الدور المُيسّر لإدارة الجودة في تعزيز العلاقة بين التحوّل الرقمي القائم على الذكاء الاصطناعي وثقافة الابتكار في الجامعات: دراسة ميدانية في قطاع التعليم العالي

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جامعة البصرة – العراق

مقدمة:

أدى التطور السريع للذكاء الاصطناعي إلى تحول رقمي شامل في قطاعات عديدة، بما في ذلك تحسين التدريب، وتغيير الأنظمة المؤسسية والنماذج التشغيلية بشكل جذري. وتدمج الجامعات، بصفتها مراكز للمعلومات والابتكار، بشكل متزايد استراتيجيات التحول الرقمي القائمة على الذكاء الاصطناعي لتحسين الكفاءة الإدارية، وتحسين عملية صنع القرار، وتهيئة بيئة أكاديمية مواتية للابتكار. ومع ذلك، فإن مدى مساهمة هذه التغييرات في تحسين أسلوب حياة الابتكار يبقى متوقفًا على عدة عناصر تنظيمية، من بينها الإدارة الجيدة التي تلعب دورًا محوريًا. وباعتبارها إطارًا راسخًا للتطوير المستمر، وتقييم الأداء، والمواءمة الاستراتيجية، تضمن مراقبة الجودة التطبيق الفعال لتكنولوجيا الذكاء الاصطناعي مع الحفاظ على المتطلبات المؤسسية. ومن خلال تخفيف التحديات، بما في ذلك الاضطرابات التكنولوجية والمقاومة التنظيمية، فإنها تعزز العلاقة بين التحول الرقمي القائم على الذكاء الاصطناعي وثقافة الابتكار الفرعية. وفي هذا السياق، يصبح تقييم الدور المُحسّن للإدارة الجيدة أمرًا بالغ الأهمية للجامعات التي تسعى إلى الاستفادة من الذكاء الاصطناعي مع الالتزام بمعايير عالية الجودة لتعزيز قدرتها الابتكارية. يتناول هذا البحث الطموحات لاكتشاف تأثير التحول الافتراضي القائم على الذكاء الاصطناعي على نمط الحياة الابتكاري في الجامعات، مع التركيز على التأثير المعتدل للإدارة الجيدة من خلال دراسة ميدانية تجريبية في قطاع التعليم العالي.

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مشكلة البحث:

تتبنى الجامعات استراتيجيات التحول الافتراضي المدعومة بالذكاء الاصطناعي لتحسين الأداء المؤسسي ودعم الابتكار. ومع ذلك، يبقى تأثيرها الفعلي على ثقافة الابتكار الفرعية مرتبطًا بالعناصر التنظيمية، ولا سيما إدارة الجودة. يمكن لإدارة الجودة أن تُسهّل أو تُقيّد دمج التكنولوجيا الذكية ضمن الأطر المؤسسية، مما يؤثر على تحقيق التحول الرقمي في تعزيز بيئات تعليمية متطورة. وهذا يُفاقم مشكلة البحث المتعلقة بمدى تأثير إدارة الجودة على العلاقة بين التحول الافتراضي المدعومة بالذكاء الاصطناعي وثقافة الابتكار في الجامعات، وهو سؤال تهدف هذه الدراسة إلى بحثه من خلال دراسة ميدانية في قطاع التعليم العالي.

اسئلة البحث:

إلى أي مدى تساهم الرقابة الاستثنائية في تعديل العلاقة بين التحول الرقمي المعتمد على الذكاء الاصطناعي وتطوير ثقافة فرعية للابتكار في الجامعات؟

اهداف البحث:

يهدف هذا البحث إلى استكشاف تأثير التحول الرقمي القائم على الذكاء الاصطناعي على بيئة الابتكار داخل الجامعات، مع التركيز بشكل خاص على التأثير المُنظِّم للإدارة المتميزة. من خلال دراسة تجريبية في مجال التعليم العالي، حيث يسعى البحث إلى دراسة كيف يُمكن لممارسات التحكم الفعّالة أن تُسهّل التكامل الناجح لتقنيات الذكاء الاصطناعي، مع تهيئة بيئة مُحفّزة للابتكار. أن نتائج هذه الدراسة ممكن ان تُقدّم رؤى قيّمة حول كيفية تطبيق الجامعات للذكاء الاصطناعي بفعالية، وتعزيز قدراتها الابتكارية من خلال الجمع بين هياكل التحكم الفعّالة.

أهمية البحث:

تركز هذه الدراسة على معرفة تأثير التحول الافتراضي القائم على الذكاء الاصطناعي على نمط حياة الابتكار في الجامعات، مع تسليط الضوء على الدور المعتدل للإدارة الجيدة في تحسين هذا النمط.

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منهج البحث:

استخدام المنهج الكمي في تحليل استمارة الاستبانة – Questionnaire الي تم توزيعها على عينة البحث.

الكلمات المفتاحية: التحول الرقمي القائم على الذكاء الاصطناعي، ثقافة الابتكار، إدارة الجودة، التكامل التكنولوجي، والأتمتة الذكية.

The Moderating Role of Quality Management in Strengthening the Relationship Between AI-Driven Digital Transformation and Innovation Culture in Universities: A Field Study in the Higher Education Sector

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Abstract:

The better schooling sector is in a rapid digital transformation fueled via artificial intelligence (AI), reshaping institutional fashions and influencing university innovation surroundings. This study examines the impact of AI-driven virtual transformation on the lifestyle of innovation in universities, highlighting the moderating position of nice management in improving this dating. Using a descriptive-analytical method supported by an area study, statistics have been collected from educational specialists and analyzed via Structural Equation Modeling (PLS-SEM) with SmartPLS4.

The findings suggest that AI-driven digital transformation appreciably complements the culture of innovation, with its effect largely depending on the effectiveness of pleasant management inside instructional institutions. Key dimensions of virtual transformation, consisting of sensible automation, data evaluation, choice-making, and consumer revel in development, definitely affect innovation, both immediately or via the mediating role of first-rate management. Furthermore, the examination shows that a systematic best management framework facilitates addressing technological integration demanding situations and aligns AI technologies with institutional goals, fostering innovation.

The review recommends strengthening good control practices as a key enabler of effective digital transformation, strategically investing in AI technologies to promote innovation, and fostering flexible academic environments that adapt to technological improvements. It additionally stresses the need for clear policies on pleasantness and innovation to maximize the advantages of virtual transformation in higher education.

Keywords: AI-driven digital transformation, culture of innovation, quality management, technological integration, intelligent automation.

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1 Introduction:

The accelerated evolution of artificial intelligence (AI) has triggered a profound wave of digital transformation across various sectors, with higher education being no exception. Universities—recognized as pivotal institutions for knowledge production and dissemination—are increasingly adopting AI-driven digital transformation strategies to enhance administrative efficiency, automate academic services, and foster an environment conducive to innovation and creativity (West, 2018; Aoun, 2017). This transformation, however, extends beyond the adoption of technology; it implicates fundamental changes in organizational culture, decision-making processes, and institutional structures. Amid these developments, cultivating a robust innovation culture has become a strategic priority for universities striving to remain relevant and competitive in the digital age (Brynjolfsson & McAfee, 2017).

While AI-driven digital transformation holds significant promise for advancing innovation, empirical evidence suggests that its impact on organizational culture—particularly the innovation culture—varies widely depending on internal organizational dynamics (Bughin, et al., 2018). One such critical dynamic is **quality management**, which plays a moderating role in shaping the effectiveness of AI integration. As a systematic approach to continuous improvement, performance evaluation, and strategic alignment, quality management ensures that digital transformation efforts are not only technically sound but also aligned with institutional missions and academic standards (Fullan, 2016) (Oakland, 2014). It provides the governance structure necessary to manage technological disruptions, reduce resistance to change, and foster a sustainable innovation climate within higher education institutions (Mohammed, 2023).

The moderating influence of quality management is particularly vital in the context of AI adoption. While AI technologies offer tools to enhance institutional agility and innovation capacity, their transformative potential can only be fully realized when integrated within a strong quality assurance framework that supports long-term objectives and academic integrity (Rouhiainen, 2019). Yet, despite growing scholarly interest in AI adoption

and innovation in higher education, there remains a **notable research gap** concerning the **intervening role of quality management** in this relationship. Existing studies often explore digital transformation or innovation culture in isolation, overlooking how quality management can act as a catalyst—or barrier—in linking AI-driven transformation with a thriving innovation ecosystem.

This study addresses this gap by investigating the **moderating role of quality management** in strengthening the relationship between **AI-driven digital transformation** and the **innovation culture** in universities. Through a field-based empirical study in the higher education sector, this research seeks to illuminate how quality management practices facilitate the effective integration of AI technologies while nurturing a culture of innovation. The findings are expected to contribute to the literature on digital transformation in higher education and offer practical guidance for institutional leaders aiming to harmonize technological advancement with continuous quality enhancement.

2 Research problem:

Universities adopt AI-pushed virtual transformation strategies to beautify institutional performance and support innovation. However, its actual impact on innovation subculture remains contingent upon organizational elements, maximum notably fine management. Quality management can either facilitate or restrict the mixing of smart technology within institutional frameworks, thereby influencing the fulfillment of digital transformation in fostering progressive instructional surroundings. This increases the research problem concerning the volume to which high-quality management moderates the relationship among AI-pushed virtual transformation and innovation tradition in universities, a question this study objective to research through a field look at inside the better education sector. The absence of a dependent technique for fine management may lead to implementation challenges, resistance to exchange, and misalignment among technological improvements and institutional targets. This leads us to invite the following question: **To what quantity does exceptional control moderate the connection between**

AI-driven virtual transformation and the improvement of an innovation subculture in universities?

Research Hypothesis:

H: Quality management plays a statistically significant moderating role in enhancing the relationship between AI-driven digital transformation and the innovation culture within universities.

H1.1: There is a significant relationship between AI-Driven Digital Transformation and Innovation Culture in Universities.

H1.2: There is a significant relationship between Quality Management and Innovation Culture in Universities.

H1.3: There is a significant relationship between AI-Driven Digital Transformation and Quality Management

3 Research variables

The present Research investigates key variables that illustrate how AI-driven digital transformation impacts the culture of innovation within universities, mediated by quality management practices. The main independent variable, AI-Driven Digital Transformation, is defined as the strategic integration of artificial intelligence technologies into university processes to fundamentally transform teaching, learning, and administrative operations. This transformation enhances institutional agility and responsiveness in an increasingly digital educational environment (Vial, 2019). One critical dimension of this transformation is Intelligent Automation, which involves the use of AI technologies such as machine learning and robotic process automation to execute repetitive or complex tasks autonomously. In higher education, intelligent automation streamlines administrative tasks and supports academic functions, thereby improving operational efficiency (Davenport & Ronanki, 2018). Data Analytics and Decision-Making represent the institution's ability to harness large datasets through AI and advanced analytics techniques to inform strategic decisions. Predictive analytics, for instance, enables universities to identify at-risk students, optimize resource allocation, and improve academic outcomes (Yu Lee, Hsu, & Cheng, 2022). Another important facet is Personalization and User Experience Enhancement, which captures how AI enables tailored educational content delivery and customized student services by adapting learning pathways and interactions to individual preferences and needs. Personalized learning environments have

been shown to improve student engagement, satisfaction, and learning outcomes (Chen, Chiang, & Storey, 2012). The dependent variable, Innovation Culture in Universities, captures the organizational environment that promotes creativity, experimentation, and the adoption of new ideas and technologies. Such a culture is essential for universities to thrive in the face of evolving educational demands (Ahmad, 1998). Lastly, Quality Management refers to systematic processes aimed at ensuring academic standards and institutional effectiveness. In the context of AI-driven digital transformation, quality management frameworks ensure the alignment of new technologies with institutional goals, supporting continuous improvement and sustainable innovation (Sallis, 2014).
Together, these variables build a comprehensive framework to understand how AI technologies, facilitated by robust quality management, cultivate a sustainable innovation culture in higher education institutions.

4 Theoretical Framework

The integration of synthetic intelligence (AI) into the virtual transformation of higher training institutions has emerged as a vital component in reshaping instructional and administrative tactics. AI-driven digital transformation signifies an essential shift that extends beyond operational and strategic frameworks to embody the cultural and institutional dimensions of universities. This transformation enables institutions to adapt to the swiftly evolving digital landscape; but it's miles inherently complex and multifaceted, encouraged by using numerous determinants which include organizational readiness, leadership procedures, automation, and human concerns. These factors together form the pace and success of AI adoption across industries, along with higher education (Taraza, Anastasiadou, Papademetriou, & Masouras, 2024) (Jacob, Daniel, Roman, & Edward, 2023). As a key thing of the Fourth Industrial Revolution, AI is using innovation and efficiency within universities, facilitating the optimization of operations, enhancement of tutorial programs, and personalization of learning experiences. AI-powered adaptive learning gear, as an example, allows institutions to tailor educational content material to fulfill the particular desires of person students. Additionally, AI contributes to the refinement of evaluation methodologies, actual-time instructional performance tracking, and the provision of personalised assist

structures, all of which serve to enrich the general pupil's enjoyment (Aldoseri, Al-Khalifa, & Hamouda, 2024).

Despite its potential, AI adoption in better education isn't always merely a technological shift; it necessitates profound cultural and organizational editions. The success of virtual transformation within academic institutions is contingent upon the improvement of administrative skills that align with rising technological developments and the capability of instructional management to navigate the moral and social implications associated with AI integration. A crucial issue of this alteration involves the upskilling of faculty and administrative groups of workers to ensure the powerful utilization of AI-driven equipment (Fenwick, Molnar, & Frangos, 2024). Automation plays a pivotal position in expediting digital transformation techniques in universities, streamlining key administrative capabilities consisting of scholar admissions, resource allocation, and academic performance tracking. By leveraging AI-based automation, institutions can enhance information-driven decision-making, refining instructional and research strategies whilst improving institutional efficiency (Aldoseri, Al-Khalifa, & Hamouda, 2024). Nevertheless, the implementation of AI in better education creates morally demanding situations, especially regarding facts privateness, and safety. Addressing these concerns requires a flexible regulatory framework that bills for the rapid evolution of AI technology whilst safeguarding moral and human values (Rorink, 2024).

A valuable component of this digital transformation is the cultivation of an innovation subculture inside better training institutions, which is essential for reshaping educational environments, fostering novel studies outputs, and equipping college students with the talents essential to navigate an unexpectedly evolving worldwide market. The global emphasis on innovation stems from improved opposition amongst universities striving to beautify their research competencies, instill entrepreneurial wondering, and bring graduates with competencies that align with industry needs (Aithal & Maiya, 2023). Establishing a dependent framework for fostering innovation inside better training is imperative to make sure that innovation permeates institutional subculture, curriculum design, and student engagement. The evolving research landscape in better schooling reflects a shift closer to an innovation-pushed paradigm, influencing pupil behaviors and academic outcomes. According to (Roffeei, Kamarulzaman, & Yusop, 2016), key determinants of innovation culture amongst students

consist of self-efficacy, effective verbal exchange, and an environment conducive to innovation. Their findings emphasize the need for universities to domesticate an atmosphere that prioritizes open conversation and self-belief, fostering progressive behaviors and entrepreneurial wondering.

Global universities are increasingly reconfiguring their curricula and research agendas to embed innovation as a fundamental issue of institutional improvement. As globalization keeps reshaping education systems, establishments ought to adapt by means of reassessing studies funding mechanisms, enhancing institutional reputations, and improving graduate employability (Fuad, Musa, & Hashim, 2022). This paradigm shift necessitates a departure from conventional educational systems in the direction of an integrative technique that carries innovation into organizational lifestyle, societal expectations, and country-wide educational policies. Fuad, (Fuad, Musa, & Hashim, 2022) discover key factors together with collaboration, management, and school engagement as important for fostering progressive mindsets that transcend traditional instructional boundaries. A successful implementation of an innovation lifestyle in universities is in addition supported through systematic frameworks designed to measure and promote innovation. Roffeei, Kamarulzaman, & Yusop (2016) recommend a framework especially tailor-made to innovation subculture in higher schooling, outlining strategic tasks that cultivate creativity, vital wondering, and entrepreneurial sports among college students. Such initiatives no longer make a contribution to institutional global standing however also beautify the popularity of universities as innovation hubs. Moreover, (McKellar, 2018)highlights the importance of fostering an innovative way of life amongst an academic body of workers, college students, and graduates, advocating for engagement with both internal stakeholders (college, team of workers) and outside stakeholders (corporations, groups) to nurture entrepreneurial competencies and drive innovation. This dual engagement approach is essential for ensuring the sustainability of innovation within the better education area, reaping rewards for both institutions and broader societal development.

Total Quality Management (TQM) performs an essential function in moderating the connection among AI-pushed virtual transformation and the enhancement of innovation culture in higher education establishments. As universities combine AI to optimize administrative capabilities,

customize mastering, and improve research skills, the implementation of a dependent satisfactory control framework guarantees that those virtual innovations align with institutional goals and contribute to a culture of non-stop development. (Yusuf, 2023) highlight the large effect of TQM on higher education satisfaction, demonstrating its function in fostering surroundings conducive to sustained innovation. (Dzimińska, 2022) further emphasizes that a strong nice culture, coupled with transformative pedagogical tactics, is a key enabler of a perfect college environment wherein intellectual, crucial, and private development are prioritized.

With the evolution of overall performance governance in better training, institutions are increasingly evaluated based on their capacity to balance virtual transformation with significant academic results (Huisman & Stensaker, 2022). The use of overall performance indicators, as tested by way of (Sarrico, 2022), displays each of the challenges and opportunities provided by means of AI integration in higher training control, ensuring that accountability mechanisms do now not impede creativity and improvement. The European Foundation for Quality Management (EFQM) Excellence Model, as explored by means of (Taraza, Anastasiadou, Papademetriou, & Masouras, 2024), affords a based technique to keeping pleasant and equity in education, reinforcing its capability to support universities in navigating digital transformation while upholding high academic requirements. Similarly, (Carvalho, Rosa, & Amaral, 2023) strain on the significance of inner and external assurance in cross-border better education, highlighting the need for cooperative frameworks to maintain educational best amid AI-driven digitalization. Internal first-rate assurance mechanisms, particularly in the Indonesian context as mentioned by way of (Sugesti, 2023) underscore the importance of unbiased institutional oversight in ensuring that virtual tools enhance instructional integrity and innovation as opposed to compromising them. The COVID-19 pandemic improved AI-driven solutions in excellent assurance, making virtual accreditation and evaluation strategies well-known practices (Hou, Lu, & Hill, 2022). These traits illustrate how virtual transformation can be effectively managed to sustain rigorous academic requirements. Collectively, those studies underscore that the strategic implementation of TQM serves as a vital moderating mechanism, ensuring that AI-pushed digital transformation now not handiest enhances efficiency but

additionally nurtures an enduring subculture of innovation inside higher schooling establishments.

5 Practical Framework

This phase goals to study the look-at's method, beginning with a detailed rationalization of the look-at populace, followed by a top-level view of the sample used in the research. Emphasis is located on the development of the studies tool, including the clinical strategies undertaken to ensure its validity and reliability. Additionally, an outline of the statistical strategies applied in studying the have look-at data is provided, supplying a comprehensive attitude on the study's framework and methodology followed in this look-at.

5.1 Research Methodology

The look at employs a descriptive-analytical approach to accumulate relevant information inside the research field, exploring the mediating function of high-quality management in strengthening the relationship between AI-pushed virtual transformation and innovative lifestyles in universities. This approach was selected because it enables a particular description and analysis of reality at the same time by considering both qualitative and quantitative variables influencing the phenomenon under investigation. The number one goal of this method is to translate descriptive and analytical insights into generalizable findings.

A questionnaire evolved because the primary data collection device was cautiously designed to acquire records from the target pattern. The gathered information was processed with the usage of the SmartPLS4 statistical software, utilizing the Structural Equation Modeling (SEM) technique based totally on Partial Least Squares (PLS-SEM). This method becomes employed to analyze the effects and test the study hypotheses, making sure of a sturdy methodological framework for inspecting the research questions.

5.2 Study Population and Sample

The examined populace consists of specialists running in the field of better schooling at the University of Basrah. A simple random sampling method turned into hired to pick participants primarily based on Morgan's table, ensuring an impartial and consultant sample of the target populace. An electronic questionnaire was dispensed through a Google Forms link to

about 288 individuals. This method facilitated green records series while keeping facts quality with the aid of minimizing human mistakes related to guide records access. However, the most effective 169 responses have been obtained, ensuing in a reaction charge of 56.33%. Notably, not one of the collected responses contained lacking values, bearing in mind the inclusion of the complete dataset within the statistical evaluation.

5.3 Research Instrument:

Based on the reviewed literature inside the theoretical framework, the researcher designed a questionnaire with the use of a 5-factor Likert scale because the number one statistics series device. This tool becomes decided on due to its suitability for the have a look at's objectives and its performance in terms of time, attempt, and value. The questionnaire is based on 4 fundamental sections. The first segment introduces the study name, targets, and the researcher's call while emphasizing the confidentiality of the facts and making sure it is used completely for clinical research functions. The second phase is split into 3 middle dimensions, with the primary specializing in AI-pushed virtual transformation and encompassing three sub-dimensions: intelligent automation, statistics analytics and choice-making, and personalization and user revel in enhancement. The 2d size examines the culture of innovation in universities, while the 0.33 size addresses high-quality management.

5.4 Analysis of Results and Hypothesis Testing

Before examining the hypotheses, it is essential to first evaluate the measurement and structural models through a series of systematic steps. The evaluation of the measurement version includes inspecting its validity and reliability, which are crucial to ensuring the accuracy and consistency of the results. Validity refers back to the quantity to which the measurement accurately reflects the intended assembly, at the same time as reliability suggests the consistency of the consequences when the test is repeated. The assessment of the measurement model's satisfaction and adequacy may be carried out by following specific methodological steps.

5.4.1 Indicator Reliability:

Indicator reliability is assessed with the aid of calculating the outer loadings of the indicators. Statements with outer loading values below 0.4 are eliminated, whilst people with values above 0.7 are retained. For

statements with loading values among 0.4 and 0.7, they are excluded if they negatively impact composite reliability. However, if no negative impact is determined, it's far best to maintain them (Ringle, Wende, & Becker, 2022). The desk offers the reliability of the signs for the examined variables.

Table 1Outer loadings

Axes		Indicators	Outer loadings
AI-Driven Digital Transformation	Intelligent Automation	The implementation of AI-driven automation has improved the efficiency of administrative processes in my institution.	0.782
		Automated AI systems effectively reduce human errors in routine operational tasks.	0.825
		The use of intelligent automation enhances decision-making by providing real-time data insights.	0.818
		AI-powered automation has optimized workflow management and task allocation within my institution.	0.844
		The integration of intelligent automation technologies has led to significant time and cost savings in daily operations.	0.778
	Data Analytics and Decision-Making	AI-driven data analytics enhances the accuracy of decision-making in my institution.	0.764
		The use of advanced data analytics tools allows for better prediction and trend analysis.	0.873
		Data-driven insights support strategic planning and policy formulation in my organization.	0.800
		AI-powered analytics improves the ability to process large volumes of data efficiently.	0.812
		Decision-making in my institution is increasingly relying on AI-generated analytical reports.	0.735
	Personalization and User Experience	The university's online platforms are personalized to meet the specific needs of each student.	0.737
		The university offers personalized academic support and resources based on individual student performance.	0.774
		The university's website is user-friendly and easily navigable for accessing information relevant to my needs.	0.743
		The academic advising system at the university is tailored to suit my personal academic goals.	0.765
		The university provides personalized learning experiences through flexible course offerings and learning resources.	0.674
Innovation Culture in Universities		The university encourages students and faculty to engage in innovative research and projects.	0.637
		The university fosters an environment where new ideas and creative solutions are highly valued.	0.726
		Faculty members at the university are open to adopting new teaching methods and technologies.	0.616
		The university promotes interdisciplinary collaboration to stimulate innovation across different fields.	0.843
		The university supports entrepreneurship and provides resources for students to turn their ideas into startups.	0.824
		The university provides platforms for students to showcase innovative projects and research.	0.866
		There is a strong emphasis on the integration of cutting-edge technologies in academic programs at the university.	0.860
		The university regularly hosts events or workshops that focus on innovation and creative thinking.	0.866
Quality Management		The university regularly evaluates the quality of its academic programs to ensure continuous improvement.	0.693
		The university has clear quality standards that are communicated to all faculty members.	0.777
		Faculty members at the university receive regular training to enhance their teaching skills and knowledge.	0.694
		The university has a system in place to collect feedback from students on the quality of courses and teaching.	0.779
		The university effectively uses feedback from students to improve the quality of academic programs.	0.767
		The university conducts regular assessments of student performance to ensure academic quality.	0.708
		The university's curriculum is regularly updated to meet current educational standards and industry needs.	0.673
		The university provides sufficient resources to support high-quality research and academic work.	0.681
		There is a clear process for handling complaints and suggestions related to academic quality.	0.754
		The university has well-established policies to maintain high standards of academic integrity and ethics.	0.714
		The university's administration works effectively to ensure the overall quality of the student experience.	0.595
		The university has a dedicated team or department responsible for quality assurance and enhancement.	0.638
		The university uses data and performance indicators to monitor and improve its academic and administrative operations.	0.690
		The university promotes a culture of continuous improvement, where everyone is encouraged to contribute to quality enhancement.	0.744

Smart pls 4 output

Based on the examination of the previous table, most of the indicators exhibited balance, with their external loading values exceeding 0.7 in all cases, except for a few objects, in which the values ranged between 0.595 and 0.694. However, the researcher determined now not to exclude those items, as disposing of them no longer brings about a significant increase in composite reliability.

5.4.2 Scale Reliability:

To verify the validity and suitability of the information series device in measuring the look at variables, the researcher employed numerous exams, which include Cronbach's Alpha, Composite Reliability (Rho_A), Composite Reliability (Rho_C), and Average Variance Extracted (AVE). Cronbach's Alpha is a conventional measure of the inner consistency of the dimensions, whilst Rho_A and Rho_C are used to evaluate the homogeneity and stability of the latent variables in the scale. AVE, on the other hand, is used to measure the quantity of variance captured with the aid of the indicators of every assembly. The effects of those tests are summarized within the following desk:

Table 2 Construct reliability and validity

Construct reliability and validity	Cronbach's alpha	(rho_a)	(rho_c)	(AVE)
Intelligent Automation	0.869	0.873	0.905	0.656
Personalization and User Experience Enhancement	0.793	0.796	0.857	0.547
Data Analytics and Decision-Making	0.856	0.861	0.897	0.637
Innovation Culture in Universities	0.908	0.917	0.927	0.618
Quality Management	0.924	0.926	0.934	0.503

Smart pls 4 output

The evaluation of construct reliability and validity famous that all measured constructs show off ideal reliability and validity based on Cronbach's Alpha, Composite Reliability (Rho_A and Rho_C), and Average Variance Extracted (AVE). Intelligent Automation demonstrates sturdy internal consistency, with a Cronbach's Alpha of 0.869 and a composite reliability (Rho_C) of 0.905, at the same time as its AVE value of 0.656 shows an exceptional level of variance defined by means of its signs. Similarly, Personalization and User Experience Enhancement has a Cronbach's Alpha of 0.793 and a composite reliability of 0.857, reflecting good enough reliability, although its AVE cost of 0.547 shows a moderate stage of convergent validity. Data Analytics and Decision-Making give a stable reliability profile, with Cronbach's Alpha at 0.856, composite reliability at 0.897, and an AVE of 0.637, demonstrating sufficient construct validity. Innovation Culture in Universities exhibits the very best reliability ratings for most of the constructs, with Cronbach's Alpha attaining 0.908 and composite reliability at 0.927, even as its AVE of 0.618 confirms its robust explanatory power. Finally, Quality Management facts the best Cronbach's Alpha at 0.924 and a composite reliability of 0.934, but its AVE of 0.503, although applicable, shows that almost half of the variance is attributed to dimension mistakes. Overall, the findings verify

the reliability and validity of the measurement model, with all constructs demonstrating excellent internal consistency and suited degrees of convergent validity.

5.4.3 Discriminant Validity:

Discriminant validity serves as a trademark of the quantity to which a latent variable is distinct from other latent variables in the structural model, as explained by Ringle et al. (2022). Discriminant validity is shown while a latent variable differentiates itself from other variables within the model. These exams are performed frequently to ensure the validity of relationships and to illustrate a clear difference among correlated variables. The primary goal of those tests is to ensure that each latent variable contributes correctly to the know-how of the structural version without unwanted overlap with other variables. The following table presents the discriminant validity of the model.

Table 3 Heterotrait-monotrait ratio (HTMT) - Matrixe

	Data Analytics and Decision-Making	Innovation Culture in Universities	Intelligent Automation	Personalization and User Experience Enhancement	Quality Management
Data Analytics and Decision-Making					
Innovation Culture in Universities	0.685				
Intelligent Automation	0.839	0.848			
Personalization and User Experience Enhancement	0.729	0.890	0.880		
Quality Management	0.657	0.894	0.842	0.795	

Smart pls 4 output

The evaluation of discriminant validity the usage of the Heterotrait-Monotrait Ratio (HTMT) well-known shows the volume to which every construct is awesome from the others inside the structural model. Generally, an HTMT value below 0.9 is taken into consideration as desirable, indicating a sufficient level of discriminant validity. The results show that Data Analytics and Decision-Making keep adequate distinction from the other constructs, with HTMT values starting from 0.657 (as compared to Quality Management) to 0.839 (as compared to Intelligent Automation). Innovation Culture in Universities well-known shows particularly strong differentiation, with HTMT values starting from 0.685 (compared to Data Analytics and Decision-Making) to 0.894 (as compared to Quality Management). Intelligent Automation shows high but ideal

HTMT values, with its maximum association being with Personalization and User Experience Enhancement (0.880). Personalization and User Experience Enhancement, whilst demonstrating close relationships with other constructs, maintains an inexpensive degree of discriminant validity, with its maximum HTMT fee recorded at 0.890 in terms of Innovation Culture in Universities. Quality Management, although strongly related to numerous constructs, stays within acceptable limits, with its maximum HTMT fee of 0.894 in terms of Innovation Culture in Universities. Overall, the findings suggest that the constructs exhibit ideal discriminant validity, assisting the integrity of the dimension model.

5.4.4 Cross-Loading:

The idea of "go-loading," as supplied inside the desk above, underscores the importance of making sure that the items inside each dimension correctly measure that specific measurement without interference from others. This is obvious whilst variables show better loadings on their corresponding dimension as compared to other dimensions. Such evaluation offers clearer information about the uniqueness of every size and its ability to correctly seize the unique trait it represents. By employing this method, move-loading validates the accuracy of measurements and complements the reliability of the statistical version used inside the have a look at.

Table 4 Cross-loadings

Cross loadings	Intelligent Automation	Data Analytics and Decision-Making	Personalization and User Experience Enhancement	Innovation Culture in Universities	Quality Management
The implementation of AI-driven automation has improved the efficiency of administrative processes in my institution.	0.782	0.424	0.502	0.547	0.531
Automated AI systems effectively reduce human errors in routine operational tasks.	0.825	0.667	0.641	0.619	0.588
The use of intelligent automation enhances decision-making by providing real-time data insights.	0.818	0.676	0.565	0.528	0.580
AI-powered automation has optimized workflow management and task allocation within my institution.	0.844	0.639	0.691	0.709	0.732
The integration of intelligent automation technologies has led to significant time and cost savings in daily operations.	0.778	0.529	0.593	0.654	0.660
AI-driven data analytics enhances the accuracy of decision-making in my institution.	0.532	0.764	0.540	0.406	0.292
The use of advanced data analytics tools allows for better prediction and trend analysis.	0.641	0.873	0.529	0.490	0.454

Cross loadings	Intelligent Automation	Data Analytics and Decision-Making	Personalization and User Experience Enhancement	Innovation Culture in Universities	Quality Management
Data-driven insights support strategic planning and policy formulation in my organization.	0.613	0.800	0.493	0.563	0.555
AI-powered analytics improves the ability to process large volumes of data efficiently.	0.608	0.812	0.498	0.481	0.511
Decision-making in my institution is increasingly relying on AI-generated analytical reports.	0.519	0.735	0.381	0.471	0.545
The university's online platforms are personalized to meet the specific needs of each student.	0.639	0.582	0.737	0.667	0.632
The university offers personalized academic support and resources based on individual student performance.	0.577	0.534	0.774	0.544	0.479
The university's website is user-friendly and easily navigable for accessing information relevant to my needs.	0.453	0.373	0.743	0.428	0.434
The academic advising system at the university is tailored to suit my personal academic goals.	0.498	0.341	0.765	0.638	0.524
The university provides personalized learning experiences through flexible course offerings and learning resources.	0.551	0.395	0.674	0.495	0.468
The university encourages students and faculty to engage in innovative research and projects.	0.426	0.454	0.509	0.637	0.458
The university fosters an environment where new ideas and creative solutions are highly valued.	0.623	0.617	0.662	0.726	0.647
Faculty members at the university are open to adopting new teaching methods and technologies.	0.522	0.288	0.600	0.616	0.561
The university promotes interdisciplinary collaboration to stimulate innovation across different fields.	0.555	0.422	0.595	0.843	0.746
The university supports entrepreneurship and provides resources for students to turn their ideas into startups.	0.612	0.361	0.587	0.824	0.686
The university provides platforms for students to showcase innovative projects and research.	0.667	0.488	0.624	0.866	0.654
There is a strong emphasis on the integration of cutting-edge technologies in academic programs at the university.	0.621	0.581	0.535	0.860	0.719
The university regularly hosts events or workshops that focus on innovation and creative thinking.	0.690	0.557	0.644	0.866	0.694
The university regularly evaluates the quality of its academic programs to ensure continuous improvement.	0.554	0.455	0.540	0.673	0.693
The university has clear quality standards that are communicated to all faculty members.	0.734	0.494	0.593	0.760	0.777
Faculty members at the university receive regular training to enhance their teaching skills and knowledge.	0.549	0.264	0.468	0.570	0.694
The university has a system in place to collect feedback from students on the quality of courses and teaching.	0.541	0.322	0.531	0.584	0.779

Cross loadings	Intelligent Automation	Data Analytics and Decision-Making	Personalization and User Experience Enhancement	Innovation Culture in Universities	Quality Management
The university effectively uses feedback from students to improve the quality of academic programs.	0.424	0.289	0.401	0.541	0.767
The university conducts regular assessments of student performance to ensure academic quality.	0.475	0.418	0.448	0.569	0.708
The university's curriculum is regularly updated to meet current educational standards and industry needs.	0.492	0.369	0.576	0.620	0.673
The university provides sufficient resources to support high-quality research and academic work.	0.443	0.359	0.438	0.486	0.681
There is a clear process for handling complaints and suggestions related to academic quality.	0.497	0.445	0.454	0.590	0.754
The university has well-established policies to maintain high standards of academic integrity and ethics.	0.577	0.543	0.456	0.585	0.714
The university's administration works effectively to ensure the overall quality of the student experience.	0.528	0.310	0.482	0.578	0.595
The university has a dedicated team or department responsible for quality assurance and enhancement.	0.638	0.586	0.529	0.525	0.638
The university uses data and performance indicators to monitor and improve its academic and administrative operations.	0.502	0.386	0.418	0.539	0.690
The university promotes a culture of continuous improvement, where everyone is encouraged to contribute to quality enhancement.	0.550	0.528	0.473	0.527	0.744

Smart pls 4 output

The preceding desk demonstrates that the loading values of variables on their corresponding dimensions are appreciably better than their loadings on different dimensions. This evaluation underscores the importance of a strong and particular correlation between variables and their related dimensions. The excessive loading values indicate statistical alignment and support confidence in the validity of the statistical version. These findings propose that the recorded values inside the desk are statistically suited, similarly improving the information of the powerful courting among variables and their respective dimensions within the examination.

5.4.5 Correlation Between Dimensions (Variable Correlation - R^2 from AVE):

The evaluation of variable correlation (R^2 from AVE) is used to make certain that there is no overlap among special dimensions inside the model. This technique emphasizes that the correlation value of a dimension with

itself needs to be better than its correlation with different dimensions. The following desk illustrates the diploma of overlap among the scale within the have a look at version.

Table 5 Fornell-Larcker criterion

	Data Analytics and Decision-Making	Innovation Culture in Universities	Intelligent Automation	Personalization and User Experience Enhancement	Quality Management
Data Analytics and Decision-Making	0.798				
Innovation Culture in Universities	0.605	0.786			
Intelligent Automation	0.732	0.757	0.810		
Personalization and User Experience Enhancement	0.614	0.757	0.743	0.739	
Quality Management	0.589	0.830	0.766	0.693	0.710

Smart pls 4 output

The Fornell-Larcker criterion analysis confirms the discriminant validity of the constructs by means of making sure that the square root of the Average Variance Extracted (AVE) for each assemble exceeds its correlations with different constructs. The outcomes suggest that Data Analytics and Decision-Making (0.798), Innovation Culture in Universities (0.786), Intelligent Automation (0.810), Personalization and User Experience Enhancement (0.739), and Quality Management (0.710) all show off AVE square roots higher than their respective correlations. Overall, the findings generally help the discriminant validity of the version.

5.4.6 Variance Inflation Factor (VIF):

The Variance Inflation Factor (VIF) is a statistical degree used to assess the degree of multicollinearity some of the have a look at indicators. Statistically appropriate VIF values are the ones underneath 5, indicating the absence of sizable multicollinearity between variables. If a VIF cost exceeds this threshold, it shows that the corresponding variable is extraordinarily correlated with different variables within the observation. The following desk affords the VIF values for the take-a look at variables, supplying insights into potential multicollinearity inside the version.

Table 6 Collinearity statistics (VIF)

1	Axes	Indicators	VIF
AI-Driven Digital Transformation	Intelligent Automation	The implementation of AI-driven automation has improved the efficiency of administrative processes in my institution.	1.936
		Automated AI systems effectively reduce human errors in routine operational tasks.	2.166
		The use of intelligent automation enhances decision-making by providing real-time data insights.	2.382
		AI-powered automation has optimized workflow management and task allocation within my institution.	2.226
		The integration of intelligent automation technologies has led to significant time and cost savings in daily operations.	1.845
	Data Analytics and Decision-Making	AI-driven data analytics enhances the accuracy of decision-making in my institution.	2.785
		The use of advanced data analytics tools allows for better prediction and trend analysis.	3.896
		Data-driven insights support strategic planning and policy formulation in my organization.	2.442
		AI-powered analytics improves the ability to process large volumes of data efficiently.	2.423
		Decision-making in my institution is increasingly relying on AI-generated analytical reports.	1.728
	Personalization and User Experience Enhancement	The university's online platforms are personalized to meet the specific needs of each student.	1.544
		The university offers personalized academic support and resources based on individual student performance.	1.688
		The university's website is user-friendly and easily navigable for accessing information relevant to my needs.	1.764
		The academic advising system at the university is tailored to suit my personal academic goals.	1.903
		The university provides personalized learning experiences through flexible course offerings and learning resources.	1.871
Innovation Culture in Universities		The university encourages students and faculty to engage in innovative research and projects.	1.669
		The university fosters an environment where new ideas and creative solutions are highly valued.	1.983
		Faculty members at the university are open to adopting new teaching methods and technologies.	1.391
		The university promotes interdisciplinary collaboration to stimulate innovation across different fields.	2.575
		The university supports entrepreneurship and provides resources for students to turn their ideas into startups.	3.880
		The university provides platforms for students to showcase innovative projects and research.	4.103
		There is a strong emphasis on the integration of cutting-edge technologies in academic programs at the university.	4.236
		The university regularly hosts events or workshops that focus on innovation and creative thinking.	4.884
Quality Management		The university regularly evaluates the quality of its academic programs to ensure continuous improvement.	3.434
		The university has clear quality standards that are communicated to all faculty members.	2.586
		Faculty members at the university receive regular training to enhance their teaching skills and knowledge.	2.665
		The university has a system in place to collect feedback from students on the quality of courses and teaching.	3.259
		The university effectively uses feedback from students to improve the quality of academic programs.	4.002
		The university conducts regular assessments of student performance to ensure academic quality.	3.507
		The university's curriculum is regularly updated to meet current educational standards and industry needs.	1.918
		The university provides sufficient resources to support high-quality research and academic work.	2.569
		There is a clear process for handling complaints and suggestions related to academic quality.	3.890
		The university has well-established policies to maintain high standards of academic integrity and ethics.	3.134
		The university's administration works effectively to ensure the overall quality of the student experience.	1.707
		The university has a dedicated team or department responsible for quality assurance and enhancement.	1.871
		The university uses data and performance indicators to monitor and improve its academic and administrative operations.	2.221
		The university promotes a culture of continuous improvement, where everyone is encouraged to contribute to quality enhancement.	2.483

Smart pls 4 output

The preceding table indicates that each one Variance Inflation Factor (VIF) value for the variables are under 5, indicating that the model is appropriate for measuring the relationships between the have a look at's variables. This indicates that multicollinearity isn't an issue, further confirming the validity of the version in assessing the interactions a number of the variables.

5.4.7 Collinearity Statistics

Collinearity records, represented via the Variance Inflation Factor (VIF), provide insights into potential multicollinearity issues in the take a look at's inner model. Multicollinearity takes place when predictor variables are surprisingly correlated, which could distort version estimates. A VIF cost

underneath 5 is commonly taken into consideration as acceptable, indicating that multicollinearity isn't always a chief issue. The results show that all VIF values fall beneath this threshold, suggesting that multicollinearity does now not pose a sizeable trouble within the version (Ringle, Wende, & Becker, 2022).

Table 7 Collinearity statistics (VIF)

Collinearity statistics (VIF)	VIF
AI-Driven Digital Transformation -> Innovation Culture in Universities	2.497
AI-Driven Digital Transformation -> Quality Management	1.000
Data Analytics and Decision-Making -> AI-Driven Digital Transformation	2.208
Intelligent Automation -> AI-Driven Digital Transformation	3.072
Personalization and User Experience Enhancement -> AI-Driven Digital Transformation	2.285
Quality Management -> Innovation Culture in Universities	2.497

Smart pls 4 output

In the collinearity information analysis, the use of the Variance Inflation Factor (VIF) suggests that every predictor variable falls inside the suitable threshold of VIF < five, suggesting no enormous multicollinearity worries. The maximum VIF price (3.072) is observed for Intelligent Automation → AI-Driven Digital Transformation, indicating a notably strong correlation but within an acceptable variety. Other predictors, together with AI-driven digital Transformation → Innovation Culture in Universities and Quality Management → Innovation Culture in Universities, each have a VIF of 2.497, reflecting moderate collinearity. Data Analytics and Decision-Making → AI-Driven Digital Transformation and Personalization and User Experience Enhancement → AI-Driven Digital Transformation showcase VIF values of 2.208 and 2.285, respectively, confirming stable relationships. The lowest VIF fee (1.000) is located for AI-driven digital Transformation → Quality Management, indicating minimal collinearity. Overall, the consequences verify that collinearity no longer poses a significant problem in the version.

After validating the standard model, the study model was adopted as follows:

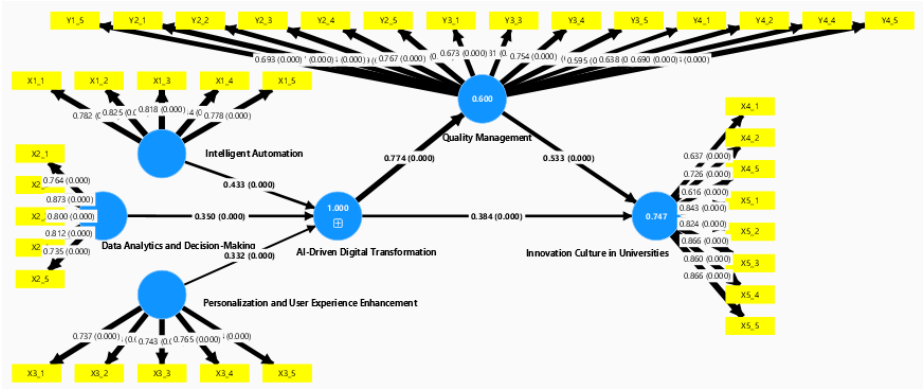

Figure (1) The study model

5.4.8 Structural Model Evaluation:

Evaluating the structural version is an important step before checking out the hypotheses, making sure the model's usual first-rate and robustness. This manner entails assessing four key criteria: the coefficient of willpower (R^2), impact length (F^2), and the Goodness of Fit (GOF) index. These standards are examined in elements as follows:

1. **Coefficient of Determination (R^2):**

The coefficient of determination (R^2) is used to estimate the accuracy of the regression coefficient. It is calculated by squaring the simple correlation coefficient. R^2 values range from 0 to 1, where values closer to 1 indicate higher accuracy in regression predictions and lower random error. R^2 values reflect the model's ability to explain the variation in the dependent variable using the independent variable. The interpretation of R^2 values is generally as follows:

- Less than 0.19: Unacceptable
- Between 0.19 and 0.33: Weak
- Between 0.33 and 0.67: Moderate
- Greater than 0.67: High

The following table presents the R^2 values for the variables used in this study:

Table 8 Quality criteria

Quality criteria	R-square	R-square adjusted
AI-Driven Digital Transformation	1.000	1.000
Innovation Culture in Universities	0.747	0.744
Quality Management	0.600	0.597

Smart pls 4 output

The evaluation of the R-square and altered R-rectangular values well-known shows the explanatory strength of the version's variables. For AI-driven digital Transformation, both the R-square and altered R-rectangular values are 1.000, indicating a super in shape and that the impartial variables completely give an explanation for the version in this structured variable, leaving no unexplained variance. This demonstrates an exceptionally excessive stage of predictive accuracy for this variable. For Innovation Culture in Universities, the R-square value is 0.747, and the adjusted R-rectangular is zero.744, suggesting a robust explanatory power. These values suggest that approximately 74.7% of the version in innovation lifestyle is explained by the unbiased variables, with a slight reduction inside the adjusted R-square to account for the quantity of predictors within the model, signifying a strong fit. In assessment, Quality Management indicates R-rectangular and adjusted R-square values of 0.600 and 0.597, respectively, reflecting a moderate match. This implies that around 60% of the variance in pleasant management is explained by way of the independent variables, suggesting an affordable stage of rationalization. Overall, the R-square and altered R-square values reveal that the model is quite effective in explaining the version of AI-pushed digital transformation and innovation culture, with slight explanatory energy for best management.

2. Effect Size (F^2):

Cohen (1988) hooked up a framework for decoding F^2 values and their corresponding effect sizes, as follows: an F^2 fee much less than zero.02 indicates no effect; an F^2 cost among 0.02 and 0.15 suggests a small effect; an F^2 value between 0.15 and 0.35 denotes a medium effect; and an F^2 cost greater than zero.35 reflects a large effect. The desk under presents the F^2 values for the variables covered on this have a look at.

Table 9 Effect Size (F^2)

	f-square
AI-Driven Digital Transformation -> Innovation Culture in Universities	0.233
AI-Driven Digital Transformation -> Quality Management	1.497
Data Analytics and Decision-Making -> AI-Driven Digital Transformation	155.806
Intelligent Automation -> AI-Driven Digital Transformation	171.375
Personalization and User Experience Enhancement -> AI-Driven Digital Transformation	135.699
Quality Management -> Innovation Culture in Universities	0.450

Smart pls 4 output

The evaluation of the F^2 values shows substantial insights into the impact sizes between the variables in this examination. The impact size between AI-driven digital Transformation and Innovation Culture in Universities is mild, with an F^2 cost of 0.233, indicating a medium effect. A good deal larger effect is determined among AI-driven digital Transformation and Quality Management, in which the F^2 cost is 1.497, reflecting a huge impact. The relationships involving Data Analytics and Decision-Making, Intelligent Automation, and Personalization and User Experience Enhancement with AI-Driven Digital Transformation show especially high effect sizes, with F^2 values of 155.806, 171.375, and 135.699, respectively, signaling huge results. Additionally, the relationship between Quality Management and Innovation Culture in Universities has an F^2 cost of 0.450, which suggests a moderate effect. These results underscore the extensive have an impact on of positive variables on AI-driven digital transformation and the importance of the various factors in shaping the model's consequences.

3. The Goodness-of-Fit Index (GOF):

The Goodness-of-Fit Index (GOF) is a critical measure used to assess how well a statistical model fits the located statistics, assessing its effectiveness in explaining the relationships between unbiased and structured variables. This index quantifies the disparity between real records and the expected values, providing insights into the model's first-rate. The GOF is calculated by taking the square root of the made from crucial metrics: the common variance extracted (AVE) and the coefficient of willpower (R^2) from the structural equation model. According to Wetzels, Odekerken-Schröder, G., & Van Oppen, (2009), a GOF price more than 0.36 is taken into consideration first-class. In this have a look at, the GOF cost is derived by computing the rectangular root of the made from the AVE and R^2 values, presenting a hallmark of the version's alignment with the statistics. The

following desk affords the GOF price for the look-at model, reflecting its average goodness of fit.

Table 10 The Goodness-of-Fit Index (GOF)

Construct reliability and validity	R-square	Average variance extracted (AVE)
Intelligent Automation		0.656
Personalization and User Experience Enhancement		0.547
Data Analytics and Decision-Making		0.637
Innovation Culture in Universities	0.747	0.618
Quality Management	0.600	0.503
AVERAGE	0.673	0.561

Smart pls 4 output

The model fit index was calculated using the following formula:

$$\sqrt{0.673 \times 0.561} = 0.6144534156$$

It is observed that the resulting index value indicates a high model fit quality, as it exceeds the threshold of 0.35, which is commonly used as a benchmark for determining the adequacy of model fit.

5.4.9 Assessment of Path Coefficients in the Structural Model:

The evaluation of direction coefficients inside the structural version entails examining and studying the relationships among the structural components of the model. This method consists of verifying the real values of the course coefficients that join the various variables within the model. The evaluation pursuits to determine whether or not there may be statistical evidence supporting or rejecting the function of pleasant control as a mediator in improving the connection among AI-driven virtual transformation and the innovation culture in universities in the studied educational institutions. The analysis consists of key statistical metrics consisting of the pattern suggestion, self-belief interval, and statistical importance derived from the bootstrapping analysis of the complete model. The outcomes of the course coefficient analysis for this hypothesis are presented in the following table.

Table 11 Path coefficients

Path coefficients	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Confidence intervals		Confidence intervals bias corrected		
						2.5%	97.5 %	Bias	2.5 %	97.5 %
AI-Driven Digital Transformation -> Innovation Culture in Universities	0.384	0.382	0.057	6.691	0.000	0.272	0.495	-0.002	0.273	0.496
AI-Driven Digital Transformation -> Quality Management	0.774	0.773	0.046	16.667	0.000	0.660	0.842	-0.002	0.639	0.835
Quality Management -> Innovation Culture in Universities	0.533	0.532	0.061	8.742	0.000	0.405	0.645	-0.001	0.403	0.644

Smart pls 4 output

The analysis of the statistics well-known shows the direction coefficients, their statistical significance, and confidence intervals between the variables within the model. For the connection among AI-driven digital Transformation and Innovation Culture in Universities, the original sample coefficient is 0.384, with a pattern suggestion of 0.382 and a general deviation of 0.057. The T-statistic price is 6.691, that is drastically greater than the important value of 1.96, indicating a robust statistical importance (p-value = 0.000). The 95% confidence c program language period for this relationship levels from 0.272 to 0.495, with a bias-corrected self-assurance c language of 0.273 to 0.496, confirming that this effect is powerful and extensively high quality.

Similarly, the relationship among AI-driven digital Transformation and Quality Management indicates an original pattern coefficient of 0.774, with a sample mean of 0.773 and a widespread deviation of 0.046. The T-statistic price of 16.667 in addition confirms the robust statistical significance of this relationship (p-cost = 0.000). The self-assurance c language spans from 0.660 to 0.842, with the prejudice-corrected c program language period starting from 0.639 to 0.835, indicating a good-sized nice effect.

Finally, for the relationship between Quality Management and Innovation Culture in Universities, the original pattern coefficient is 0.533, with a sample mean of 0.532 and a trendy deviation of 0.061. The T-statistic value of 8.742 and the p-value of 0.000 indicate statistical importance. The 95% confidence c language for this relationship is between 0.405 and 0.645, with a bias-corrected self-belief c programming language of 0.403 to 0.644,

again assisting the sizeable high-quality effect of fine management on innovation subculture.

5.4.10 Specific indirect effects

Table 12 Specific indirect effects

Specific indirect effects	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Confidence intervals		Confidence intervals bias corrected		
						2.5%	97.5%	Bias	2.5%	97.5%
Intelligent Automation -> AI-Driven Digital Transformation -> Innovation Culture in Universities	0.166	0.166	0.024	6.869	0.000	0.121	0.214	0.000	0.121	0.215
Data Analytics and Decision-Making -> AI-Driven Digital Transformation -> Innovation Culture in Universities	0.134	0.133	0.022	6.198	0.000	0.091	0.175	-0.001	0.094	0.178
Personalization and User Experience Enhancement -> AI-Driven Digital Transformation -> Innovation Culture in Universities	0.127	0.127	0.021	6.179	0.000	0.085	0.167	-0.001	0.086	0.167
Intelligent Automation -> AI-Driven Digital Transformation -> Quality Management	0.335	0.337	0.023	14.410	0.000	0.291	0.384	0.001	0.289	0.382
Data Analytics and Decision-Making -> AI-Driven Digital Transformation -> Quality Management	0.271	0.269	0.022	12.231	0.000	0.220	0.307	-0.002	0.218	0.307
Personalization and User Experience Enhancement -> AI-Driven Digital Transformation -> Quality Management	0.257	0.256	0.021	12.139	0.000	0.205	0.290	-0.001	0.200	0.287
AI-Driven Digital Transformation -> Quality Management -> Innovation Culture in Universities	0.413	0.411	0.054	7.588	0.000	0.299	0.512	-0.002	0.297	0.511
Intelligent Automation -> AI-Driven Digital Transformation -> Quality Management -> Innovation Culture in Universities	0.179	0.179	0.025	7.119	0.000	0.131	0.231	0.000	0.131	0.231
Data Analytics and Decision-Making -> AI-Driven Digital Transformation -> Quality Management -> Innovation Culture in Universities	0.144	0.143	0.020	7.092	0.000	0.101	0.183	-0.001	0.105	0.185
Personalization and User Experience Enhancement -> AI-Driven Digital Transformation -> Quality Management -> Innovation Culture in Universities	0.137	0.136	0.020	6.856	0.000	0.095	0.175	-0.001	0.097	0.175

Smart pls 4 output

The analysis of the information concerning the speculation that first-class control mediates the connection among AI-driven digital transformation and innovative lifestyles in universities reveals large findings across all dimensions of virtual transformation. For Intelligent Automation, the indirect impact on innovation culture via AI-pushed virtual transformation is 0.166, with a sample implication of 0.166 and a fashionable deviation of 0.024. The T-statistic of 6.869 and the p-price of 0.000 strongly assist the statistical significance of this route, whilst the confidence periods (ranging

from 0.121 to 0.214 and from 0.121 to 0.215 for the unfairness-corrected model) in addition affirm the robustness of the impact. Similarly, the size of Data Analytics and Decision-Making shows an oblique impact of 0.134 on an innovative way of life, with a pattern implication of 0.133 and a widespread deviation of 0.022. The T-statistic of 6.198 and a p-price of 0.000 imply a considerable courting, with self-belief durations spanning from zero.091 to 0.175 and from 0.094 to 0.178 for the bias-corrected durations, indicating an advantageous and statistically massive mediation. In the case of Personalization and User Experience Enhancement, the indirect effect on innovation lifestyle is 0.127, with a sample implication of 0.127 and a popular deviation of zero.021. A T-statistic of 6.179 and a p-fee of 0.000, in addition, substantiate the statistical importance of this mediation, with confidence durations starting from 0.0.5 to 0.167 and from 0.086 to 0.167 for the prejudice-corrected durations, reinforcing the effective relationship. Furthermore, the relationships among AI-driven digital transformation and high-quality management were additionally observed to be sizeable across all dimensions. Intelligent Automation demonstrates a direct effect of 0.335 (with a sample suggestion of 0.337 and a preferred deviation of 0.023), supported by a T-statistic of 14.410 and self-assurance periods starting from 0.291 to 0.384. Data Analytics and Decision-Making show an immediate impact of 0.271 (pattern imply of 0.269, preferred deviation of 0.022), with a T-statistic of 12.231 and confidence intervals ranging from 0.220 to 0.307. Likewise, Personalization and User Experience Enhancement display an impact of 0.257 (pattern imply of 0.256, popular deviation of 0.021) with a T-statistic of 12.139 and self-assurance intervals between 0.205 and 0.290. The mediation impact of excellent control in addition strengthens the relationship among AI-driven digital transformation and innovation culture in universities. The direct impact of AI-pushed digital transformation and quality management on innovation subculture is 0.413, with a pattern suggest of 0.411 and a widespread deviation of 0.054, supported via a T-statistic of 7.588. The self-assurance periods range from 0.299 to 0.512, confirming the considerable effect of this courting. When thinking about the total mediation effect, Intelligent Automation through both AI-driven digital transformation and best control yields an oblique impact of 0.179, with a T-statistic of 7.119 and confidence durations between 0.131 and 0.231. For Data Analytics and Decision-Making, the whole mediation

impact on innovation culture is 0.144 (T-statistic = 7.092), with self-belief durations ranging from 0.101 to 0.183, similarly emphasizing the nice mediation. Personalization and User Experience Enhancement also show off.

6 Results:

The findings of the current study underscore the critical mediating role of quality management in enhancing the relationship between AI-driven digital transformation and the culture of innovation within universities, reflecting and extending prior academic work in the fields of digital transformation, quality assurance, and organizational innovation. (Vial, 2019) conceptualized digital transformation as a process leading to fundamental shifts in organizational structures and value creation mechanisms, requiring adaptive leadership and management frameworks. This study supports that conceptualization by empirically demonstrating how quality management systems serve as essential conduits through which AI technologies—such as intelligent automation, data analytics, and personalized user experiences—translate into tangible improvements in institutional innovation culture. Consistent with (Gkrimpizi, Peristeras, & Magnisalis, 2023), who identified quality management as a catalyst for successful technological integration in higher education, the current research reaffirms the positive influence of digital quality initiatives on institutional agility, further substantiating the statistically significant mediating role of quality management, with indirect effect coefficients ranging from 0.127 to 0.413. (Chen & Lin, 2020) emphasized the importance of AI in enhancing student engagement and learning effectiveness through automation and personalization; this study adds specificity by showing that such benefits must be embedded within a structured quality management system to sustain innovation outcomes. The significant direct effects of AI-driven transformation on quality management, with coefficients ranging from 0.257 to 0.335, are also aligned with the conclusions of (El-Masri & Tarhini, 2017), who contended that digital infrastructure must be complemented by robust institutional governance to impact educational quality. Consequently, the present study offers a more integrated understanding of how universities can strategically harness AI capabilities to promote innovation through quality-driven

structures. In practical terms, universities should institutionalize AI-supported quality management frameworks to enable real-time monitoring of academic and operational metrics, invest in capacity building for faculty and administrative leaders to interpret and utilize AI-generated data effectively, and cultivate a data-driven innovation culture by applying predictive analytics and intelligent feedback mechanisms in curriculum and research management. Additionally, integrating AI-based personalization tools into learning management systems can enhance educational delivery, provided such systems are continuously evaluated using quality benchmarks. Finally, aligning AI interventions with institutional objectives through structured quality processes ensures that technological adoption remains purposeful, coherent, and conducive to long-term academic excellence.

7 Recommendations:

Based on the findings of this study, several hints can be made to enhance the connection between AI-pushed virtual transformation and the way of life of innovation in universities, with a particular recognition on leveraging nice management as a mediator:

1. Strengthening Quality Management Practices: Universities should prioritize the enhancement of best management structures as a foundational detail for using virtual transformation. By improving great management techniques, universities can create an environment that fosters innovation and enables the successful implementation of AI-pushed technologies.
2. Investing in AI Technologies: To optimize the impact on innovation subculture, universities have to maintain to put money into AI-driven virtual transformation projects, particularly in areas likewise automation, information analytics, and consumer enjoy personalization. These dimensions have demonstrated sturdy links to fostering a subculture of innovation, and their powerful implementation will pressure non-stop development.
3. Promoting a Culture of Innovation: Universities have to actively foster a lifestyle of innovation via management tasks, support for studies, and the established order of surroundings that encourages

creative questioning and hassle-fixing. When excellent management and AI-driven virtual transformation are efficaciously incorporated, they offer a strong foundation for a thriving innovative atmosphere.

In conclusion, the evaluation of the facts strongly helps the hypothesis that first-class management acts as a large mediator in improving the connection between AI-driven virtual transformation and the tradition of innovation in universities. The effects suggest that all three dimensions of AI-pushed digital transformation—Intelligent Automation, Data Analytics, and Decision-Making, and Personalization and User Experience Enhancement—show statistically good-sized oblique effects on innovation tradition via every AI-driven virtual transformation and first-rate control. Furthermore, the direct results of AI-driven virtual transformation on terrific control had been additionally sizeable throughout all dimensions, reinforcing the significance of exceptional manipulation in fostering innovation. The continually excessive T-facts, low p-values, and slender self-assurance durations confirm the robustness and reliability of the findings, emphasizing the pivotal characteristic of quality manipulation in strengthening the impact of AI-pushed digital transformation on innovation tradition. This has a look at underscores the need for universities to prioritize first-rate management practices as a strategic mediator to efficiently leverage virtual transformation and domesticate a progressive organizational subculture.

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