

Training as a Strategic Lever for Blockchain Process Integration in Moroccan Organizations: An Educational Science Perspective.

Auteur 1 : EHIRI NAAMA.

EHIRI NAAMA

Faculty of Sciences of Education - Rabat

Laboratory for Research in Analysis and Evaluation of Education and Training Systems - Rabat.

Déclaration de divulgation : L'auteur n'a pas connaissance de quelconque financement qui pourrait affecter l'objectivité de cette étude.

Conflit d'intérêts : L'auteur ne signale aucun conflit d'intérêts.

Pour citer cet article : EHIRI NAAMA (2026) « Training as a Strategic Lever for Blockchain Process Integration in Moroccan Organizations: An Educational Science Perspective », African Scientific Journal « Volume 03, Num 37 » pp: 1012 – 1033.



DOI : 10.5281/zenodo.21770412

Copyright © 2026 – ASJ



Abstract

Blockchain is increasingly presented as a socio-technical infrastructure capable of improving trust, traceability, transparency and process automation in organizations. However, successful blockchain process integration depends not only on technological availability, but also on actors who understand distributed governance, smart contracts, data integrity, interoperability, cybersecurity, legal constraints and the redesign of organizational routines. This article examines training as a strategic lever for blockchain process integration in Moroccan organizations from an Educational Science perspective. Methodologically, it adopts a conceptual and interpretive research design combining a narrative review of literature on blockchain adoption, adult learning, competency-based training, organizational learning and technology acceptance with a contextual analysis of Moroccan digital-transformation priorities. The documentary sample, rather than a respondent sample, consists of scientific works selected for their relevance to these five thematic streams, together with Moroccan institutional and policy documents. The sources are synthesized into an integrated training-based model structured around competence diagnosis, modular learning pathways, experiential experimentation, organizational transfer and impact evaluation. The main conclusion is that training acts as a mediating organizational capability: when learning is competency-based, experiential and connected to workplace transfer, it strengthens readiness and trust, reduces resistance to innovation and facilitates sustainable blockchain process integration. The article contributes by reframing blockchain adoption as a learning and capacity-building issue and by offering Moroccan organizations a practical roadmap and research propositions for future empirical testing.

Keywords : Blockchain; professional training; educational sciences; organizational learning; digital transformation; Morocco; competency-based education; technology adoption.

Introduction

Blockchain technology has moved beyond its initial association with cryptocurrencies and is now considered a broader distributed ledger infrastructure capable of transforming inter-organizational processes (Yaga et al., 2018; Casino et al., 2019; Risius & Spohrer, 2017). Its core characteristics--distributed validation, immutability, cryptographic security, programmable execution and shared records--make it relevant for domains such as finance, supply chains, public administration, higher education credentials, health data management, land registration and digital identity. Yet the organizational integration of blockchain remains complex because the technology modifies not only information systems, but also work routines, roles, decision rights, data responsibilities, trust mechanisms and institutional relationships.

In emerging economies, the challenge is particularly important. Organizations may recognize the potential of blockchain for traceability, transparency and automation, but they often face gaps in digital skills, limited technological readiness, regulatory uncertainty, scarce experimentation spaces and insufficient managerial understanding. Consequently, blockchain adoption should not be reduced to the acquisition of a platform or the launch of a pilot project. It should be analyzed as a process of learning, organizational change and capacity development. This perspective is central to Educational Sciences, which study how knowledge, competencies, practices and identities are constructed and transferred in formal, non-formal and professional contexts.

Morocco provides a relevant context for this analysis. Digital transformation has become a national strategic priority, and the Digital Morocco 2030 strategy positions digital technology as a driver of social and economic development (Ministry of Digital Transition and Administrative Reform, 2024). The strategy also identifies digital talent development, initial training, upskilling and reskilling as key accelerators for competitiveness and modernization (Ministry of Digital Transition and Administrative Reform, 2024; U.S. International Trade Administration, 2025). At the same time, Moroccan organizations face practical constraints: uneven digital maturity across sectors, heterogeneous skills among employees, cybersecurity concerns, data-governance requirements and the need to align technological experimentation with legal and institutional frameworks. These conditions make training a decisive variable in any attempt to integrate blockchain processes.

This article argues that training is not a secondary support activity in blockchain adoption. It is a strategic lever that shapes the perceived usefulness of blockchain, reduces perceived complexity, supports trust, enables experimentation and facilitates the transfer of new routines

to the workplace. From an Educational Science perspective, training can transform blockchain from an abstract technological concept into a set of operational competencies, shared meanings and organizational practices. The central question addressed is therefore: how can training facilitate the integration of blockchain processes in Moroccan organizations?

The article pursues three objectives. First, it clarifies the relationship between blockchain integration and competence development. Second, it proposes a theoretical framework combining technology adoption models, organizational learning and adult education. Third, it develops a practical training roadmap adapted to Moroccan organizations. The article is conceptual and does not present empirical survey results. Its contribution is to build a structured analytical model and research propositions that can guide future empirical work.

1. Literature Review

1.1. Blockchain as a socio-technical innovation

A blockchain can be defined as a distributed ledger in which transactions are recorded in blocks, validated by network participants according to a protocol and linked through cryptographic mechanisms (Nakamoto, 2008; Yaga et al., 2018). This infrastructure makes it possible to maintain shared records without relying exclusively on a single central authority. From an organizational point of view, the interest of blockchain lies less in the technology itself than in the new coordination mechanisms it enables: shared truth, automated verification, traceable transactions and programmable rules through smart contracts (Iansiti & Lakhani, 2017; Swan, 2015; Tapscott & Tapscott, 2016).

However, blockchain is not appropriate for every organizational problem. It becomes relevant when several actors need to share data, when trust is limited or costly, when traceability is essential, when auditability matters, or when a process requires verifiable coordination between independent parties. For Moroccan organizations, possible applications include secure certificates and diplomas, supply-chain traceability, public procurement records, land and notarial documentation, trade finance, customer due diligence, insurance claims, identity verification and inter-administrative data exchange. These use cases require technical, legal and managerial competences that are rarely concentrated in a single professional profile.

The socio-technical character of blockchain means that adoption depends on the interaction between technological architecture, human capabilities, organizational routines and institutional rules. If employees do not understand the logic of distributed trust, if managers cannot identify relevant use cases, or if legal and compliance staff cannot assess data protection and accountability risks, the implementation may remain superficial. Training therefore becomes a mechanism for building shared understanding across departments and for translating technological possibilities into organizational processes.

1.2. Organizational adoption of blockchain technology

Research on blockchain adoption frequently mobilizes the Technology-Organization-Environment framework, the Technology Acceptance Model, the Unified Theory of Acceptance and Use of Technology and diffusion of innovation theory (Tornatzky & Fleischer, 1990; Davis, 1989; Venkatesh et al., 2003; Rogers, 2003). These approaches show that adoption is influenced by perceived usefulness, perceived ease of use, organizational readiness, top-management support, technological compatibility, regulatory pressure, competitive pressure and facilitating conditions. In the case of blockchain, additional factors are especially important:

interoperability with legacy systems, governance of consortium networks, data privacy, legal validity of records, cybersecurity, trust among participants and the availability of skilled personnel.

Blockchain adoption is also marked by uncertainty. Many managers perceive the technology as promising but difficult to understand, expensive to implement and risky in terms of regulation. This uncertainty can generate innovation resistance. Training can reduce uncertainty by clarifying concepts, distinguishing blockchain from cryptocurrency speculation, explaining use-case selection criteria and enabling actors to test prototypes in controlled environments. Therefore, training affects not only individual knowledge but also organizational readiness and strategic decision-making.

Readiness assessment studies emphasize that blockchain initiatives require alignment between stakeholders, governance structures, technical infrastructure and institutional support (Balasubramanian et al., 2021; Clohessy et al., 2019; Queiroz & Wamba, 2019). This suggests that training should not be limited to developers. It must include executives, project managers, business analysts, legal officers, compliance teams, human-resource managers, trainers, end-users and external partners. Each group needs a different level of blockchain literacy and a different competence profile.

1.3. Training, adult learning and competence development

Educational Sciences offer a useful lens for understanding how organizations learn to integrate emerging technologies. Adult learning theory highlights that professional learners need to understand the relevance of training, connect it to real problems, participate actively and apply knowledge to authentic situations (Knowles et al., 2015; Mezirow, 1991). Experiential learning emphasizes cycles of concrete experience, reflective observation, conceptualization and experimentation (Kolb, 1984). Competency-based education focuses on observable capabilities, performance standards and evidence of mastery rather than simple exposure to content.

For blockchain integration, these principles are essential. Employees cannot be expected to adopt blockchain processes merely after a theoretical presentation. They need to analyze organizational problems, map processes, identify pain points, compare centralized and distributed solutions, design a basic smart-contract logic, evaluate ethical and legal risks, and simulate governance scenarios. Training must therefore combine conceptual understanding, practical exercises, collaborative learning and workplace transfer.

Training also contributes to organizational learning (Argyris & Schön, 1978; Nonaka, 1994; Wenger, 1998). When participants from different departments learn together, they can create a common vocabulary and develop shared mental models. This is particularly important for blockchain because the technology cuts across functional boundaries. A supply-chain blockchain project, for example, may require coordination between logistics, finance, procurement, IT, legal services and external partners. Training can create a community of practice that continues to exchange knowledge after the formal program.

1.4. Blockchain education and skills gaps

Recent literature on blockchain in education shows that the technology can support credential verification, academic record management, digital identity and trustworthy certification (El Koshiry et al., 2023; Fartitchou et al., 2024). Nevertheless, the same literature stresses major barriers: limited technical knowledge, interoperability problems, data protection concerns, cost, scalability and institutional readiness. These barriers are not only technical. They are educational barriers because they reveal a gap between technological potential and the competencies required to design, govern and use blockchain systems responsibly.

In organizational settings, the blockchain skills gap has at least four layers. The first layer is conceptual literacy: understanding what blockchain is, what it is not, and when it is relevant. The second layer is functional literacy: knowing how blockchain may affect a specific business or administrative process. The third layer is technical literacy: understanding architecture, nodes, consensus, smart contracts, wallets, cryptography and interoperability. The fourth layer is governance literacy: knowing how to manage legal compliance, data ethics, stakeholder rights, accountability and change management. Effective training should address these layers progressively rather than assuming that all participants require the same technical depth.

1.5. The Moroccan context: digital transformation and training needs

The Moroccan context is characterized by a strong national orientation toward digital transformation (Ministry of Digital Transition and Administrative Reform, 2024; World Bank, 2026). Digital Morocco 2030 aims to position the Kingdom as a digital hub and to accelerate social and economic development through digital technology. The strategy highlights digital talents as an accelerator and emphasizes initial training, upskilling, reskilling, bootcamp-type programs, vocational adaptation to labor-market needs and the reinforcement of digital trainers. This policy environment creates an opportunity to integrate blockchain competencies into broader digital capacity-building programs.

Public information on Morocco's digital economy also identifies cloud computing, artificial intelligence, connectivity and talent development as key enablers, while noting challenges related to institutional coordination and regulatory complexity (U.S. International Trade Administration, 2025). These contextual elements are directly relevant to blockchain because blockchain projects depend on interoperable data flows, cybersecurity, cloud or distributed infrastructure, institutional trust and cross-sector collaboration. Training programs therefore need to be designed in alignment with national priorities and organizational realities rather than as isolated technical workshops.

Another contextual factor is the sensitivity of virtual currencies and digital assets. Bank Al-Maghrib draws attention to risks associated with virtual currencies, including lack of consumer protection, volatility, illicit uses and non-compliance with foreign-exchange and capital-market regulations (Bank Al-Maghrib, 2026). For educational programs, this means that blockchain training in Morocco must clearly distinguish enterprise blockchain, distributed ledger applications and process integration from speculative cryptocurrency activities. Regulatory literacy is indispensable for responsible adoption.

(1) Tableau 1 : Theoretical lenses mobilized in the article

Theoretical lens	Main assumption	Contribution to the article
Technology Acceptance Model / UTAUT	Users adopt technology when they perceive it as useful, usable and supported by facilitating conditions.	Explains how training can reduce perceived complexity and increase intention to use blockchain processes.
Technology-Organization-Environment framework	Adoption depends on technological, organizational and environmental conditions.	Positions training as an organizational readiness factor and as a response to environmental uncertainty.
Adult learning theory	Adults learn better when training is problem-centered, relevant and connected to experience.	Guides the design of blockchain training around real Moroccan organizational problems.
Experiential learning	Learning occurs through cycles of action, reflection, conceptualization and experimentation.	Supports the use of blockchain labs, simulations, sandboxes and pilot projects.
Organizational learning	Organizations transform when knowledge becomes embedded in routines, norms and practices.	Frames blockchain integration as workplace transfer and process redesign, not only skills acquisition.

Source : Auteurs

2. Methodology

This paper adopts a conceptual research design. Conceptual articles are appropriate when a phenomenon is emerging, when empirical evidence is fragmented and when theoretical integration is needed to guide future studies (Jaakkola, 2020). The objective is not to measure the current level of blockchain adoption in Morocco, but to construct a coherent framework explaining how training can facilitate blockchain process integration in organizations.

Epistemologically, the study adopts an interpretive-constructivist positioning because it seeks to understand and theoretically organize the meanings, competencies and organizational mechanisms through which actors appropriate blockchain processes. It does not aim to establish causal regularities from a statistically representative sample. The mode of reasoning is primarily abductive: established theories of technology adoption, adult learning and organizational learning are iteratively confronted with the specificities of the Moroccan digital-transformation context in order to generate an integrated explanatory framework and empirically testable propositions.

The methodological approach combines three elements. First, a narrative review of literature on blockchain adoption, technology acceptance, organizational readiness, adult learning, organizational learning and competency-based training was conducted. Second, relevant institutional and policy documents on Moroccan digital transformation were analyzed to identify national orientations concerning digital talent, upskilling and organizational modernization. Third, the concepts were synthesized into a training-based model of blockchain integration and translated into practical propositions for future empirical testing. The documentary corpus constitutes the analytical sample: it includes foundational and recent scientific works selected for their direct relevance to the thematic streams mobilized in the framework, together with Moroccan contextual documents. The unit of analysis is the conceptual or contextual contribution of each document. Selection was guided by thematic relevance, theoretical authority, applicability to organizational process integration and, for policy sources, recency. A narrative review was preferred because the objective is interdisciplinary theoretical integration rather than exhaustive bibliometric mapping or statistical aggregation.

The article therefore produces analytical outputs rather than statistical results: a competence framework, a training intervention matrix, a conceptual model, research propositions and an implementation roadmap. These outputs can serve as a basis for future qualitative case studies, surveys, design-based research or mixed-method studies in Moroccan organizations. This

methodological choice is justified by the limited availability of large-scale empirical data on blockchain training in Moroccan organizations and by the need to develop a theoretically grounded framework before measurement. Table 2 summarizes these methodological choices and their analytical function.

(2) Tableau 2 : Summary of the methodological positioning

Methodological dimension	Choice retained in the article
Research design	Conceptual research article focused on theoretical integration and framework development.
Epistemological positioning	Interpretive-constructivist perspective centered on meanings, competencies and organizational appropriation.
Mode of reasoning	Primarily abductive reasoning linking established theories with the Moroccan digital-transformation context.
Analytical sample	Scientific literature relevant to the mobilized thematic streams and Moroccan institutional and policy documents; no respondent sample.
Analytical strategy	Narrative thematic synthesis, contextual analysis and conceptual model building.
Expected outputs	Competence framework, training matrix, conceptual model, research propositions and implementation roadmap.

Source : Auteur

3. Conceptual Framework: Training-Based Blockchain Process Integration

The proposed framework is based on the idea that blockchain process integration is mediated by training. In other words, technology does not directly transform organizational processes. Transformation occurs when trained actors understand the technology, identify relevant use cases, redesign workflows, collaborate across functions, govern risks and transfer learning into daily routines. Training is thus positioned as a strategic organizational capability.

Five dimensions structure the framework. The first is competence diagnosis. Organizations should begin by assessing the digital literacy, process knowledge and blockchain awareness of different groups. The second is modular learning. Instead of a single generic course, training should be organized into levels: awareness, functional application, technical design, governance and strategic leadership. The third is experiential experimentation. Participants should work with process maps, case studies, prototypes and sandboxes. The fourth is organizational transfer. Learning should be connected to pilot projects, internal procedures, communities of practice and managerial support. The fifth is impact evaluation. Training should be evaluated not only by satisfaction, but also by learning, behavioral transfer, process integration and organizational outcomes.

This framework links educational design to organizational adoption. It suggests that the quality of training influences perceived usefulness, perceived ease of use, trust, readiness and resistance to change. These variables then influence the probability that blockchain will be integrated into real organizational processes.

(3) Figure 1 : Conceptual model of training-based blockchain process integration

Training	Inputs
Competence diagnosis modular curriculum trainers learning resources	
↓	
Learning	Mechanisms
Conceptual literacy experiential labs collaborative problem-solving regulatory awareness	
↓	
Adoption	Mediators
Perceived usefulness perceived ease of use trust readiness reduced resistance	
↓	
Process	Integration
Use-case selection workflow redesign pilot projects governance routines interoperability	
↓	
Organizational	Outcomes
Traceability transparency efficiency accountability innovation capacity	

Source : Auteurs

4. Blockchain Competencies Required in Moroccan Organizations

A major difficulty in blockchain training is the diversity of competencies involved. Blockchain projects require more than coding skills. They require the ability to diagnose a process, identify trust problems, model transactions, manage stakeholders, evaluate legal issues and design change-management mechanisms. In Moroccan organizations, this is especially relevant because blockchain integration may concern both public-sector modernization and private-sector competitiveness.

The following table proposes a competence map by organizational function. It does not mean that every employee must become a blockchain expert. Rather, it shows the specific level of literacy and capability required for each group to participate effectively in a blockchain project.

(4) Tableau 3 : Blockchain competency requirements by organizational function

Organizational function	Required blockchain competencies	Training orientation
Top management	Strategic understanding, use-case selection, investment evaluation, governance choices, risk appetite.	Executive seminars focused on strategy, organizational value, regulation and decision criteria.
IT departments	Architecture, nodes, APIs, smart contracts, cybersecurity, interoperability, testing and maintenance.	Technical modules, labs, sandbox experimentation and certification-oriented pathways.
Operations and process managers	Process mapping, traceability needs, workflow redesign, performance indicators and coordination with partners.	Applied workshops based on real organizational processes and pilot use cases.
Legal and compliance teams	Data protection, contractual validity, liability, auditability, digital identity and regulatory constraints.	Regulatory literacy modules, case analysis and risk assessment exercises.

Human resources and training units	Competency mapping, learning design, change management, communities of practice and evaluation of training impact.	Train-the-trainer programs and competency-based curriculum design.
End-users and frontline staff	Basic blockchain literacy, new procedures, data-entry discipline, responsibility in shared records and user security.	Short practical sessions, simulations and workplace coaching.
External partners	Shared governance rules, data-sharing protocols, interoperability and collaborative standards.	Inter-organizational workshops and consortium training sessions.

Source : Auteurs

5. Training Design for Blockchain Process Integration

5.1. From awareness to operational capability

A frequent weakness of digital training programs is the confusion between awareness and capability (Kirkpatrick & Kirkpatrick, 2006; Knowles et al., 2015). Awareness is necessary because it introduces terminology and reduces fear. However, awareness alone does not enable process integration. A manager may understand the definition of blockchain but still be unable to evaluate whether a procurement process, a certificate verification process or a supply-chain process requires a distributed ledger. A staff member may know that blockchain is secure but still be unable to apply correct data-entry procedures in a shared record system.

The proposed training path should therefore be progressive. Level 1 focuses on blockchain awareness and demystification. Level 2 focuses on use-case identification and process diagnosis. Level 3 focuses on technical and functional design. Level 4 focuses on governance, regulation, cybersecurity and ethics. Level 5 focuses on pilot implementation, evaluation and scaling. This progression supports both individual learning and organizational maturity.

5.2. Pedagogical principles

The training design should follow six pedagogical principles. The first is relevance: examples must be connected to Moroccan sectors such as education, finance, logistics, public administration, agriculture, health, insurance and notarial services. The second is interdisciplinarity: participants should learn in mixed groups to avoid a purely technical vision. The third is experiential learning: participants should manipulate cases, process maps and simple prototypes. The fourth is regulatory responsibility: training must clarify the difference between blockchain applications and unregulated virtual-currency activities. The fifth is transfer: each module should end with an action plan for the workplace. The sixth is evaluation: training success should be measured through behavioral and organizational indicators.

These principles transform training into a mechanism of organizational change. Instead of producing isolated knowledge, training creates conditions for employees to reinterpret their work processes and participate in innovation. This is particularly important in Moroccan organizations where hierarchical structures, administrative routines and uneven digital maturity may slow down technological experimentation.

(5) Tableau 4 : Training intervention matrix by blockchain adoption phase

Adoption phase	Main training objective	Recommended methods	Expected outputs
Pre-adoption	Create shared understanding and identify relevant use cases.	Executive briefings, awareness seminars, sectoral case studies.	Common vocabulary, initial opportunity map, risk awareness.
Readiness diagnosis	Assess skills, processes, infrastructure and stakeholder maturity.	Competence tests, process mapping workshops, interviews.	Training needs analysis, readiness score, priority use cases.
Design and experimentation	Translate use cases into prototypes and governance models.	Labs, design thinking, sandbox exercises, smart-contract simulations.	Prototype, process redesign, data governance rules.
Pilot implementation	Support workplace transfer and user adoption.	Coaching, communities of practice, user manuals, helpdesk learning.	Pilot adoption, user feedback, corrected procedures.
Scaling and institutionalization	Embed blockchain routines into organizational culture and performance systems.	Train-the-trainer programs, internal certification, evaluation meetings.	Internal expertise, standardized procedures, measurable organizational impact.

Source : Auteurs

6. Discussion

The analysis confirms that blockchain integration is inseparable from learning. The same blockchain platform can produce different outcomes depending on the competencies of its users, the readiness of managers, the quality of governance and the capacity of the organization to transfer training into practice. For this reason, Moroccan organizations should approach blockchain not as a fashionable technology, but as a strategic learning project.

The Moroccan digital transformation agenda creates a favorable context for this orientation because it emphasizes talent development and upskilling. However, the existence of national strategy does not automatically produce organizational capability. The translation of strategy into practice requires training institutions, universities, professional organizations and employers to collaborate. Educational Sciences can contribute by designing curricula, evaluating learning outcomes, analyzing resistance to change and developing models of professional competence.

A key point is the need to distinguish blockchain literacy from cryptocurrency speculation. In the Moroccan context, where virtual-currency activities are associated with regulatory and consumer-protection risks, training should provide clear legal and ethical boundaries. This distinction can increase trust among managers and public institutions, and it can help learners focus on responsible enterprise and public-service use cases such as certification, traceability, auditability and secure data exchange.

Another discussion point concerns SMEs. Large organizations may have access to consultants and technical teams, but SMEs often lack internal expertise. Training programs for SMEs should be shorter, more practical and sector-specific. They should help decision-makers answer basic questions: What problem are we trying to solve? Is blockchain really necessary? What data will be shared? Who are the partners? What are the costs and risks? Which competencies are missing? Such questions prevent technological imitation and support responsible innovation.

Finally, training should be evaluated beyond participant satisfaction. A seminar may receive positive feedback while having no effect on organizational processes. A stronger evaluation model should measure knowledge acquisition, change in attitudes, ability to identify use cases, behavioral transfer, pilot implementation and process performance. This orientation is compatible with the Kirkpatrick model but should be adapted to blockchain by including indicators of readiness, governance, interoperability and trust (Kirkpatrick & Kirkpatrick, 2006; Balasubramanian et al., 2021).

7. Implications

7.1. Implications for Educational Sciences

The article contributes to Educational Sciences by showing that emerging digital technologies should be studied through learning, competence and transfer mechanisms. Blockchain integration is not simply a question of IT deployment; it is a transformation of professional knowledge and organizational practices. Researchers in Educational Sciences can investigate how employees build blockchain literacy, how training changes attitudes toward innovation, how communities of practice support transfer and how competence-based curricula can be designed for non-technical learners.

This perspective opens a research agenda on digital professional education in Morocco. Universities and training institutes can develop interdisciplinary programs that connect education, management, law, information systems and public policy. Doctoral research can also examine how blockchain training differs across sectors, how adults learn complex digital concepts and how training evaluation can capture organizational impact.

7.2. Implications for managers and HR departments

Managers should treat blockchain training as a strategic investment. Training budgets should not be limited to technical certification for IT staff. They should include executive literacy, functional workshops, legal and compliance modules, end-user training and train-the-trainer programs. HR departments can play a central role by mapping competencies, selecting learning pathways, coordinating external partnerships and integrating blockchain learning into broader digital-transformation plans.

Managers should also avoid technological determinism. A blockchain solution does not automatically improve transparency or efficiency. These outcomes depend on correct process selection, accurate data input, user discipline, stakeholder trust and governance. Training is the mechanism that aligns these conditions.

7.3. Implications for policymakers and training institutions

For policymakers, the article suggests that national digital strategies should be accompanied by sector-specific training frameworks. Blockchain competencies can be integrated into digital talent programs, vocational training, continuing education and university curricula. Partnerships between universities, public institutions, professional associations and technology providers can create learning ecosystems adapted to Moroccan priorities.

Training institutions should design modular, stackable and certification-oriented programs. A first certificate may cover blockchain literacy for managers. A second may cover functional

process design. A third may cover technical implementation. A fourth may cover governance and compliance. This modular architecture allows organizations to train different profiles without imposing the same technical depth on all learners.

8. Limitations and Future Research

The main limitation of this article is its conceptual nature. It does not measure the current level of blockchain training in Moroccan organizations and does not test the proposed propositions statistically. The framework should therefore be considered a theoretically grounded model rather than an empirical finding. Another limitation is the heterogeneity of Moroccan organizations. Public administrations, banks, universities, SMEs and logistics firms differ in digital maturity, regulatory obligations and available resources. A single training model cannot be applied mechanically to all sectors.

Future research should conduct empirical studies. Qualitative case studies could explore how Moroccan organizations that have experimented with blockchain or related distributed-ledger technologies manage training and change. Quantitative surveys could test the propositions developed in this paper by measuring relationships between training quality, perceived usefulness, resistance, readiness and adoption intention. Design-based research could develop and evaluate a blockchain training module for Moroccan managers or educators. Comparative research could also analyze differences between Morocco and other African or MENA countries.

Conclusion

This article has examined training as a strategic lever for blockchain process integration in Moroccan organizations from an Educational Science perspective. The central argument is that blockchain adoption is not merely a technological decision. It is a learning process through which organizations develop the competencies, shared meanings, governance routines and practical capabilities required to redesign processes around distributed trust and traceability.

The proposed framework identifies five dimensions: competence diagnosis, modular learning, experiential experimentation, organizational transfer and impact evaluation. It also provides a competence map, a training intervention matrix, research propositions and a twelve-month roadmap. These contributions can help Moroccan organizations avoid superficial adoption and move toward responsible, context-sensitive and competence-based blockchain integration.

For Morocco, the issue is timely. National digital transformation strategies emphasize talent development and organizational modernization. Blockchain can contribute to this agenda only if organizations invest in human capacity, regulatory literacy and cross-functional learning. Training is therefore not an accessory to blockchain projects; it is the condition that makes meaningful integration possible.

Références

- (1) Argyris, C., & Schön, D. A. (1978). Organizational learning: A theory of action perspective. Addison-Wesley.
- (2) Balasubramanian, S., Shukla, V., Sethi, J. S., Islam, N., & Saloum, R. (2021). A readiness assessment framework for Blockchain adoption: A healthcare case study. *Technology Forecasting and Social Change*, 165, 120536. <https://doi.org/10.1016/j.techfore.2020.120536>
- (3) Bank Al-Maghrib. (2026). Virtual currency. <https://www.bkam.ma/en/Find-information-about/Virtual-currency>
- (4) Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). A systematic literature review of blockchain-based applications: Current status, classification and open issues. *Telematics and Informatics*, 36, 55-81. <https://doi.org/10.1016/j.tele.2018.11.006>
- (5) Clohessy, T., Acton, T., & Rogers, N. (2019). Investigating the influence of organizational factors on blockchain adoption. *Industrial Management & Data Systems*, 119(7), 1457-1491. <https://doi.org/10.1108/IMDS-08-2018-0365>
- (6) Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. <https://doi.org/10.2307/249008>
- (7) Duan, K., Pang, G., & Lin, Y. (2024). Exploring the current status and future opportunities of blockchain technology adoption and application in supply chain management. *Journal of Digital Economy*, 3, 1-18. <https://doi.org/10.1016/j.jdec.2024.01.005>
- (8) El Koshiry, A., Eliwa, E., Abd El-Hafeez, T., & Shams, M. Y. (2023). Unlocking the power of blockchain in education: An overview of innovations and outcomes. *Blockchain: Research and Applications*, 4(4), 100165. <https://doi.org/10.1016/j.bcra.2023.100165>
- (9) Fachrunnisa, O., & Hussain, F. K. (2020). Blockchain-based human resource management practices for mitigating skills and competencies gap in workforce. *International Journal of Engineering Business Management*, 12, 1-13. <https://doi.org/10.1177/1847979020966400>
- (10) Fartitchou, M., Lamaakal, I., El Makkaoui, K., El Allali, Z., & Maleh, Y. (2024). BlockMEDC: Blockchain smart contracts for securing Moroccan higher education digital certificates. arXiv. <https://arxiv.org/abs/2410.07258>

-
- (11) Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard Business Review*, 95(1), 118-127.
 - (12) Jaakkola, E. (2020). Designing conceptual articles: Four approaches. *AMS Review*, 10, 18-26. <https://doi.org/10.1007/s13162-020-00161-0>
 - (13) Kirkpatrick, D. L., & Kirkpatrick, J. D. (2006). *Evaluating training programs: The four levels* (3rd ed.). Berrett-Koehler.
 - (14) Knowles, M. S., Holton, E. F., & Swanson, R. A. (2015). *The adult learner: The definitive classic in adult education and human resource development* (8th ed.). Routledge.
 - (15) Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
 - (16) Mezirow, J. (1991). *Transformative dimensions of adult learning*. Jossey-Bass.
 - (17) Ministry of Digital Transition and Administrative Reform. (2024). *National strategy Digital Morocco 2030*. Kingdom of Morocco.
 - (18) Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. <https://bitcoin.org/bitcoin.pdf>
 - (19) Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14-37. <https://doi.org/10.1287/orsc.5.1.14>
 - (20) OECD. (2024). *OECD Skills Strategy Framework and Dashboard*. OECD Publishing.
 - (21) Queiroz, M. M., & Wamba, S. F. (2019). Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. *International Journal of Information Management*, 46, 70-82. <https://doi.org/10.1016/j.ijinfomgt.2018.11.006>
 - (22) Risius, M., & Spohrer, K. (2017). A blockchain research framework. *Business & Information Systems Engineering*, 59, 385-409. <https://doi.org/10.1007/s12599-017-0506-0>
 - (23) Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
 - (24) Swan, M. (2015). *Blockchain: Blueprint for a new economy*. O'Reilly Media.
 - (25) Tapscott, D., & Tapscott, A. (2016). *Blockchain revolution: How the technology behind Bitcoin is changing money, business, and the world*. Portfolio.
 - (26) Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.
-

- (27) U.S. International Trade Administration. (2025). Morocco - Digital economy. Country Commercial Guide. <https://www.trade.gov/country-commercial-guides/morocco-digital-economy>
- (28) Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478. <https://doi.org/10.2307/30036540>
- (29) Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.
- (30) Wong, S., Yeung, J. K. W., Lau, Y.-Y., Kawasaki, T., & Kwong, R. (2024). A critical literature review on blockchain technology adoption in supply chains. *Sustainability*, 16(12), 5174. <https://doi.org/10.3390/su16125174>
- (31) World Bank. (2026, June 12). Two new programs to advance Morocco's digital transformation and climate resilience. <https://www.worldbank.org/en/news/press-release/2026/06/12/two-new-programs-to-advance-morocco-s-digital-transformation-and-climate-resilience>
- (32) Yaga, D., Mell, P., Roby, N., & Scarfone, K. (2018). Blockchain technology overview (NISTIR 8202). National Institute of Standards and Technology. <https://doi.org/10.6028/NIST.IR.8202>