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Artificial Intelligence as a Catalyst for Institutional Transformation in Higher Education

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ABSTRACT

Introduction: Artificial intelligence (AI) has evolved from a technological innovation into a strategic catalyst for institutional transformation in higher education. This study explores how AI supports the modernization of academic structures, pedagogical practices, and decision-making processes, moving beyond traditional models of technology adoption toward systemic educational innovation.

Objectives: This work aims to examine how AI contributes to the modernization of higher education by identifying key factors influencing its adoption. It also seeks to develop a strategic framework that aligns technological integration with institutional objectives, leadership practices, and organizational culture to foster sustainable academic transformation.

Methods: A mixed-methods approach was applied, combining quantitative and qualitative techniques. Guided by the Unified Theory of Acceptance and Use of Technology (UTAUT) and Sociotechnical Systems Theory, the study used Likert-scale surveys and focus group discussions with faculty and administrators to analyze individual and organizational perspectives on AI implementation.

Results: Findings reveal that successful AI integration depends not only on user training and technological proficiency but also on leadership engagement, institutional culture, and alignment with educational goals. Interdisciplinary collaboration and ethical awareness emerged as essential components for achieving meaningful and sustainable innovation through AI in higher education.

Conclusions: AI adoption in higher education represents a shift from isolated technological use to systemic innovation. A strategic framework is proposed emphasizing continuous professional development, ethical governance, and collaborative engagement to ensure that AI enhances quality, inclusiveness, and sustainability across institutional and pedagogical dimensions.

Keywords: Artificial intelligence; higher education; pedagogical innovation; educational technology.

1. INTRODUCTION

In the era of rapid digital evolution, artificial intelligence (AI) is no longer simply a technological curiosity within higher education—it has emerged as a strategic lever for institutional transformation. Universities are increasingly recognizing that AI can reshape pedagogical practices, streamline operations, and realign their missions for the 21st-century learner [1]. Indeed, a recent systematic review underscored the exponential growth of AI research in higher education, highlighting a shift from focusing primarily on student-level tools to examining broader institutional and organizational implications [2].

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Despite this momentum, many higher education institutions (HEIs) struggle to conceptualize AI as more than a collection of point solutions. Instead of incremental adoption, a holistic perspective is required—one that treats AI as an enabler of institutional transformation, influencing strategy, governance, infrastructure, and human capability. This shift from technology-driven adoption to strategic integration echoes the concept of the "smart university", which posits that universities can evolve by integrating AI and other advanced technologies to enhance accessibility, personalization, and operational efficiency [3].

The need to adopt a systemic lens is particularly compelling when considering the feedback loops and dynamic interactions that AI introduces into higher education ecosystems. For example, a systems-thinking study of AI in HEIs developed a causal loop diagram to illustrate how investment in AI can reshape an institution's value creation by altering learning processes, administrative workflows, and market positioning [4]. This reinforces the view that institutions should not only adopt AI but also reshape organizational culture, leadership and governance to realize its full potential.

In Latin America and other emerging regions, the transformation drive is underpinned by both opportunity and constraint: digital infrastructure, institutional readiness and faculty AI-literacy are uneven, causing fragmentation in AI uptake. In such contexts, AI has the potential not only to modernize but also to deepen equity, responsiveness and sustainability in higher education. For the Universidad Autónoma de Coahuila (UAC) in Mexico, the challenge thus becomes not simply "Will we adopt AI?" but "How can we orchestrate AI-driven change across institutional layers—pedagogy, leadership, infrastructure and governance?"

This study advances this question by exploring AI integration at UAC from an institutional-transformation perspective, focusing on how academic structures, decision processes and pedagogical practices evolve in response to AI. Unlike prior studies that focus exclusively on individual acceptance models, this research draws on a combined theoretical lens of organizational strategy and sociotechnical systems. To provide more depth, the present study also links to decision-making frameworks and computational intelligence tools developed in complex environments—for instance, decision-support systems for highly complex project-portfolio situations [5] and multi-criteria classification methods informed by evolutionary algorithms [6]. These tools highlight the methodological rigor possible when organizational decisions are framed within advanced AI-enabled systems. Moreover, parallels can be drawn with computational intelligence approaches in domains such as stock-portfolio management [7], illustrating how AI integration in institutional contexts can leverage similar algorithmic decision-support architectures.

Accordingly, the objectives of this research are threefold: (1) to analyze how UAC's institutional systems, culture, leadership and infrastructure influence the strategic deployment of AI; (2) to examine how AI-enabled transformation is reflected in pedagogical innovation, faculty practices and student learning pathways; and (3) to develop a strategic framework for AI-driven institutional transformation in higher education. By doing so, the study offers a novel contribution to the literature by repositioning AI from being a tool of individual adoption to a catalyst of institutional renewal.

2. LITERATURE REVIEW

2.1 Artificial intelligence in higher education: scope and trends

Since 2023, scholarship has documented a rapid broadening of AI's role in higher education (HE) from classroom-level tools to institution-wide change agendas. A widely cited systematic review synthesized 138 peer-reviewed articles (2016–2022) and reported steep growth in AI-in-HE publications and use cases, spanning assessment, prediction/early-alert systems, AI assistants, intelligent tutoring systems, and learning management applications [2]. Subsequent work has advanced this descriptive base toward strategic transformation narratives, arguing that AI should be framed not merely as a set of technologies but as a lever for organizational renewal and "smart university" development [3].

Where earlier studies often centered on individual acceptance and classroom impacts, recent research calls for system-level perspectives that connect AI to strategy, governance, data infrastructure, and culture. A systems approach proposed for higher education institutions (HEIs) maps feedback loops—e.g., how leadership commitment and data capability amplify AI investment, which in turn reshapes pedagogy and operations—highlighting that

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durable outcomes depend on institutional learning and governance, not tool deployment alone [4]. This aligns with strategic management views of AI in HE that emphasize change management, capability building, and alignment with educational missions [3].

2.2 AI-enabled decision support and multi-criteria governance

A parallel literature on decision support and computational intelligence provides actionable architectures for HEIs to operationalize AI at the governance layer—e.g., for portfolio selection, program prioritization, and resource allocation. Multi-criteria decision-making (MCDM) and preference-learning methods offer transparent, auditable mechanisms for complex choices under multiple goals and constraints. Evidence from adjacent domains illustrates how comprehensive decision support systems integrate soft computing, optimization, and rule-based screening to handle high-dimensional portfolios [8], [9]. Within the MCDM family, recent advances learn parameters of ELECTRE-based sorting methods to align system outputs with stakeholder preferences, reducing reliance on ad-hoc heuristics and improving explainability [10]. Similarly, multicriteria models have been applied to public-policy problems—such as the evaluation of common-jurisdiction violence across Mexican state capitals—demonstrating the portability of these frameworks to contextualized, high-stakes governance [11]. Together, these contributions suggest a design space for HEIs to embed MCDM-plus-AI approaches into institutional decision processes, thereby linking data pipelines, value criteria, and transparent accountability.

Across recent studies, four enabling conditions recur. First, leadership and strategy: AI initiatives are most effective when anchored to institutional goals and overseen by cross-functional governance that can adjudicate trade-offs among innovation, equity, and academic quality [3], [12]. Second, culture and capabilities: faculty and staff need sustained opportunities to develop AI and data literacies, ethical awareness, and redesign skills for AI-infused pedagogy and services [13]. Third, data and infrastructure: system-level benefits depend on interoperable platforms, data quality, and privacy-by-design principles [4]. Fourth, integrity-aware assessment and policy: as GenAI reshapes learning and assessment, institutions must align policies, assessment formats, and student support to promote responsible, high-trust use [14]. This literature motivates the present study's shift from individual adoption to institutional transformation, and it informs a governance-aware, decision-support-oriented framework for AI strategy in higher education.

Finally, the rapid diffusion of generative AI has elevated governance from a peripheral concern to a central pillar of institutional AI strategies. Multi-institution case analyses show universities converging on guidance that balances opportunity with risks to academic integrity, clarifies role-specific responsibilities, and distributes oversight across academic units and central offices [12]. Complementary scholarship underscores that effective AI governance requires attention to knowledge stewardship, ethical literacy, and legal compliance among students and staff [13]. Systematic reviews likewise document the evolving integrity landscape, noting both the pedagogical benefits of GenAI and the need for robust policies, detection limits awareness, and assessment redesign [14].

3. METHODS

3.1 Research design

This study adopts a mixed-methods, explanatory sequential design aimed at understanding how artificial intelligence serves as a catalyst for institutional transformation at the Autonomous University of Coahuila. Quantitative data were collected first to measure the extent and perception of AI use across academic units, followed by qualitative inquiry to interpret the underlying organizational and cultural dynamics that shape AI integration. The integration of both methods provides a comprehensive view that links measurable adoption indicators with deeper institutional and pedagogical transformations.

The study is grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT) and complemented by Sociotechnical Systems Theory. The UTAUT model enables the assessment of how performance expectancy, effort expectancy, social influence, and facilitating conditions affect individuals' intention to use AI. The sociotechnical perspective broadens this understanding by examining how technical infrastructures, organizational structures, and human factors interact to influence institutional transformation [4]. The research population consists of 354 faculty members distributed among four academic divisions at the UAC Torreón Campus. A stratified random sampling

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approach was used to ensure representation across disciplines. The sample size was determined using a 95% confidence level and a 5% margin of error, resulting in a minimum of 185 participants.

3.2 Quantitative phase

A structured questionnaire was developed and administered electronically using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The instrument contained three sections: (1) demographic and professional background, (2) AI awareness and use, and (3) institutional and pedagogical impacts.

The constructs measured corresponded to UTAUT's four core factors plus two additional variables derived from the sociotechnical perspective: institutional readiness and organizational culture. The instrument was adapted from validated models in prior AI-in-education studies [2], [3] and subjected to content validation by five experts in educational innovation and information systems. Reliability was assessed using Cronbach's alpha, yielding coefficients above 0.80 for all constructs, indicating strong internal consistency. Quantitative data were analyzed using SPSS v.29, employing descriptive statistics, exploratory factor analysis (EFA), and multiple regression to test relationships among variables.

3.3 Qualitative phase

To complement the quantitative results, focus group interviews were conducted with 16 participants selected from the survey respondents to represent different faculties and levels of AI adoption. The sessions explored perceptions of institutional support, ethical concerns, professional development, and governance mechanisms associated with AI use. Interviews were transcribed verbatim and analyzed through thematic coding using NVivo 14, following Braun and Clarke's [15] six-phase framework for thematic analysis. Triangulation was achieved by comparing themes emerging from qualitative data with quantitative findings.

Building on literature that connects AI with decision-support systems and multi-criteria modeling, the methodological framework incorporates conceptual parallels from complex decision environments. In particular, the approach mirrors multi-criteria and preference-learning systems previously developed for financial and social-governance contexts [9], [10], [11]. These frameworks informed the interpretation of institutional decision-making processes regarding AI policy, resource allocation, and faculty training priorities.

3.4 Ethical considerations and limitations

The research protocol complied with the UAC Research Ethics Guidelines (2024). Participation was voluntary and anonymous. Respondents provided informed consent and were assured of confidentiality. Data were stored in encrypted repositories and used exclusively for academic purposes.

Two primary limitations were recognized. First, although the study is grounded in a case-study approach, results may not generalize to all institutions due to contextual variations in governance and infrastructure. Second, the survey relies on self-reported measures, which may be influenced by response bias. These limitations were mitigated through triangulation between quantitative and qualitative evidence and by aligning findings with external benchmarks from recent global studies.

4. RESULTS

4.1 Descriptive statistics

A total of 263 valid responses were obtained from the 354 faculty members invited, representing a 74.3% response rate. Respondents were distributed across four academic divisions: Engineering (34%), Social Sciences (28%), Administrative Sciences (22%), and Humanities (16%). The sample reflected balanced gender representation (52% female, 48% male) and a broad range of teaching experience (from 1 to 35 years, $M = 14.6$).

Awareness of artificial intelligence (AI) was nearly universal, with 97.7% of respondents indicating familiarity with at least one AI-based educational or productivity tool. However, only 23.5% reported regular use (weekly or daily) of AI in their teaching or research activities, while 61.6% used AI occasionally and 14.9% reported never having applied AI tools in their professional context.

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The mean scores of the key constructs were as follows (on a five-point Likert scale):

- *Performance expectancy* = 4.12 (SD = 0.63)
- *Effort expectancy* = 3.78 (SD = 0.71)
- *Social influence* = 3.55 (SD = 0.80)
- *Facilitating conditions* = 3.62 (SD = 0.77)
- *Institutional readiness* = 3.41 (SD = 0.84)
- *Organizational culture for innovation* = 3.28 (SD = 0.81)

Overall, results reveal moderate institutional support and readiness for AI, with relatively higher optimism about AI's potential benefits compared to perceptions of organizational preparedness.

An exploratory factor analysis (EFA) using principal component extraction and varimax rotation confirmed the six-factor structure hypothesized from the UTAUT and sociotechnical frameworks. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.89, and Bartlett's test of sphericity was significant ($\chi^2 = 1862.7$, $p < 0.001$). The six components explained 71.4% of the total variance.

Reliability analysis yielded Cronbach's alpha values ranging from 0.81 (*Social influence*) to 0.92 (*Performance expectancy*), indicating strong internal consistency across all constructs.

4.2 Regression analysis

A multiple regression analysis was performed to determine the predictors of behavioral intention to use AI. The overall model was significant ($F(6, 256) = 34.87$, $p < 0.001$), explaining 48.6% of the variance in behavioral intention.

Table 1. Results of the regression analysis

Predictor Variable	Standardized β	t-value	Sig. (p)
Performance expectancy	0.33	6.25	< 0.001
Effort expectancy	0.21	4.18	< 0.001
Social influence	0.12	2.51	0.013
Facilitating conditions	0.19	3.89	< 0.001
Institutional readiness	0.26	5.47	< 0.001
Organizational culture	0.18	3.62	< 0.001

The strongest predictors of AI adoption were performance expectancy, institutional readiness, and effort expectancy, suggesting that both perceived benefits and the university's structural capacity substantially shape adoption behaviors.

4.3 Qualitative findings

Analysis of the focus group discussions produced four overarching themes:

1. Pedagogical experimentation and innovation.

Faculty members described using AI for content creation, assessment, and research design. However, experimentation was largely individual and unsystematic. Participants emphasized the need for institutional frameworks and ethical guidelines to standardize use.

2. Institutional and leadership support.

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Participants agreed that leadership endorsement and cross-departmental collaboration are essential. They called for formal recognition of AI-driven innovation in teaching evaluations and promotion criteria, aligning with findings by [3].

3. Ethical and data governance concerns.

Faculty expressed apprehension about plagiarism detection, data privacy, and the reliability of AI-generated outputs. These concerns mirror global findings that governance and transparency are decisive for trust and sustained use [12], [13].

4. Capacity building and training.

The absence of structured professional development emerged as the most cited barrier. Participants requested ongoing workshops, AI literacy certification, and mentoring programs that connect pedagogical design with AI ethics and technical skills.

4. 4 Integration of quantitative and qualitative results

The integration of both phases confirmed that technological familiarity alone does not ensure adoption. While individual attitudes toward AI are positive, systemic and institutional conditions—such as training, governance, and resource allocation—mediate actual implementation. This aligns with the systems approach proposed by [4], which highlights the co-evolution of technological and organizational subsystems in AI transformation.

Findings also suggest that AI readiness is multidimensional, encompassing not only access to infrastructure but also decision-support frameworks capable of prioritizing initiatives and balancing ethical considerations. In this sense, the university's transformation process parallels multi-criteria decision environments previously modeled in computational-intelligence research, where optimization, transparency, and stakeholder preferences must coexist [9], [10], [11].

Quantitative data demonstrate that perceived usefulness, institutional readiness, and supportive culture are the principal drivers of AI adoption among UAC faculty. Qualitative insights reveal a complementary narrative: enthusiasm constrained by uneven policy, training, and governance. Together, these results validate the need for a strategic, institution-wide AI framework that integrates technological, organizational, and human dimensions to achieve sustainable transformation in higher education.

5. DISCUSSION

This study set out to examine how AI operates as a driver of institutional transformation in higher education through a case study of the UAC. Integrating quantitative analysis under the UTAUT approach with qualitative exploration informed by Sociotechnical Systems Theory, the findings highlight that AI adoption at the university level is not merely a question of technological availability or individual willingness; it is an institutional, cultural, and strategic process.

The quantitative results demonstrated that institutional readiness and organizational culture exert a significant influence on faculty intention to use AI, alongside traditional predictors such as perceived usefulness and ease of use. This underscores that sustainable AI integration requires a supportive ecosystem (comprising leadership endorsement, governance structures, data infrastructure, and faculty empowerment) rather than isolated technological initiatives. Without institutional alignment, the potential of AI remains underutilized and fragmented across units.

The mixed-methods findings confirm that AI's true value in higher education emerges when institutions move beyond pilot-level adoption to strategic and systemic integration. The presence of isolated experimentation among UAC faculty indicates an emergent innovation culture, but one lacking institutional coordination. Aligning these efforts under a unified strategy would enable the university to transition from individual-level innovation to organization-wide transformation. This observation is consistent with recent system-level analyses of AI governance and transformation in universities [3], [4].

Qualitative data emphasized persistent concerns regarding ethics, data governance, and faculty preparedness. Addressing these areas requires the establishment of AI governance frameworks that ensure ethical standards, transparency, and accountability, as highlighted by [12] and [13]. Furthermore, professional development initiatives—continuous training, AI literacy certification, and communities of practice—must be institutionalized to build confidence and competence among educators.

Drawing on the parallels between multi-criteria decision-making (MCDM) and institutional governance, this study proposes the adoption of AI-enabled decision-support systems to guide resource allocation, policy design, and project prioritization. Similar frameworks have proven effective in complex contexts such as portfolio management and public-policy evaluation (Solares, De-León-Gómez, Salas, & Díaz, 2022; López, Gamboa, Solares, Santiesteban, Díaz, & Flores, 2023; Navarro, Fernández, Solares, Flores, & Díaz, 2023). Applying these models within universities can enhance transparency, fairness, and efficiency in AI-related decisions.

For policymakers and university leaders, the findings suggest that AI integration should be treated as a strategic transformation agenda, not an IT modernization project. The UAC experience demonstrates the need for:

- A university-wide AI governance council linking academic, technical, and ethical perspectives.
- Investment in data ecosystems that support analytics and decision-making.
- The incorporation of AI competencies into academic promotion and evaluation systems.
- The design of interdisciplinary research and training programs that position the university as an AI learning organization.

This case study, while rich in contextual depth, is bounded by its focus on a single institution. Future studies should include comparative analyses across universities, longitudinal tracking of transformation processes, and model-based simulations to evaluate the long-term impacts of AI governance frameworks. Additionally, integrating computational-intelligence techniques for institutional scenario analysis—such as those demonstrated in complex project-portfolio systems [5]—could deepen the predictive and strategic dimensions of AI policy research.

Ultimately, the study reveals that the transformative potential of AI in higher education lies not in technology itself but in the institutional capacity to learn, adapt, and decide intelligently. By embedding AI within decision processes, ethical standards, and strategic planning, universities can evolve toward becoming adaptive, data-informed, and ethically grounded ecosystems capable of meeting the challenges of the digital age.

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