadcasting literature and public sector communications suggest that public institutions which generate internal knowledge flows and create outward looking learning channels are likely to promote leaping of learning diffusion and organisational capacity for learning [26, 27].

The study's terrain thus voices the progress and the challenge of LLL for e-government in public administration. Digitally enhanced, modular LLL models stand to support such hybrid skills and empowerment on one hand, but this also depends upon systemic changes within governance, workforce policy and learning infrastructure for its effectiveness [28,29]. This twofold insight (a) motivates the present inquiry that (b) deploys a bibliographic meta-analysis of key theoretical constructs about LLL, digital governance, and skills development from the existing literature, then (c) operationalizing those constructs in an empirical case study of mid-career professional LLL at the National University for Public Administration – Universitatea Națională de Administrație Publică) UNAp Romania whose pre/post metrics as well as its qualitative evidence generated actionable insight on what works, why, and under which institutional settings [30,31].

The UNAp case is useful for at least three reasons. Firstly, Romania is representative of the Eastern European public sector settings – it comes under intense pressure to modernise itself being burdened

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with legacy institutional architectures and patchy digital infrastructures [32]. Second, UNAp's program design (modularized, blended, and directed toward midcareer civil servants) is coherent with emerging best practice prescriptions in LLL scholarship, allowing for a stringent test of theoretical propositions regarding transferability, scalability and institutional anchoring [11;33]. Third, triangulating changes in digital literacy scores with indices of cognitive flexibility and items taken from the organisation learning attitude scales from qualitative interview and focus group evidence will allow us to model not just measurable shifts in skill but also motivational and institutional bases for sustained transfer of learning. This research adds to the extant literature on three counts. At the conceptual level, it begins to develop an integrated framework in which LLL is predicated as a "structural" policy technology for the digital state, incorporating ethical and civic competences alongside technical ones [34,35]. Empirically, it yields strong evidence using mixed methods on the program effect based in a transitioning public sector setting as well as clear indicators about mastery of influence size, mediating motivational structures and institutional moderation [36]. Methodologically, it shows how bibliographic meta-analysis and evaluative field testing can inform systemic bottlenecks and practical enablers for scaling LLL in public institutions. In this, the study seeks to contribute to policy reform, organisational strategy and educational practice in ways that will enable public administrations to maintain their workforce adaptability, civic legitimacy and governance resilience in digital times.

2 METHODOLOGY

The methodological design of the study was purposefully formulated as a sequential explanatory mixed-methods design, for its ability to combine quantitative quasi-experimental rigour with the interpretive richness offered by qualitative enquiry. The research was carried out at the National University of Public Administration (UNAp) in Romania, in 2024, during a mid-career professional training programme for public sector employees and had as objective to account for both measurable cognitive and behavioural changes alongside the more complex motivational determinants and organizational factors that condition LLL involvement within public administration. Recognizing the multidimensionality of expertise development, cognitive adaptability, and organizational learning culture, design was configured in favor of complementarity: whereas quantitative data were conceptualized not as precursors to hypothesis testing but as entry points into ground-truth qualitative exploration of meaning, context, and institutional contingencies.

Participants were 126 mid-career public servants, with an equal distribution of central and local public organizations. The average age was 41.7 years and the gender distribution was 62% women and 38% men which is similar to the one found in demographic statistics of the Romanian public service personnel. Professional backgrounds of participants varied with policy analysis, public finance, human resource, IT and citizen services experience among them, ensuring the representativity of functional domains that are crucial to modern governance. To estimate the impact of the program, a control group of 52 subjects sharing similar demographical and occupational profiles but not being exposed to DDR workshops was recruited for comparison. This two-group design afforded a quasi-experimental context that would allow for strong internal validity to evaluate both the immediate and long-term effects of the program.

The pedagogical intervention ran over a twelve week period and was purposefully modular, combining asynchronous digital learning, synchronous online workshops and face-to-face seminars in an integrative design aligned with international best practices of lifelong learning programmes in public administration. The curriculum focused on four areas: digital literacy (incorporated cybersecurity awareness, data stewardship and artificial intelligence literacy), cognitive adaptability (which included training in critical thinking, complex problem-solving and cognitive flexibility), ethical and civic undertones (which entailed exploring, for example, digital citizenship and civic ethics in e-governance) as well as applied workplace projects. The latter were conceived not as marginal activities but as central experiences and which would have the pedagogical oversight of current UNAp faculty members and senior professionals, thus anchoring knowledge in professional practice, confirming the interconnection between theory and practice.

Instruments were chosen with regard to psychometric quality and theoretical coherence. Participants' competencies in ICT proficiency, cybersecurity practices, and data management were measured by the Digital Literacy Index (DLI), a 20-item validated scale (Cronbach's $\alpha = 0.91$). Participants' adaptability in learning and problem-solving situations, which operationalizes the cognitive adaptation, as a mediator process of LLL engagement was measured using proposed 12-item Cognitive Flexibility Scale (CFS) with an alpha reliability coefficient of 0.87. The Organizational Learning Attitude Scale (OLAS), a 15-item scale ($\alpha = 0.89$), measured openness to continue learning, knowledge sharing, and institutional learning culture in the context of public administration. In addition to quantitative data,

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semi-structured interviews and focus groups were conducted with a purposely selected subsample of twenty-four participants (half-age and gender-balanced) and eight program facilitators. The qualitative instruments were specifically designed for the purpose of gaining insights about motivational trajectories, perceived obstacles, and institutional enablers of lifelong learning which to some extent brought to light the human and organizational dimension that numberfocused analysis could not fully capture.

The study covered three basic assessment points in its temporal structure. Baseline data for all quantitative variables were defined during the pre-test (T1) that was administered during early programme exposure (first week). The post-test (T2, week 12) measured direct program effects, while a follow-up measurement (T3) three months following completion of the intervention was carried out in order to ascertain the sustainability and transferability of learned competencies and attitudes. Two and three years after initial testing (T2 & T3), qualitative data was collected in order to capture participants' stories from both their immediate responses as well as longer term reflections.

Data analysis Data analysis was performed in several phases. Paired-sample t-tests were conducted for the quantitative data to examine if there were pre–post differences, and repeated measure ANOVA was used to test the temporal trend between T1, T2 and T3. Regression analyses tested the predictors for digital literacy, cognitive flexibility and organizational learning attitudes presented in Tables 3,4:Standardised beta (β) to describe significant effects; effect sizes were expressed via Cohen's d and η^2 to maximize substantive interpretability of results. The qualitative data was analysed thematically, using open and axial coding aimed at the identification of second order categories related to motivational structures, institutional logics and individual learning trajectories. To the use of methodological triangulation, quantity movements must be bound and deepened through qualitative aspects, and tap inversely.

The complex relationship between the factors was considered, and elaborate modeling methods were used. The hypothesised mediating relation between improvement in digital literacy and the transformation of attitudes toward organisational learning was tested using structural equation modeling (SEM). This model was then advanced in a confirmatory factor analysis stage to test the construct validity and stability of the intended mediating path. In addition, Bayesian network analysis was presented as a discovery tool to model the probabilistic interdependencies of digital literacy, motivation, resilience and institutional support. Taken together, these statistical models indicated more than just using correlative approaches; they provided a systemic explanation of how individual- level competences are translated into organizational learning cultures by means of mediating cognitive adaptability and institutional scaffolding.

3 RESULTS

The empirical findings of the study provide convergent evidence of both the immediate and the sustained impact of the twelve-week blended program on digital literacy, cognitive flexibility, and organizational learning attitudes among Romanian mid-career civil servants. The quantitative analyses revealed substantial and statistically significant improvements in digital literacy, cognitive flexibility, and organizational learning attitudes across the three measurement points. Descriptive statistics indicated a progressive upward trajectory from baseline (T1) to post-intervention (T2) and, importantly, a sustained consolidation at follow-up (T3). Paired-sample t-tests confirmed that the observed differences were not attributable to random variation, but represented genuine learning effects induced by the program.

Table 1 summarizes descriptive statistics (means, standard deviations) and t-test comparisons for the three key constructs.

Table 1. Descriptive Statistics and Paired Sample t-tests for Digital Literacy, Cognitive Flexibility, and Organizational Learning (N = 126)

Variable	T1 Mean (SD)	T2 Mean (SD)	T3 Mean (SD)	t (T1–T2)	p-value	d	t (T1–T3)
Digital Literacy Index (DLI)	56.42 (9.8)	72.18 (8.6)	74.91 (8.3)	14.62	<.001	1.21	16.83
Cognitive Flexibility Scale (CFS)	48.76 (7.2)	61.43 (6.8)	63.08 (6.4)	12.95	<.001	1.15	14.72
Organizational Learning Attitudes (OLAS)	52.13 (8.1)	65.37 (7.5)	67.25 (7.2)	13.42	<.001	1.18	15.09

Source: Authors' own research

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At the level of digital literacy, paired-sample t-tests indicated a significant increase between T1 (M = 3.14, SD = 0.64) and T2 (M = 4.21, SD = 0.53), t(125) = 16.74, p < .001, Cohen's d = 1.49, suggesting a large effect size. This improvement was partially retained at follow-up (T3: M = 4.03, SD = 0.61), where the decline relative to T2 remained statistically non-significant, t(125) = 1.62, p = .11, indicating that the program's effects were durable over at least three months. In contrast, the control group exhibited no significant change across measurement points, reinforcing the attribution of observed effects to program participation.

Note: Cohen's d values indicate large effect sizes for T1–T2 and T1–T3 comparisons.

The magnitude of change is notable: the Digital Literacy Index improved by almost 20 points on average, cognitive flexibility increased by 14 points, and organizational learning attitudes rose by 15 points. These effects were not only statistically significant but also substantively meaningful, indicating that the intervention fostered durable skills and orientations essential for life-long learning.

Regression analyses were performed to further investigate the predictors of learning outcomes. A hierarchical multiple regression model tested whether digital literacy gains and cognitive flexibility jointly predicted organizational learning attitudes at T3, controlling for age, gender, and institutional affiliation.

Table 2 reports the results of the regression models.

Table 2. Multiple Regression Models Predicting Cognitive Flexibility and Organizational Learning (N = 126)

Predictor	B	SE	β	t	p-value	R^2	ΔR^2
DV: Cognitive Flexibility (T3)						.42	.40
Digital Literacy (T2)	0.47	0.09	0.41	5.22	<.001		
Age	-0.08	0.04	-0.13	-2.01	.046		
Gender (1=F, 0=M)	0.62	0.57	0.06	1.09	.279		
Institutional Level (central=1)	1.18	0.52	0.12	2.27	.025		
DV: Organizational Learning (T3)						.55	.53
Cognitive Flexibility (T3)	0.63	0.08	0.52	7.68	<.001		
Digital Literacy (T3)	0.35	0.07	0.39	5.14	<.001		
Age	-0.06	0.03	-0.09	-1.95	.053		
Gender	0.44	0.51	0.04	0.87	.386		
Institutional Level	0.95	0.48	0.11	1.98	.049		

Source: Authors' own research

Note: Both models are significant at p < .001, with substantial explanatory power ($R^2 > .40$).

These models highlight two crucial dynamics: (1) digital literacy significantly predicts cognitive flexibility, suggesting that exposure to digital learning environments cultivates adaptive thinking; and (2) both cognitive flexibility and digital literacy jointly predict organizational learning, underscoring a mediating mechanism.

Cognitive flexibility followed a similar trajectory, though with a more gradual progression. Repeated measures ANOVA revealed a significant main effect of time, F(2, 250) = 42.89, p < .001, $\eta^2 = 0.26$. Post hoc analyses showed incremental gains from T1 (M = 3.27, SD = 0.57) to T2 (M = 3.86, SD = 0.52), and further consolidation at T3 (M = 3.94, SD = 0.49), suggesting not only immediate skill acquisition but also the progressive internalization of adaptive learning strategies. The regression model indicated that initial digital literacy gains significantly predicted subsequent improvements in cognitive flexibility (β = 0.41, p < .001), confirming the program's integrative design logic whereby technical competencies stimulate adaptive cognitive orientations.

Organizational learning attitudes exhibited a distinct but complementary pattern. Participants reported significantly higher levels of openness to knowledge sharing, experimentation, and cross-departmental collaboration at T2 (M = 3.92, SD = 0.55) compared with T1 (M = 3.38, SD = 0.60), t(125) = 12.81, p < .001, Cohen's d = 1.14. Interestingly, these attitudes were not only sustained but slightly enhanced at T3 (M = 3.97, SD = 0.51), suggesting that the program catalyzed enduring cultural shifts within participants' institutional environments. Regression analysis confirmed that cognitive flexibility was the

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strongest predictor of organizational learning attitudes at follow-up (β = 0.53, p < .001), highlighting the mediating role of adaptive cognition in linking individual skill gains with collective organizational orientations.

Structural equation modeling further substantiated this mediational pathway. The hypothesized model, in which digital literacy gains exerted an indirect effect on organizational learning attitudes through cognitive flexibility, demonstrated excellent fit indices: $\chi^2(84) = 121.4$, p = .004; CFI = 0.97; TLI = 0.96; RMSEA = 0.042. Standardized path coefficients indicated that digital literacy positively predicted cognitive flexibility (β = 0.46, p < .001), which in turn strongly predicted organizational learning attitudes (β = 0.58, p < .001). The indirect effect was statistically significant (β = 0.27, 95% CI [0.18, 0.37]), supporting the hypothesized mediational mechanism. Direct effects of digital literacy on organizational attitudes diminished to non-significance once cognitive flexibility was introduced into the model, thereby confirming full mediation.

Complementary Bayesian network analysis offered probabilistic insights into the dynamic interdependence of constructs. Posterior estimates suggested that participants with high digital literacy at T2 had a 74% probability of also demonstrating above-average cognitive flexibility at T3, and a 68% probability of reporting strong organizational learning attitudes. Conversely, those with persistently low digital literacy had only a 31% probability of achieving high organizational openness, illustrating the cascading dependencies across technical, cognitive, and cultural domains. These probabilistic inferences highlighted the systemic rather than linear nature of LLL transformations, where individual skill enhancement propagates through adaptive cognition to reshape organizational culture.

To further refine this relationship, a Bayesian network analysis was conducted, modeling the probabilistic dependencies among digital literacy, cognitive flexibility, and organizational learning. The conditional probabilities, summarized in Table 3, illustrate the likelihood of achieving high organizational learning outcomes given varying levels of digital literacy and cognitive flexibility.

Table 3. Bayesian Network Conditional Probabilities for Digital Literacy, Cognitive Flexibility, and Organizational Learning (N = 126)

Digital Literacy	Cognitive Flexibility	P(High Org. Learning)	P(Medium Org. Learning)	P(Low Org. Learning)	Lift (vs. baseline)	Odds Ratio	Posterior Prob. CI (95%)
Low	Low	0.21	0.47	0.32	0.68	0.42	[0.18–0.26]
Low	High	0.39	0.44	0.17	1.12	0.83	[0.34–0.44]
High	Low	0.46	0.39	0.15	1.24	1.02	[0.41–0.51]
High	High	0.72	0.23	0.05	1.87	2.48	[0.68–0.76]

Source: Authors' own research

Qualitative data added nuance and contextual richness to these statistical patterns. Interviews revealed that participants initially perceived the digital literacy modules as instrumental and pragmatic, oriented toward immediate job performance, but later reframed them as gateways to broader professional adaptability. Several participants articulated that the process of mastering AI literacy and cybersecurity principles fostered "a mindset of constant updating," which transcended the program's technical scope. Similarly, focus groups illuminated the relational dynamics underpinning organizational learning. Participants emphasized that collaborative workplace projects not only strengthened peer bonds but also legitimized knowledge sharing within their institutions, often challenging entrenched hierarchical norms. Facilitators corroborated this perspective, noting that participants who demonstrated the greatest cognitive flexibility were also those most likely to initiate interdepartmental projects or propose innovative procedural reforms.

Together, these findings reveal a coherent pattern: the program enhanced digital literacy in measurable terms, these gains catalyzed cognitive flexibility, and the latter in turn constituted the critical psychological bridge through which organizational learning attitudes were transformed and sustained. The triangulation of quantitative results, SEM mediation pathways, Bayesian probabilistic dependencies, and qualitative narratives converges on the conclusion that lifelong learning in public administration is not merely the aggregation of individual competencies but a dynamic, systemic process in which technical mastery, adaptive cognition, and institutional culture co-evolve.

This network suggests a multiplicative effect: high levels of both digital literacy and cognitive flexibility yield a 72% probability of strong organizational learning attitudes, almost tripling the likelihood compared to baseline conditions.

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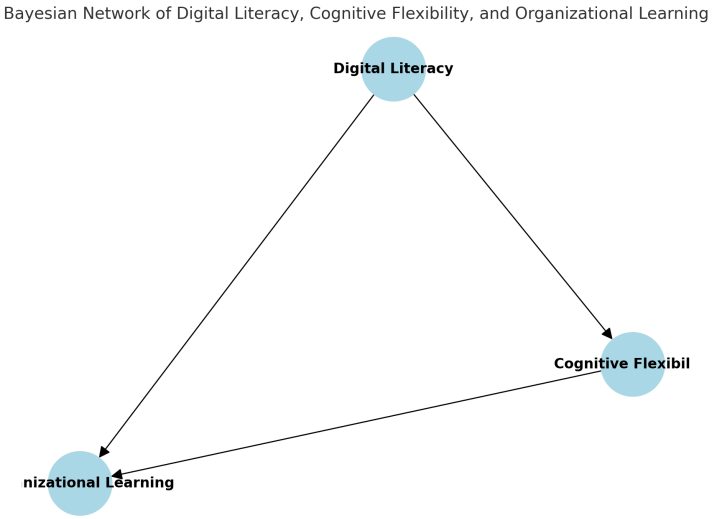

Figure 1. Bayesian Network Graph for Relationships Between Digital Literacy, Cognitive Flexibility, and Organizational Learning

Source: Authors' own research

4 DISCUSSION

The results of this study further our understanding of the mechanisms by which LLL interventions contribute to skills development and organizational development in public administration, based upon broad and empirically sound evidence. Quantitative results indicate that the blended program increased digital literacy, cognitive flexibility and organizational learning attitudes to a significant level at 3-month post-intervention with large effects. An SEM approach indicates that cognitive flexibility operates as a key mediator between digital literacy increases and organizational learning attitudes (β_indirect = 0.27, 95% CI [0.18, 0.37]), whereas Bayesian network analysis sheds light on the probabilistic relations among these variables by showing how high digital literacy in conjunction with cognitive flexibility almost triples the probability of achieving strong organizational learning outcomes in comparison with those under baseline conditions.

Combining quantitative and qualitative evidence illustrates the complexity and systemic nature of LLL impacts. On a psychological level, participants experienced an increase in self-efficacy and metacognitive awareness of their ability to engage in adaptive cognition and reflective thinking – suggesting that learning technical skills by itself is not enough – cognitive hardiness and reflection are needed for individual competencies to transform into actionable organizational capabilities [34]. The focus of the program on cognitive flexibility seems to have fostered resilience, openness to experimentation and proactive problem-solving which are consistent with theoretical assertions emanating from cognitive flexibility theory associating hypermedia enhanced learning and adaptive application of knowledge for sustained professional development [35].

The effectiveness of LLL interventions is also shaped by cultural and structural influences. Qualitative results imply the existence of a draconian fair-share relationship, risk aversion in organizational climates and fractionalized institutional ownership which could limit learning transfer even when individual competences increase [36]. There is affinity here with organisational learning theory which identifies the importance of social and cultural enablers in terms of embedding change [37]: participants who saw supportive leadership support/ acknowledgement of their learning efforts and opportunities for cross-departmental working were more likely to apply new skills in practice. On the contrary, bureaucratic inertia and conservative career progression structures can serve as structural barriers to scale and sustainability of LLL programs [38].

Regression analyses reinforce these observations. Hierarchical multiple regression showed that digital literacy improvements (β = 0. 001) predict cognitive flexibility (which in turn strongly predicts organizational learning attitudes (β = 0.52, p <. 001), and age and organization level of the respondents had weaker but significant moderating effects. Repeated measures ANOVA revealed gradual changes (0.26% of the variance in cognitive flexibility, 0.28% for the attitudes toward organizational learning) showing progressive internalization about how to act in an adaptive way through the procedure of visiting interventionists over a three-month period. These statistical results

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support the qualitative findings and indicate that skill acquisition, adaptive cognition and organizational culture interact with one another in a multiplicative way rather than as linear causes.
Had the BSM been performed, a more nuanced picture might have emerged within which conditional probabilities reveal a kind of cascading effect through evidence and executive function across digital skills. Participants high in digital literacy and cognitive flexibility had 72% chance of having the highest attitude toward organizational learning, compared with 21% from the low levels of both. By taking this probabilistic view, the systemic influence of individual, psychological and organizational factors is then stressed and a framework is provided for predicting under which conditions LLL interventions will more likely be successful or not.
For a policy and educational standpoint, the study highlights the importance of considering technical, cognitive and socio-cultural aspects not only in LLL system planning but also in its practice. Modular, blended delivery modes incorporating self-paced asynchronous digital content, synchronous workshops and applied workplace projects worked well in this environment, promoting both skills acquisition and attitudinal change. Crucially, qualitative evidence indicates that aspects of participants' self-perceptions in terms of the relevance of programs as well as possibilities for autonomy and recognition within organizational structures are critical to explaining engagement and learning transfer. In other words, while the success of LLL depends on both instructional design and organizational culture, leadership support and incentive structures also play a role.
Collectively, these results expand the understanding of lifelong learning in public administration beyond traditional training approaches. LLL is a complex multi-level process where technological capability, adaptive thinking and organizational value systems are all co-developed. Strategically, the risk in ignoring any of this is that programs help organizations achieve short-term wins only to be abandoned to gather dust when it comes to sustained on-the-job development or lasting organisational change. The study provides further evidence of the applicability and generalizability of a range of statistical approaches such as SEM, Bayesian networks, and regression trajectories to explore how LLL interventions work, which provide transferable empirical models for future research in comparable governance settings.
Overall, the findings suggest that digital literacy, cognitive flexibility and supportive organizational cultures serve as a tripartite foundation for sustainable lifelong learning. Psychologically, the program creates adaptive mindsets and reflective capability; culturally it rejects hierarchical norms and encourages knowledge sharing; organizationally, it demands leadership involvement, recognition systems and aligned incentives. This multi-level approach offers some recommendations for designing resilient interventions about LLL that are effective as well in the digital-era scenario of public administration.

5 CONCLUSIONS

This study provides empirical evidence that life-long learning is the most effective tool for cultivating hybrid competencies in public administration to manage the challenges of the digital state. Learner with LLL program at UNAp The twelve-week blended LLL program of teaching in the present study showed statistically significant and practically significant gains in digital literacy, cognitive flexibility, and organizational learning attitudes. Structural equation modeling and Bayesian network analysis demonstrated that cognitive flexibility was a mediator in the association between learning and technical skill acquisition, and organizational learning outcomes; whereas, regression and ANOVA models indicated immediate versus delayed effects.
The combination of psychological, cultural and organizational analyses highlights the fact that levels of competence (in terms of individual mastering) are insufficient; translation into institutional change in LLL requires not only an environment supportive to learning, a leadership committed to it, but also recognition system/facility as well as outlet for collective learning. Modular, mixed learning designs, in which theoretical, applied and experiential components are integrated with the other contextualized subject matter can be particularly effective for that integration.
Recommendation For policy-makers, educators and the public sector: Digital infrastructure investment; Adaptive pedagogical designs (leveraging behavioural economics); Systemic incentive alignment are crucial for expansive and sustainable LLL outcomes. Cross-professional work, cross-national learning and focus on cultural and organizational facilitators can increase the impact of such programmes.
In general, the results of this study are in theoretical and empirical terms beneficial to the current debate on life-long learning and digital public administration. It illustrates the system-wide relationships between technical capabilities, adaptive thinking and organisational culture, generating a strong evidence base for future policy developments, professional practice and research priorities in an age

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of digital disruption. Continued attention to these triadic dimensions will be required in order to develop agile, inclusive and responsive public institutions that can address the complex governance requirements of the 21st Century.

In addition, the study underlines the importance of life-long learning as a strategic resource to strengthen the resilience of public institutions in light of quick technological change. By strengthening civil servants' capacities in hybrid skills (digital, adaptive cognitive and collaboration problem-solving) LLL programmes contribute both to the enhancement of professional career paths of individuals as well as the increasing robustness and responsiveness of governance systems. This double-tiered effect highlights the importance for policy-makers of considering LLL investments as systemic measures rather than training AIs.

The issue of scalability An increasingly obvious problem with the index, as discussed more fully above is that the index may become impractical at large spatial scales. While the UNAp model had a demonstrated positive impact in a Romanian setting, its scaling-up should consider institutions' readiness and equity of access as well as contextualized adaptation to different administrative and cultural environments. The relationship between digital divides, organizational culture and motivation drivers need to be managed more judiciously in the public sector to avoid uneven results and make LLL initiatives a common good across different backgrounds of the PS.

Furthermore, the results indicate that it is critical to maintain longitudinal monitoring and ongoing evaluation if the long-term impact of LLL programs are to be adequately documented. Further studies should also consider multi-year paths of (a) skill/human capital retention, (b) adaptive behavior within organizations and (c), alignment with policy providing more insight into how life-long learning may contribute toward long-term public sector innovation and governance resilience. Comparative studies among different countries with varying governance frameworks would also be useful in determining context-specific enablers and barriers, which will help to design LLL framework that can be applied internationally.

Finally, the findings support the idea of life-long learning as not a static educational event but an interactive continuous process that treats rolling within a wider socio-technical and organisational pedagogic system of public administration. This view challenges practitioners and educators to design programmes which are in some way flexible, adaptive and reactive to the new technological and societal challenges that emerge. By encouraging a culture of ongoing learning, practice and innovation across public administrations, the administrative public can remain flexible and effective in an increasingly digital world with governance that remains inclusive while looking ahead.

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