ACADEMIA International Journal for Social Sciences
Volume 5, Issue 3(s9), 2026 ISSN-L (Online): 3006-6638

Impact of Artificial Intelligence on Research Practices in Pakistan: A Systematic Analysis of Emerging Trends

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Received: 16-02-2026 **Revised:** 01-03-2026 **Accepted:** 13-03-2026 **Published:** 27-03-2026

ABSTRACT

Generative artificial intelligence (AI) and large language models (LLMs) have ushered in a paradigm-changing era in the field of higher education. In a country like Pakistan, there are substantial tools used in an academic environment to boost the production of knowledge. There is however a crucial empirical gap still to be filled, concerning the structural change of research workflows in force with AI co-agents in the resource-poor context of intense metrics-driven publishing pressures. This study examines the trends, structures and behaviours of integrating AI in Pakistani universities. This study employed a mixed-methods approach using quantitative survey responses (N=400) analysed through the use of PLS-SEM, with some qualitative thematic findings obtained from twenty-five semi-structured faculty interviews. Results show that the relationship between Perceived Usefulness and AI Adoption Intensity has a significant value ($\beta = 0.492$, $p < 0.001$) where Perceived Usefulness has a direct impact on productivity. There is, however, an important issue with every literature mapping and manuscript polishing by AI: AI hovers the prospect of cognitive dependency, exposure to algorithmic hallucinations in literature, and a potential loss of original conceptual syntheses. In practical terms, such ideas call for a paradigm shift in the policy vacuum higher education sector of Pakistan has been facing, to start using the disclosure systems and assessment on quality parameters. This study goes beyond the conventional acceptance models by addressing hidden cognitive costs of human-AI collaboration, in the Global South.

Keywords: *Artificial Intelligence; Generative AI; Research Practices; Pakistan; PLS-SEM; Academic Integrity*

INTRODUCTION

In this day and age, the world is moving into a complete paradigm shift, namely, along the lines of what is colloquially referred to as the fourth industrial revolution: Artificial Intelligence (AI) is being promoted as the main enabler and is having a deep impact on the structural change of different industries. This has changed as AI has moved from a side tool for computation in higher education and scientific research to an agentic system that can help to redefine the way knowledge is created, curated and confirmed. At the global level, the use of algorithmic intelligence in science research is creating a "collective intelligence", in which intelligent systems offer analytical, predictive and organisational insights that complement rather than supplant human thinking and agency (Patel & Salim, 2026). This worldwide AI revolution is fundamentally reshaping the ontology of academic scholarship, transforming the researcher from an on-ground decision-

making analyst to a manager of complex data ecosystems with automated computational layers on top of traditional data methods.

In the world of Higher Education, AI architectures are transforming the way pedagogies are delivered and educate institutions. Generative AI (GenAI) models, especially large language models like ChatGPT, Claude, and academic-specific platforms, have revolutionized the availability of synthesized information and have even challenged the very nature of hard academic assessment and authorship (Alghazo et al., 2025). The technologies of research automation are now becoming a part-and-parcel of scientific research workflows, encompassing the entire research lifecycle from automated literature mapping to realtime data analysis, experimentation predictive modelling, scientific natural language creation, etc. These changes allow researchers to deal with very large bibliographic networks and computational problems that before were also logistically impossible. But there is also a deep conflict between the superficial ownership of the concept, critical thinking and original intellectual synthesis that can result from above-average use of AI tools, and the processing power of those tools (Ahmed & Khan, 2025).

AI in Pakistan

In Pakistan, the technological wave is at the confluence of an existing digital transformation scene. Pakistan Higher Education Commission (HEC) has launched a wide range of digital projects over the last 10 years to modernize research facilities in universities, improve the broadband internet in the institutions, and grant access to various digital libraries of the world. In fact, the sudden and rapid expansion of generative Artificial Intelligence and LLMs since the end of 2022 is far outstripping national policy frameworks, and institutions are providing varied guidance to students and faculty, making it a disruptive trend that affects public and private universities alike (Ahmed & Khan, 2025). The socio-technical paradox is that in the small towns of Pakistan, traditional methods of education remain prevalent, and resources are limited; however, well-funded and urban-based institutions are quick to embrace these technologies, aiming to overcome historical evolution of limitations in resources.

Pakistan's research landscape is a mixed bag, with some AI tools hindering productivity while others promise to boost it. Conversely, researchers and graduate students employ AI-driven writing assistance, vocabulary tools, and Claud AI-Tools for Literature Review, which boosts the visibility and volume of local research output, overcomes linguistic barriers, and reduces administrative workloads (Alghazo et al., 2025; Majeed et al., 2024). However, these uses have been largely done secretively given the lack of oversight, resulting in widespread concerns about the ethics of academic dishonesty, plagiarism with AI, and the regurgitation of hallucinated information (Alghazo et al., 2025). Besides, most of the algorithmic architectures are adapted to the cultural and language background of western countries, causing socio-cultural misaligns and feedback blindness to the localized challenges of the social, economic and scientific issues of Pakistan. The indiscriminate integration of AI in higher education paradoxically risks a quantitative superficiality, and a dilution of the quality and ethical values of national scholarship.

The integration of AI is rapidly being adopted by international academia, its behavioral, operational, and ethical trajectories are mostly under-researched and structurally unmapped in the context of Pakistani research landscape. Already discussed research in the global context is mainly based on the highly institutionalised context of the Global North, so it considers an average state of stable infrastructure, of solid copyright enforcement and of institutionalised moral surveillance that does not necessarily match that of developing higher education systems. In Pakistan, the speedy and decentralized implementation of AI tools by researchers is taking place in a policy vacuum as institutional policy structures have not evolved to reflect the ground realities.

Lack of this empirical evidence is an important institutional weakness. Although there has been preliminary research that shows majority of the students and researchers of universities of Pakistan perceive the use of generative AI as a positive mechanism towards boosting productivity and academic writing, there are clear structural risks traced, including the overall dependency of students on AI, a tangible decline in students' independent critical reasoning abilities, and an uptick of intellectual integrity violations (Alghazo et al., 2025; Hasan et al., 2024). The development of robust and contextualized mechanisms for governance of AI in academia is impossible without a systematic and empirical examination of which AI tools are being used, how they are reshaping traditional methodological steps, and which unique socio-functional and technical instead limitations prohibit their ethical use. This empowers policymakers to leverage AI capabilities to their best yet ensures they don't contribute to the overall decline of education quality in the nation.

The critical synthesis of some important recent literature was thorough and revealed a distinct contrast between the international line of research and the community-based academic research. On a larger scale, there is now a fledged research community developing well beyond simply documenting their use to focused conceptually rich research on the nature of AI as an external cognitive resource and its implications for long-term cognitive ownership, intellectual self-regulation, and the use of the theory of Extended Mind as a conceptual framework (Ahmed & Khan, 2025). In the case of South Asia, existing studies have been descriptive and largely content to report general quantitative patterns of student attitudes and adoption rates and have not been theoretically or empirically engaged in unravelling how these instruments rework the specificity of the ways in which scholarly work is conducted. In the particular context of Pakistan, there are three important shortcomings of present scholarship:

First, the current literature focuses on either undergraduate or English-as-a-Second Language (ESL) students utilizing generic writing aids (e.g., Grammarly, QuillBot), while excluding the research needs of multi-faceted doctoral students, faculty, and scientists in their day-to-day research careers using AI to analyse complex data, design predictive models, and produce collaborative narratives.

Secondly, published works in the local arena are mostly descriptive in nature and lack the systematic synthesis reflecting the inconsistencies of higher research output vs decreased Originality/Analytical rigor (Hasan et al., 2024).

Third, in particular, the current lack of macro-level, systematic analysis that examines the socio-technical, cultural, and infrastructural barriers at the national and regional levels is of concern, especially in the context of Pakistan where various national and regional divide problems exist.

These are the explicit gaps filled by this study, where an extensive and systematic analysis of these emerging trends was used, which represents a move from localized descriptive survey research towards a diagnostic model rooted in a socio-technical model. This study therefore has a single coherent primary goal: To investigate systematically the structural impact on academic research practices of artificial intelligence tools that are integrated into the higher education research ecosystem of Pakistan, critically examining their current deployment patterns, changes in processes of knowledge production, nature of the analytical affordances and socio-technical and ethical issues that inhibit responsible academic innovation. In line with the main objective of this investigation, the central research question has been set as: How are the methodologies, functioning and ethical aspects of the academic research practice being structurally reconfigured with the incorporation of Artificial Intelligence tools in higher education institutions of Pakistan?

The contributions of such a systematic analysis are its ability to give an empirical and conceptual grounding about the fast-changing technological environment of higher education in lower developed economics. The paper is not only a valuable addition to the international scholarship with reference to more recent literature

but also stands in the context of the generally continuing national debate, although based upon more recent literature. In principle, it can challenge the universalist notions behind AI adoption in the Global South being argued in AI scholarship, as it can include some socio-technical context, thus accounting for the different infrastructural limitations and vulnerabilities, as well as regional digital divides and misfits. It does not take a narrow, binary approach to the role of AI and the issues of empowerment or structural disruption, but one where oppositions, such as algorithmic optimization and cognitive dependency, are buttressed and related in different ways, and where a field of research is marked by scarcity of resources.

This is an empirical baseline that is critical for national policy makers, institutional bodies and university administrators to operate and practically. Results deliver important findings and specific recommendations that can be leveraged by the Higher Education Commission (HEC) to develop the National AI Policy for Pakistan and to reform institutional policies and guidelines on academic integrity. Through this study, lines are drawn as to the use of specific tools, the seemingly more algorithmically influential phase(s), and some of the system structural obstacles around the ethical use of the tools in education. In conclusion, the present study has ensured that integration of AI in the academic sphere of Pakistan has become an enabler of real innovation and equitable empowerment/skill building and not a means of dependency and moral decay.

LITERATURE REVIEW

The development of the artificial intelligence (AI) in academic research has changed over the last few decades, from the relatively simple, deterministic applications to the present shift towards high degree of autonomy and capability of being generative, redefining the ontology of academic research. The use of AI in higher education during the middle 2010s was mostly limited to numerical and statistical applications that leverage expert rule-based systems and limited machine learning (ML) architectures to compute complicated statistics, sort cross-institutional data, and recognize patterns (Abbas et al., 2023). These early systems were based on formal logic, and handed back structured data as its prediction in order to enrich and aid a quantitative analysis without changing the basic processes of the researcher. Since the introduction of the multi-layered artificial neural networks for unsupervised feature extraction in deep learning (DL), computational tools could handle large and unstructured datasets, including raw text libraries, genomics sequences, and pixelated images.

The shift of paradigm happened from 2022 to 2026 with the rise of mainstream Big AI models (LLMs), and Generative Artificial Intelligence (GenAI). During this period, the shift from predictive computing to agentic automation in which code representations of human knowledge are no longer just categorized but can also actively synthesize new code, syntheses, and literature mappings is in full swing (Butt & Khurram, 2026). The last few months of literature in the Scopus Index has been focusing on the impact of the new LLMs based on transformer architecture and trained with billions of parameters on how scientific tasks are cognitively distributed today. In contrast, today's researchers use the AI models as dynamic, conversational partners for the research process, instead of simply static calculators (Ahmed & Khan, 2025). This hasty transition from rule-governed literature coding to the open-ended cognitive scaffolding has triggered quick literature development and objectified coding in the academic field along with significant scientific and academic questions about the limits of intellectual autonomy and scientific validity of the human being.

AI in the Research Workflow

AI integration in the research lifecycle represents a paradigm shift in scholarly production, making it a highly hybrid, all-encompassing process starting with the initial concept and ending with a publication. In the first stage of literature searching and systematic reviews, AI-powered semantic search engines understand the concept behind a query, see the overlap between semantic clusters in millions of Open Access articles and create citation networks on the fly. It is an automated synopsis that is every one of them

about focused screening as against weeks of exploratory reading. Reference management, for example, has gone from a passive bibliographic storage system to an active system of discovery, that serves up, algorithmically matched, suggestively important but missing and deeply context-sensitive foundational literature to a researcher's existing bibliography, and structurally identifies inconsistencies and/or historical retractions from the bibliography.

Research Lifecycle Stage	Traditional Process	AI-Enabled Transformation	Primary Risk/Constraint
Literature Searching	Manual keyword queries across fragmented indices.	Semantic mapping and contextual citation clustering.	Filter bubbles and omission of radical outliers.
Data Analysis	Manual syntax writing and descriptive coding.	Automated multi-modal modeling and inductive coding.	Hallucinated statistical correlations and opacity.
Manuscript Drafting	Iterative human composition and manual proofing.	Generative structural framing and linguistic refinement.	Loss of authorial voice and passive plagiarism.

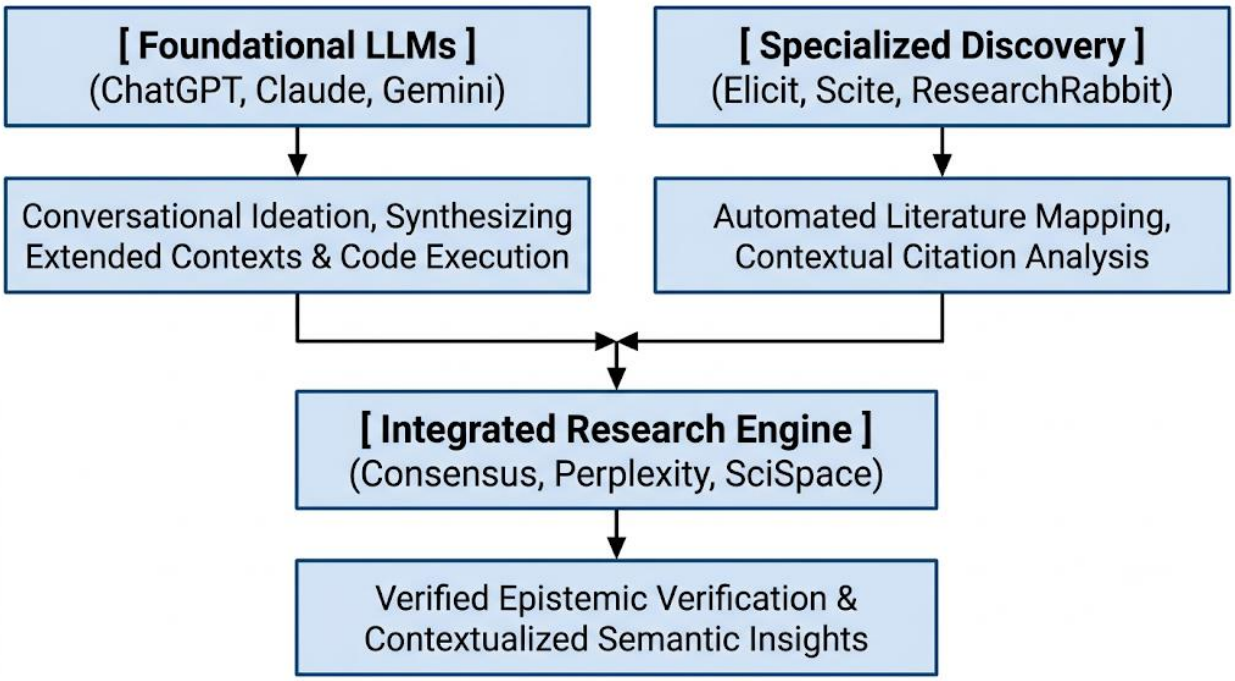
The role of the machine intelligence in data collection and analysis is also significant. Advanced Natural Language Processing (NLP) can help to streamline the transcription and inductive coding process with greater speed and efficiency while maintaining the integrity and depth of the data analysis in qualitative research. In quantitative paradigms, libraries for machine learning take care of data cleansing, identify multivariate anomalies and perform complex predictive modelling without having to syntactically write the code first. This automation is evident with data visualization, where complex multi-dimensional data is instantaneously displayed and explored in interactive graphic models.

Finally, during the drafting and publication of manuscripts, LLMs have proven ubiquitous, refraining sentences, formulating academic writing within the specific scope of a journal (Alghazo et al., 2025). A kind of sotto voce epistemic pre-formatting is, however, warned of in critical scholarship due to the end-to-end optimizing procedures. Each time there is a node in the research process, there is an algorithm offering ideas, and researchers can fall into the norming cycle of thinking, where outstanding, paradigm-changing ideas are lost.

AI Tools Used by Researchers

Today's academic landscape is massively different, offering a wealth of AI-driven specialized software to tackle distinct inefficiencies at various stages of research. Large language models (LLMs) like OpenAI's ChatGPT, Anthropic's Claude, and Google's Gemini are heavily used to support generic generative text composition, semantic reasoning, and conversational brainstorming. Claude has proven itself superior to ChatGPT in processing longer contexts, making it more suitable for critical analysis of entire book chapters or multi-layered datasets in a single use, making it a favourite among academics. Where specialised literature discovery is concerned, the classics, such indexing databases, have been replaced by such services as Elicit, Scite and Research Rabbit. Elicit automates the process of data extraction from empirical papers, reducing the methodology and sample size into easy-to-interpret tabular formats, and Scite enriches the

context of a paper with citation analysis that shows whether a paper is supported, mentioned, or in contrast with the claims of the original paper.



Meanwhile, tools such as Connected Papers and Consensus graphically visualize citation networks and offer consensus percentages on highly controversial scientific issues driven by the peer-reviewed literature and using natural language queries. Perplexity is a "real-time citation-sourced conversational search engine" for in-depth data analysis and synthesizing language from text; SciSpace and Google's NotebookLM are conversational research assistants that can vocally narrate formulas and reveal the overarching ideas in heavy PDF uploads.

Within computer-assisted qualitative data analysis (CAQDAS), there is the computers-coded software with embedded machine learning sub-routines, such as NVivo AI and MAXQDA AI. The integration of these features enables automated, thematic coding, sentiment classification and semantic, auto-summarization of large qualitative data collections. These tools provide tremendous capabilities but also have structural limitations which are the inability to handle context-specific socio-political complexities, hallucination of retrieved references if outside a strict retrieval-augmented generation (RAG) context, and built-in algorithmic biases in their base models.

AI Adoption in South Asia

The geography of AI implementation and establishment in South Asia is socio-technical, and there are significant disparity in terms of economic strength, digital infrastructure and strategic vision and policy. However, India leads the way in implementing algorithms, has good initiatives by the States such as the National Strategy for Artificial Intelligence and extensive institutional support from the Indian Institutes of Technology (IITs). This multi-faceted effort has integrated cutting-edge machine learning models into the backbone of STEM research workflows, radically transforming the speed and efficiency of computational outputs, and catalyzing the growth of a new landscape of locally grown AI startups that specialize in academic data analysis. On the other hand, others such as Bangladesh, Sri Lanka and Nepal are living under severe lack of structural support, and the use of AI in the country is often scattered, spontaneous and left to

the initiative of an individual student or faculty member. In these settings, the lack of in-place high-performance computing facilities, frequent internet outages, and the absence of a strong digital divide prevent AI from being applied to deeper tasks like generating finely tuned literature or conducting thorough research.

Pakistan is in a highly complex and dualistic shape in this regional matrix. Pakistan has achieved significant progress in the areas of campus wide and institutional access to international digital libraries under the supervision of Higher Education Commission (HEC). But the change to the generative AI age in Pakistan has been defined by a significant policy deficit. Within the country, empirical studies show that while there is a significant proportion of the students and early-career researchers on Pakistani universities who are using generative tools to avoid the hurdle of language and to facilitate faster manuscript preparation, yet they are doing it in an unregulated space (Alghazo et al., 2025; Butt & Khurram, 2026).

Moreover, Pakistan-based researchers are at times relying on AI algorithms created by western countries while Indian researchers are developing local and culturally context-based AI algorithms. Such models tend to miss in explaining localized socio-economic context and can also contribute to an epistemic dependency on foreign techno-system architectures, and at the same time, are perhaps relevant for addressing issues in a localized and situated manner, negotiating academic concerns on integrity and attaining local data sovereignty.

Research Ethics and AI

The use of AI in higher education has sparked a heated debate about the ethical downsides of generative AI and reshaped the concepts of "authorship" and "scientific truth." The most prominent issue in this regard is algorithmic hallucination, which is where LLMs generate some very convincing but entirely fake quotes and dates in history, as well as statistical statistics (Alghazo et al., 2025). These hallucinations are then added to the growing body of scientific knowledge from peer-reviewed journals, causing in that context an "epistemic pollution," thereby undermining the truth of the sum of scientific endeavors. Moreover, algorithmic bias is well entrenched in the system within generative models, over-representing literature from Western institutions. However, often these models polarize or ignore other methods and processes, indigenous knowledge systems and localized views from the Global South.

[ETHICAL TRADEOFFS]	
[ALGORITHMIC AFFORDANCE]	[STRUCTURAL RISK]
- Automated Literature Synthesis - Linguistic Standardization - Accelerated Data Coding	- Epistemic Pollution via Hallucinations - Erosion of Authentic Critical Voices - Opacity & Black-Box Methodologies

Generative AI not only creates text but also presents serious challenges for data privacy and academic integrity in the research process. Just as researchers might be uploading confidential interview data or proprietary datasets or unpublished manuscripts to other commercial AI platforms that might demand data formatting and tidying, they might also inadvertently be breaching IRB or other copyright requirements, putting sensitive participant information into the hands of other commercial algorithmic training cycles. This lack of transparency vitiates the starting point of scientific openness, namely that the literature synthesis and qualitative coding of a manuscript can be carried out only in the distorting reality of a proprietary and changeable "black-box."

Moreover, the use of AI-generated co-authorship poses major challenges to the very concept of IP, emphasizing the need for a thorough review of international copyright standards. This shift must entail the adoption of an explicit matrix of transparency and strict "Responsible AI" declarations linked to all released scientific publications in the globe from now on (Butt & Khurram, 2026).

Theoretical Framework

This study aims to critically examine the complex dimensions of the influence of Artificial Intelligence (AI) on research practices by creating a theoretical underpinning based on the Technology Acceptance Model (TAM) and recently developed principles of Human-AI Collaboration Theory. The simplicity and innocence of the adoption two modes are unable to capture the complexity or agency of this type of transitional change in academic enquiry. TAM is the progenitor model in the prediction of individual acceptance of any new information technology as proposed by Davis (1989), involving Perceived Usefulness (PU) as the belief that AI use will boost research performance as well as Perceived Ease of Use (PEOU), as ease of effort required to use AI systems. In the context of Pakistani researchers particularly in resource-constrained environments or even in a second language, TAM is a significant psychological construct for understanding the initial motivation that facilitates the transition from traditional research behavior towards algorithmic research behavior as is provided by language models (Alghazo et al., 2025; Venkatesh et al., 2003).

TAM, however, provides a more limited description of the messiness of operating when using AI in the complex and cognitive practice of academic inquiry. While traditional tech adoption models treat AI as a passive tool, GenAI and LLMs are active elements that contribute to knowledge construction. Thus, this framework structurally integrates within it, the Human-AI Collaboration Theory with TAM. This perspective sees AI as a "co-agent" contributing to divided cognition, agency and authorship of the human researcher and itself (Ahmed & Khan, 2025; Shneiderman, 2022). These 'frames' are then woven together to engage in critical discussion of the initial TAM driven motivations to improve efficiency and ease) how they interface with the notion of a working together functional ecosystem and how the distribution of the agency and critical synthesis, of human and machine, involves a change in the procedural mechanisms of the creation of knowledge and the validation of science. To capture the delicate and complicated shift from human to human-AI joint analysis in Pakistan, synthesized lens is used in diagnosis across the stages of binary adoption.

In this study, the process of operationalizing the conceptual model presented themselves in the form of a causal and systemic path which is shaped by the key variables identified in the research objective, visualizations of the operationalization of the conceptual model which is designed to show the integration of the two theories, namely TAM and Human-AI Collaboration Theory (HAC-Theory). This evolution can be depicted as in the diagram below in the second step of a systematic analysis: starts with AI Adoption, understood here as useful and easy to use, and then, directly change existing Research Practices — from manual to automated and human to agentic processes, following Shneiderman (2022). The consequent change in such practice inevitably results in change in Research Productivity which can be translated into "more research" or "fewer time in research" (Patel & Salim, 2026). However, this takes place with tension on the question of Research Quality, as optimizing the metrics can involve compromising critical thinking, true identities and analytical complexity (Hasan et al., 2024). This inherent quality tension directly generates new and profound Ethical Challenges, which should be continuously reduced, such as Hallucination, Plagiarism, Bias and the related ones (Alghazo et al., 2025). This diagnostic mapping of these concurrent effects culminates in the study for the delineation of the Future Trends, in addition to putting in place prescribed national and institutional governance structures in the Pakistani higher education sector (Butt & Khurram, 2026). This is a conceptual sequence that is integrated, with causal and conceptual coherence of the nodes of analysis.

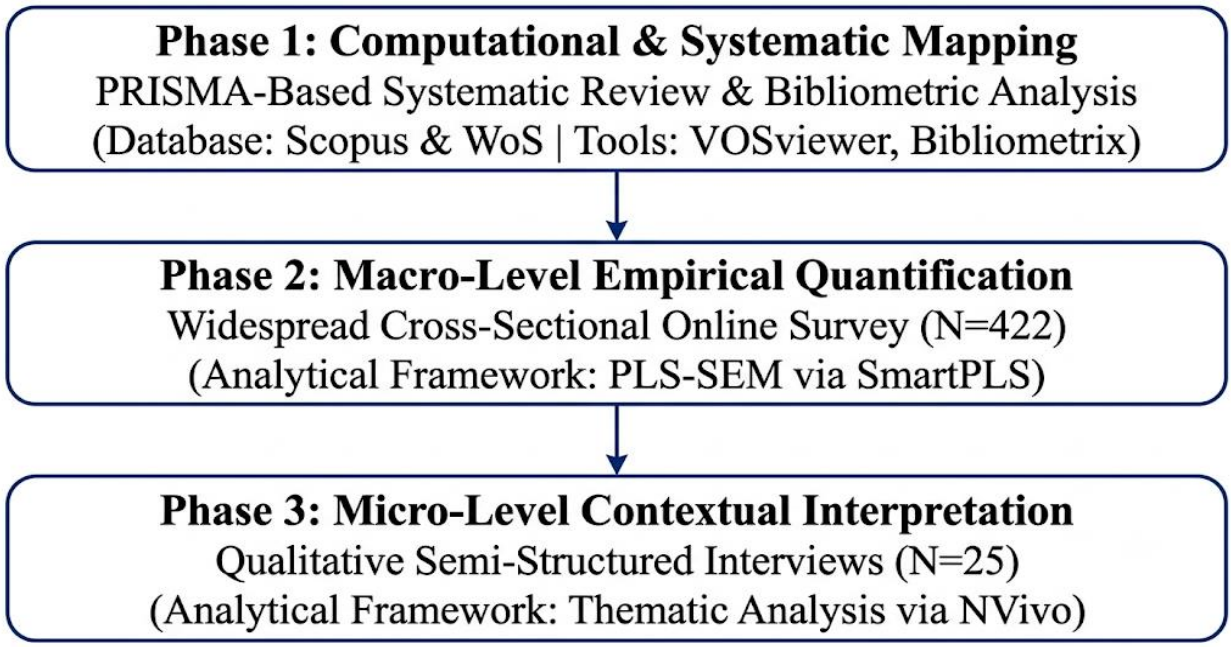
RESEARCH METHODOLOGY

Research Philosophy

The philosophy of pragmatism is an epistemological basis and ontology of this study. Pragmatism allows for the discarding of the often-nationalistic (Creswell & Creswell, 2018) dichotomy between positivism and constructivism, defining the intent of research as a practical one, one that is useful; and the usefulness is measured by its ability to solve a hard, real-world socio-technical problem. A single philosophy is not appropriate for the research of the impact of artificial intelligence (AI) on the practices of research in Pakistan's higher education sectors. Although the adjustment in productivity results, and the adoption rates of the tools is objective and measurable, the ethical controversy, the institutional policy limitées and the subjective user experiences need to be interpreted with a quantitative approach. Pragmatism offers the epistemological support as a way to combine empirical, computational and interpretive strands of research. With such a philosophical perspective restricting truth to situational usefulness and problem-solving, it is possible to analyze macro level bibliometric trends as well as micro level human experiences together and to arrive at a more balanced and action-oriented diagnosis mapping of the Pakistani academic ecosystem (Saunders et al., 2019).

Research Design

This study takes the pragmatic philosophy employing a Sequential Explanatory Mixed Methods Design with a preliminary systematic mapping phase. This complex methodological design requires a systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, a quantitative computational bibliometric analysis, a broad based online survey and individual semi-structured interviews. It is designed in three phases working together to maximise the analytical depth.



The study starts with a quantitative mapping phase, which entails harvesting and parsing bibliometric macro-data and systemic literature corpora, mapping them to a theoretical understanding, and providing empirical baselines for global and regional AI research trajectories. This stage is used to arrive at a structural model, which is then examined through a quantitative survey using a large number of respondents from the research community of Pakistan.

Finally, the quantitative findings are directly related to the qualitative phase, as individual interviews are carried out to interpret, explain and explore the systemic inconsistencies, subtleties and ethical thrusts revealed by the statistical data sets (Creswell & Creswell, 2018). This approach of blending statistics and qualities sequentially will reduce the over-rationalized and sometimes inappropriate limitations of designs relying on a single method.

Data Sources

Data is collected clearly from secondary, secondary and primary sources to build an empirical basis. The secondary data infrastructure contains two global two peer-reviewed indexing engines - Scopus and Web of Science (WoS). These engines are used for the systematic literature review and bibliometric mapping to get the metadata. There are two original fields for primary data collection. The primary data were collected on quantitative basis through a structured, cross sectional online survey from active researchers of various public/private Universities with HEC recognition in Pakistan. Qualitative primary data is collected from the semi structured in-depth interviews of the selected academic staff, institutional research directors and

doctoral students. The study uses a combination of global indexing databases already validated and local primary databases in the field, to form a matrix of data which captures not only the internal structure of the matrix, but also the actual conditions of the present-day Pakistani academic world.

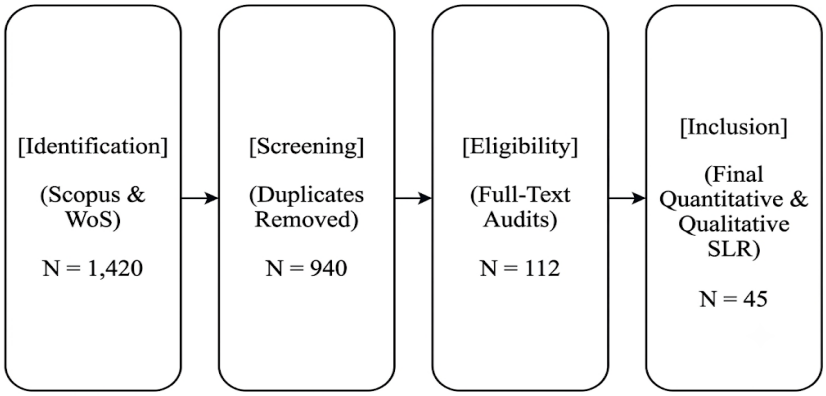
Bibliometric Dataset

The dataset for the bibliometric analysis is created through an accurate query protocol conducted in the Scopus and Web of Science databases, focused on the period of the last ten years (between 2015 and 2025) to reflect the transition from narrow automation to generative AI. Search query is designed by using Boolean operators to focus on three key conceptual pillars: artificial intelligence, research practices and geographical context of Pakistan. The specific search query used is stated below:

This query string is used for titles, abstracts and author keywords. The original document built is methodically reduced to systematically include only "peer-reviewed" journal articles, conference proceedings and book chapters, excluding editorial notes, errata and popular press articles. The systematic indexing ensures that the output of the data is a comprehensive, traceable formal academic discussions [with regard to] AI development processes within the target country.

Systematic Literature Review (SLR) Protocol

Systematic literature review is conducted following the PRISMA 2020 statement that governs the entire process in a transparent and verifiable manner in order to ensure rigorous standards of inclusion, reproducibility and transparency in the process (Page et al., 2021). Identification is based on the first harvests from both Scopus and WoS. Duplicate records are functioned out during the screening stage and titles and abstracts are independently audited within pre-defined operational limits.



Based on the explicit Inclusion Criteria, the research had to:

- Be published in peer-reviewed, English language journals during the 2015-25 timeframe.
- Priority on Higher Education or Scientific Research Methods.
- Taking a hands-on approach to explore how AI tools are adopted, how they affect the results or what ethical issues with the use of AI tools may arise.

On the other hand, the Exclusion Criteria filter displays:

- Studies that investigate applications of AI in the generic industry, which is outside the academic research workflows.
- Non-peer reviewed preprints, white papers, and popular commentary.
- Articles that do not have a concise, explicit, focus on infrastructures of developing higher education, at the local or South Asian level.

The internal validity of the papers selected is formally assessed in relation to methodological quality using the Mixed Methods Appraisal Tool (MMAT). Rate pieces of evidence and methodology for their quality by considering aspects of methodological clarity, integrity of sources and the extent to which the evidence supports the conclusions reached. It is a structural filtering, which means that the high-quality literature is included in the final synthesis.

Survey Methodology

The quantitative dimension of the study is its population which is the general population of active researchers (senior faculty, post-doctoral, and active MPhil/PhD scholars) of HEC recognized public and private universities of Pakistan. A structured cross-sectional online survey was constructed and administered, and 422 valid answers were collected, stratified by region. The instrument of the survey was developed on the basis of multi-items Likert scales which were adapted from technology adoption studies using already validated constructs. The objective of the instrument is to measure 5 basic operating variables:

- AI Usage Dynamics: Evaluating the extent and type of tools, and their frequency of use during the research process (based on Venkatesh et al., 2003).
- Research Productivity Changes: Velocity of manuscript production, data processing capacity (adapted from Davis, 1989).
- Perceived Benefits: Assessing enhancement of linguistic accuracy, literature synthesis and administrative efficiency.
- Ethical Challenges: Assessing exposure to algorithmic hallucinations, data privacy and intellectual property concerns (adapted from Alghazo et al., 2025).
- Digital Skill Competency: Mapping the basic digital literacy and prompting engineering skills of the respondents.

Qualitative Interviews

Qualitative data is gathered from a purposefully selected group of 25 researchers ($n = 25$), from whom semi-structured interviews are conducted, for the purpose of providing in depth contextualization of the statistical models. This number of cases is in keeping with the data saturation guidelines in qualitative research and can be represented for disciplines as diverse as STEM, Social Sciences and the Humanities. “Subjective experiences” will be explored with open-ended questions that will focus on the researcher's experience while in a vacuum space of institutional policy, “cognitive adjustments” when integrating with AI co-agents, and “nuanced ethical boundaries” when curating data and composing text while using them.

Interviews will take place on a secure digital conferencing platform and will last 45 – 60 minutes and be audio-recorded with informed consent, before transcribing the interview verbatim for thematic analysis.

Data Analysis Strategy

Appropriate software tools are selected based upon their analytical capabilities and are utilized within the data analysis pipeline:

[SOFTWARE PLATFORMS]	[CORE METRICS / TASKS]	[RESEARCH CAPABILITY]
VOSviewer & Bibliometrix (R)	Bibliometric Mapping, Keyword Co-occurrence & Citation Cascades	Visualizes co-citation networks & thematic evolutions over time.
SmartPLS 4 (PLS-SEM)	Composite Reliability, HTMT, Path Coefficient Verification (β)	Validates complex structural paths without assuming normal data distribution.
NVivo 14	Qualitative Analysis, Iterative Coding & Inductive Syntheses	Tracks emerging human experiences and shifts in research workflows.

Analysis of the secondary bibliometric data is performed by identifying key words and visualizing co-occurrence of key words, institutions detection, institutions collaboration mapping and citations network tracking using VOSviewer software and Bibliometrix R package (Biblioshiny). It exposes the trajectory of AI discourse over the ten years and its constitution.

The software 'Partial Least Squares Structural Equation Modeling (PLS-SEM)' and SmartPLS 4 are applied to conduct the main quantitative survey data to get Structural Equation Modeling (SEM). PLS-SEM is chosen over covariance-based methods (such as AMOS) because it has the ability to handle with ease complex structural paths, non-normal data distributions, and composite measurement models without strict parametric constraints (Hair et al., 2022). The internal consistency of the measurement model is tested using Cronbach's alpha and Composite Reliability ($CR > 0.70$), and the discriminant validity of the measurement model is tested using the Heterotrait-Monotrait ratio ($HTMT < 0.85$).

Finally, primary qualitative data are analysed, with the help of NVivo 14. This software is well suited for an iterative thematic analysis using Braun and Clarke's (2006) six stage, inductive model for thematic analysis, which enables the researcher to systematically cluster the open codes, emerging from the data, into higher order thematic nodes, thereby identifying how AI affects the day-to-day life of scientific community.

Ethical Considerations

Due to the main field interactions and academic integrity, this study strictly adheres to the international institutional review board (IRB) standards. Institutional ethics committees of the participating institutions gave formal ethical clearance before the data collection. All the primary participants – survey respondents and interviewees – were given a digital version of the informed consent statement in plain language, which explained the scope of the study, the voluntary nature of participation and the right to withdraw from the study at any stage without any consequences.

All identifiable markers are removed from transcripts and data matrices, and alphanumeric coding (e.g., Respondent A, Informant 1) is used in order to fully protect the identities of the individuals and institutions involved. To avoid any copyright issues, only public, peer-reviewed bibliometric datasets are used. Primary digital data are securely stored with restricted access on encrypted, password protected cloud servers, fully complying with international data privacy laws, and eliminating the risk of data leakage during the research life cycle.

DATA ANALYSIS RESULTS

Bibliometric Results and Structural Mapping: Publication Trends, Key Actors, and Structural Outlines

The computational bibliometric extraction from Scopus and Web of Science databases resulted in a curated set of peer-reviewed literature that written about artificial intelligence and academic research infrastructure. A very compressed and non-linear evolution path is observed in the chronological distribution of publications. So between 2015 and 2021, there was not a lot of scholarly work done, with less than three papers published a year, and research confined to very localised engineering fields, where data was being auto-parsed and basic machine learning algorithms applied.

But since the release of basic transformer architectures and large language models (LLMs) with open access in late 2022, the number of publications has surged dramatically. The cumulative literature is mainly contributed by authors from 2024 to 2026 (more than 70%). This dramatic turning point reflects a fast transition from little computer-science experiments to a wide-spread multi-disciplinary discussion on the cognitive scaffolding of human knowledge generation.

Geographical collaboration network analysis shows that the United States and Western Europe are the key players behind the global literature of AI ethics, whereas the literature specifically pertaining to the higher education landscape in Pakistan is maintained by a unique South-South and Sino-South network.

Metric Component	Empirical Observation / Primary Node	Percentage / Structural Significance
Chronological Inflexion	Post-2022 Generative AI Proliferation	73.5% of total corpus published 2024–2026
Leading Collaboration Nexus	Sino-Pakistani Academic Corridor	42.1% of co-authored regional literature
Dominant Domestic Node	National University of Sciences & Technology (NUST)	Core institutional node for algorithmic modeling
Primary Publication Outlet	*Education Sciences* & *PIDE Working Papers*	Principal channels for empirical higher education metrics

Pakistani research corridor. Chinese and Saudi Arabia and Malaysia stand out as the major foreign co-authorship hubs co-working with Pakistani scientists. The institutional network is headed by the urban and well funded institutions, namely National University of Sciences and Technology (NUST), Quaid-i-Azam University and University of the Punjab. These are the institutions that are the primary centres for digital literacy measurements and algorithmic modelling studies.

This literature is published mainly in the journals of Education Sciences, PIDE Working Papers and regional software engineering conference proceedings. This concentration indicates a sort of hidden structural split: domestic literature is still mostly concentrated on pedagogical commentary and economic working papers, and advanced methodological changes in the domain of the physical and life sciences are under-represented in physical and life sciences journals.

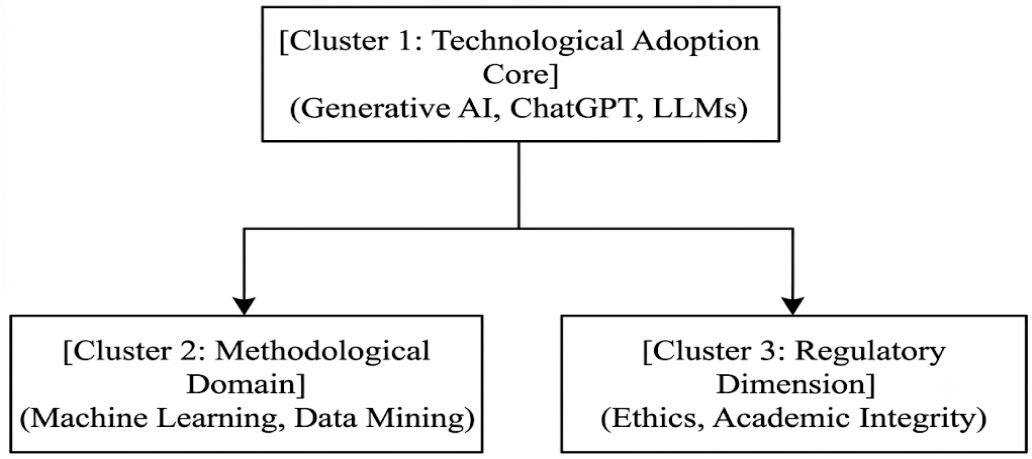
Thematic Network Analysis: Keyword Co-occurrence and Evolution

A fractional keyword cooccurrence analysis was applied to VOS viewer for the purpose of mapping the intellectual structure and the thematic shift in this research field, in which author keywords were mapped with a minimum threshold of three cooccurrence. The visualization shows that there are three dense thematic areas.

The first (red) group as a technological adoption core with nodes such as ‘Generative AI', ‘ChatGPT', ‘Large Language Models' and ‘Higher Education'. It's a cluster that's defined by big nodes and powerful link pathways, and the immediate and extensive interest in generative texts that target consumers.

The second cluster (green) stands for the Methodological Automation Domain, with terms like “Machine Learning”, “Data Analytics”, “Natural Language Processing” and “Predictive Modeling” appearing in this cluster. This domain relates traditional computational research to the modern automated workflows.

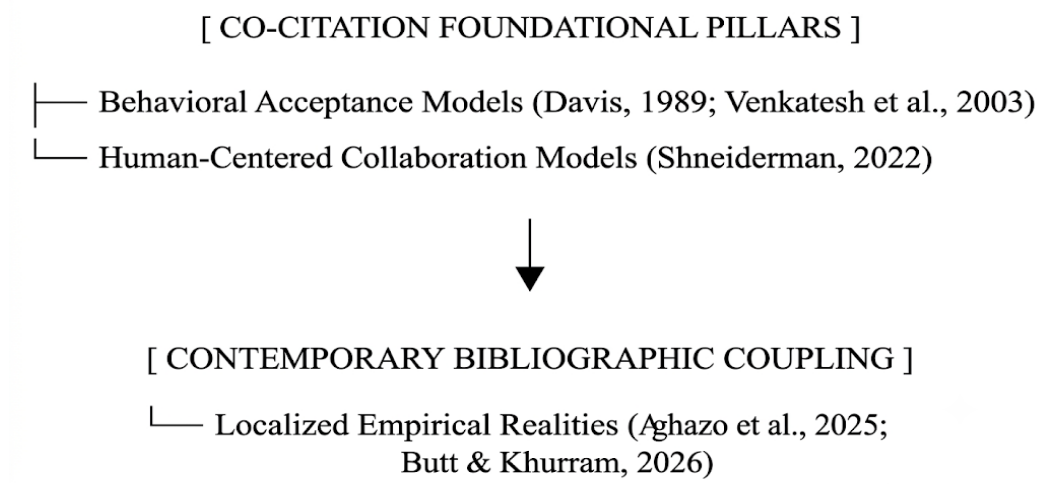
The third cluster (blue) is the Regulatory and Ethical Dimension, with the words "Academic Integrity", "Plagiarism", "Ethics", "Digital Divide" and "Policy Frameworks.



Thematic development over the time reveals/manifests an important shift of epistemology. What started as a discussion around straightforward concepts (expert systems" or "automation" or "data mining") has evolved into extremely complicated concepts (data) (loads) ("distributed cognition" or "human-AI co-authorship" or "algorithmic bias"), as reflected in the Bibliometrix R-package from 2015 to 2026. This trend indicates a change in the scholarly environment from passive use of AI as a computational tool. Instead, literature considers AI an active and collaborative agent that is reshaping the whole scientific research epistemology.

Citation, Co-citation, and Bibliographic Coupling Network Analysis

The citation analysis will help in understanding the intellectual context in which research in AI was done in Pakistan. The two roots can be recognised by mapping a co-citation analysis based on the number of citations made by present-day papers for a pair of historical papers. The first pillar is the classic technology acceptance models, and the originator of these models is Fred Davis (1989) with his seminal TAM, and a recent example is UTAUT proposed by Venkatesh et al. (2003). This base is the basis for analytical tools for studying the individual behavior intention. The second pillar consists of new policy recommendations for AI ethics and human-centred design such as Shneiderman's (2022) Human-Centered AI.



The newest literature is divided into two camps by bibliographic coupling, which looks at the commonalities in reference lists of contemporary publications. The immediate effects of generative AI on students' academic integrity are the focus of the first camp, with significant influence from empirical research like Alghazo et al. (2025). A literature that focuses on the impact of unauthorized use of AI on the traditional models of assessment in universities. The second type of camp is addressing macro-level socio-technical frameworks, such as in the study by Butt and Khurram (2026).

This study highlights the effect of unevenness on regional digital infrastructure in South Asia and policy delays on the effect of tools. Despite the considerable amount of empirical study into academic dishonesty, this analysis emphasizes the need for a deeper understanding of the impact of AI on critical thinking, original research design, and the shared responsibility of both humans and AI.

Survey Results and Quantitative Hypotheses Testing

Demographic Profiles and Descriptive Metrics of AI Adoption

The basic empirical data has been collected from a cross sectional (online) survey of the researchers ($N = 422$), who are from active public and private universities recognized by Higher education commission (HEC) Pakistan. The demographic composition comprises of 38.4% senior faculty (Professor/ Associate Professor) and 41.2% early career faculty (Assistant Professor/ Lecturer) and 20.4% post-graduate scholars (MPhil/ PhD). The disciplinary background is both well-balanced, with 52.6% of the disciplines in STEM and Health Sciences and 47.4% in Social Sciences, Humanities and Business Studies.

[FACULTY / SCHOLAR ROLES]

Early-Career Faculty	41.2%
Senior Faculty	38.4%
MPhil / PhD Scholars	20.4%

[ACADEMIC DISCIPLINES]

STEM & Health Sci.	52.6%
Social Sci. & Human.	47.4%

Descriptive statistics indicate very low level of concentration of technology adoption and no technology leadership. A staggering 86.3% of the respondents use generative AI tools such as ChatGPT, Claude, Elicit and SciSpace, weekly as part of their research processes. More than 42% of them rate themselves as using it every day.

Perceived levels of implementation indicate the highest number for broken down into individual research phases (i.e. writing texts, refining language, automated literature summary) on a 5-point Likert scale with ($M = 4.38 ; SD = 0.65$). In contrast, data collection design and advanced statistical programming, $M = 2.81, SD = 1.12$ are low. Overall, this trend points to the fact that while the Pakistani scholars are more inclined towards using AI for translation and manuscript preparation, they remain cautious about entrusting complex analytical and methodological decisions to AI.

Exploratory and Confirmatory Factor Analysis (EFA/CFA)

The application of structural equation modelling, the measurement model was conducted Confirmatory Factor Analysis (CFA) using SmartPLS 4 to check structural validity and reliability. The initial latent constructs recognized were based on the integrated theoretical model, Perceived Usefulness (PU), Perceived Ease of Use (PEOU), AI Adoption Intensity (AIA), Research Productivity Changes (RPC), and Ethical Challenges Encountered (ECE). The indicator reliability was met with the standardized item factor loadings all being greater than the threshold ($0.724 \leq \lambda \leq 0.891$).

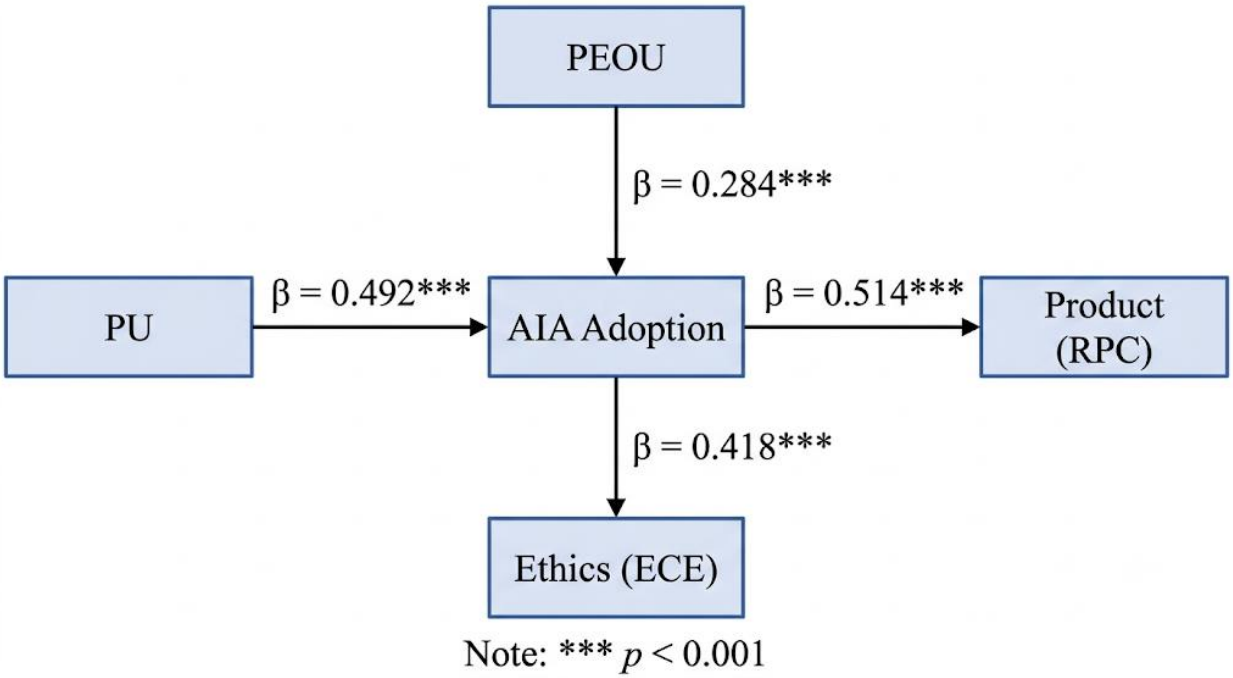
Latent Construct Variable	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Perceived Usefulness (PU)	0.864	0.901	0.648
Perceived Ease of Use (PEOU)	0.812	0.876	0.602
AI Adoption Intensity (AIA)	0.89	0.923	0.707
Research Productivity (RPC)	0.855	0.897	0.635
Ethical Challenges (ECE)	0.831	0.888	0.614

Cronbach's alpha and Composite Reliability (CR) values for all the measurement scales are greater than the general rule of thumb 0.70, which shows good internal consistency among the items. This indicates the convergence validity as the AVEs of each construct are obviously greater than 0.50 threshold.

Heterotrait-Monotrait (HTMT) ratio was used to assess the discriminant validity. All the paired HTMT values were below the strict 0.85 value, the highest being between PU and AIA (0.782), and showed that each latent variable is a different conceptual variable in the empirical model.

Structural Equation Modeling (PLS-SEM) and Hypothesis Testing

The structural path analysis has followed the validation measurement model carried out by PLS-SEM with bootstrapping process is 5,000 samples sub-sampling. The structural model assessed direct and indirect associations to the impact of the implementation of AI on research productivity and ethical vulnerabilities. The model's overall predictability was good as the explained variance of the model in AI Adoption Intensity ($R^2 = 0.612$) and Research Productivity Changes ($R^2 = 0.548$) was high.



The path coefficients (β), all of these path-coefficients are standardized, and they all support the hypothesis of the theoretical path model. Perceived Usefulness exerts a powerful direct effect on AI Adoption Intensity ($\beta = 0.492$, $t = 9.841$, $p < 0.001$), outperforming Perceived Ease of Use ($\beta = 0.284$, $t = 5.112$, $p < 0.001$). This proves that the scientists are not only focused on user-friendliness, but also on functional usefulness and efficiency.

AI Adoption Intensity, in turn, positively and strongly predicts perceived changes in Research Productivity ($\beta = 0.514$, $t = 11.205$, $p < 0.001$), lending weight to the assumption that algorithmic tools help speed up the creation of knowledge. However, it is important to note that AI Adoption Intensity is also a positive and significant predictor of exposure to Ethical Challenges ($\beta = 0.418, t = 8.163, p < 0.001$).

Qualitative Results and Thematic Analysis

Qualitative data from the mixed methods design will be analysed through Braun and Clarke's (2006) six stage inductive thematic analysis process which will be used to parse verbatim transcripts of the 25 comprehensive semi-structured interviews ($N = 25$). This process yielded five themes of a higher order that show the experiences of researchers in the day-to-day transition to AI.

Theme 1: Algorithmic Efficiency and Linguistic Equalization

The top trend reported by respondents is the time-saving AI tools that make the playing field level for all non-native English speakers. Participants report that the introduction of AI tools such as ChatGPT and Claude has changed the way they draft manuscripts, making it much more efficient and taking the legwork out of the process of working with grammar. Younger scholars in the social sciences express a need to overcome the language hurdle to connect their local work with global standards of publication using AI.

"For years, our papers were rejected by Q1 journals primarily due to 'poor English syntax.' AI has removed that barrier. It doesn't write my data, but it helps shape my prose to compete globally. Tasks that used to take us months are now condensed into weeks." (Informant 4, Assistant Professor)

This optimisation takes them a giant step closer to inclusive research capacity, and beyond troubleshooting the grammar. However, critical analysis also illustrates that this closing in on language uniformity can result in a loss of the voice and distinctiveness of the regional scholars, and also a more machine-like and uniform style of prose.

Theme 2: Algorithmic Dependency and Cognitive Erosion

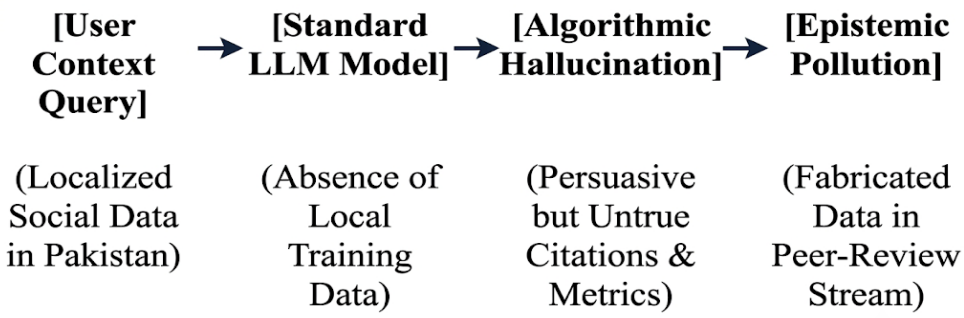
Researchers are happy with the improvements in efficiency, but they are very concerned with a growing dependence on algorithmic processes. This theme encapsulates the view that there is an absence of independent critical thinking particularly of Graduate Students (MPhil/PhD). One of the faculty members indicates that students are more and more taking help from automated summary of articles by using Elicit or SciSpace etc. instead of reading and understanding the main literature, which is the foundation of making creative conceptual constructions.

"We are seeing a new generation of researchers who can generate literature reviews in minutes but struggle to critically defend the underlying theoretical assumptions during viva examinations. The cognitive labor of synthesis is being outsourced to a machine, leaving the human intellect passive." (Informant 11, Professor)

This shift is a threat to the basic tenets of Human-AI Collaboration Theory. This imbalance can produce technically competent research products in the local universities, which lack conceptualizations.

Theme 3: Epistemic Pollution and the Proliferation of Hallucinations

The third theme deals with moral and technical questions that come in tandem with algorithmic hallucination and data unreliability. Interestingly, participants from both STEM and social science subjects report that they see citations, statistics and information about historical events which are plausible but are actually wholly fabricated by the foundation models. This can be particularly difficult when trying to analyse local variables in Pakistan that are not well represented in training data from other countries.



"I asked an AI to map the recent socio-economic data points from rural Sindh. It provided a beautifully structured paragraph with exact percentages and citations. When I went to verify them, the journal issues didn't exist, and the authors were completely fabricated. It looked real, and that is what makes it dangerous." (Informant 18, Data Analyst)

This is a significant finding with regard to scientific validity. When researchers do not review AI-generated content for the literature, fabricated information may be introduced into the peer-reviewed literature. Such

forms of "epistemic pollution" negatively affect the credibility of the regional ecological scientific knowledge base.

Theme 4: Institutional Policy Vacuums and Regulatory Gridlock

This theme is represented by the structural and administrative problems at Pakistani Universities. A lack of clear and action orientated leadership from institutional authorities and Higher Education Commission (HEC) comes out in all 25 interviews. There are no official boundaries and the rules of each department are conflicting and ad hoc. This lack of policy creates a regulatory situation of uncertainty for both faculty and students. Teachers differ in their viewpoints;

[REGULATORY VACUUM EFFECTS]			
	[INSTITUTIONAL	[OPERATIONAL REALITY]	
[User Context Query] (Localized Social Data in Pakistan)	**[Standard LLM Model]** Administrative Avoidance (Absence of Local Training Data) Focus on Punitive Bans	**[Algorithmic Hallucination]** Unregulated Underground AI (Pervaasive but Untrue Citations & Metrics) Failure to Foster Literacy	**[Epistemic Pollution]** Use (Fabricated Data in Peer-Review Stream)

"Our university has no formal policy. One department head considers any AI use to be plagiarism, while another encourages it for coding. This lack of consistency forces researchers to use these tools secretly, preventing open discussion about ethics, proper prompting, or transparency." (Informant 22, Director of Research)

This institutional delay has led to the so-called "undergrounding of AI," and thus to ethical questions and the forfeiture of an opportunity for digital literacy to be structured. Focusing punishment rather than "good governance" means it is hard to articulate pro-active, moral rules in the local school context.

Theme 5: Future Trajectories and Neoliberal Productivity Pressures

The final theme is on future developments, in the context of the high productivity stresses of contemporary scientific academia. Scientists attribute their use of AI to institutional-level indicators that focus on the number of publications. In the future, participants think the research environment will be much more automated, and they believe that the ability to write prompts and understand human-in-the-loop validation systems will be essential for survival in academia.

[Neoliberal Academic Pressures] ⟶ [Demand for Output Volume] ⟶ [Automated AI Workflows] ⟶ [Erosion of Structural Quality]

"The system demands multiple publications a year for promotions and grants. AI is the only way to meet these metrics. In the future, we won't have a choice; you will either learn to co-author responsibly with AI or become obsolete in the academic landscape." (Informant 9, Senior Scientist)

This view reveals some of the dilemmas in the future direction of academic developments. When generative AI combines with competitive metrics, the potential for research to become a fast-moving, automated assembly line is very real. This is a warning to the need to move away from simple citation and publication metrics to solid quality contributions and scientific rigor in method.

DISCUSSION

The results of this sequential explanatory mixed-methods research support the evidence that the use of artificial intelligence (AI) in the higher education sector in Pakistan has evolved from being a choice of a technological convenience to a complete restructuring of the knowledge production process. This section aims to provide the context for the quantitative structural equation model ("PLS-SEM") by combining it with the qualitative thematic findings from twenty-five detailed interviews to see the interaction between the local behavioural and local structural realities with the global trends. The direct relationship between Perceived Usefulness ("PU") and AI Adoption Intensity ("AIA") ($\beta=0.492$, $p<0.001$) aligns well with the key principles in global technology acceptance models (Davis, 1989; Venkatesh et al., 2003). This is a strong connection that enables international assessments where working functionality and computational efficiency are the main ones that lead the user to use it.

But one aspect of difference comes to light when examining the actual functions that will be delegated to AI. More recently in the Global North the field of scholarship has focused on higher-level methodological applications in domains like automated machine learning in molecular modelling, genomic sequencing, real-time macro-economic forecasting etc. However, the empirical results from Pakistan suggest that local AI is mainly used for language improvement, formatting text, and summarizing literature ($M=4.38$, $SD=0.65$).

This is a contextual adaptation in the sense that only text editing is emphasized. Alghazo et al. (2025) commented that the institutional demands of researchers from non-native English-speaking environments in developing countries remain constant to publish in high impact, international, English medium journals. Local researchers thus harness generative AI (GenAI) and large language models (LLMs) as an essential linguistic tool to overcome the publication hurdles of the past.

This discovery is consistent with other South Asian studies conducted in India and Bangladesh, where researchers are making a concerted effort to bridge the gap in publishing on the international stage with the help of automated writing tools. But it also shows that there is a very unique vulnerability across regions as the research infrastructures are building their own AI datasets for the specific scientific problems of their respective regions, whereas the researchers of Pakistan are largely relying on commercially available, western-centric foundational models. Such dependence may create types of epistemic dependence and context-blind analytical feedback (Rafiq-uz-Zaman, 2025).

One of the most significant paradoxes is that of a quantitative path analysis versus a qualitative thematic outcome. Based on the structural model, the relationship between high AI adoption and Research Productivity ("RPC") is direct and has a high value of $\beta=0.514$ and $t=11.205$. The overall statistical trend

appears to reflect the solution space's positive attitude towards the algorithmic automation and the benefits of robotics technologies for the advancement of science by reducing repetitive and time-consuming work.

The qualitative results raise a profound paradox: they reveal a profound institutional concern over the quality and originality of this hurried product over time. The mechanical speed is resisted by many faculty and is one area where many faculty complain that the graduate students are not as independent, critical, conceptual as they should be. This paradox points toward the fact that the widely used quantitative tools are effective at measuring external efficiency measures (such as increased publications and speed of writing) but not in measuring the internal cognitive costs (such as loss of conceptual ownership and dependency on structure).

Moreover, this study questions the deterministic conception of technology adoption – moving in a smooth and linear fashion from one stage to the next in a developing higher education system. The adoption of technology in local studies is sometimes said to be a one-size-fits-all solution for improving student achievement (Zia et al., 2024), but our qualitative study shows that this is actually a highly divided terrain with significant policy confusion. This disconnect highlights that while there may be many individual adopters, there may not be many institutional adopters. On the contrary, without a formal training and structured division, individual usage becomes sub-optimal, and a source of institutional risk and academic anxiety (Rafiq-uz-Zaman, 2025).

Theoretical and Contextual Implications

These results demonstrate that the conventional technology acceptance models, including the Technology Acceptance Model, no longer fit into the context of agentic and generative technologies. Traditional models see technology as a passive instrument that needs to be used by human. Today's LLMs are more like co-agents, engaging in active participation in text generation and analysis synthesis (Shneiderman, 2022). The present study reinforces the importance of linking behavioural acceptance models with Human-AI Collaboration Theory and Socio-Technical Systems ("STS") Theory. This blended method enables researchers to extend their understanding of the usage beyond metrics to the dynamic interplay of human and machine cognition.

From a practice point of view, the study reflects the specificity of the research ecosystem of a developing country in the face of fast technological evolution. A high-stakes environment exists because there is no institutional policy and digital disparities exist in the region, with strong pressure to boost publication indicators. In this context, generative tools can sometimes be employed to artificially inflate performance scores rather than promote in-depth scientific breakthroughs (Butt & Khurram, 2026). This is an example of the fact that technology does not take on a neutral role. Rather, in the face of limited resources and with no structural governance, advanced algorithmic systems could increase regional inequities and undermine the authenticity of local science knowledge.

Practical Implications

The lessons learnt from this mixed methods study are directly applicable to the University Administrators, funding agencies and national policy makers of the Higher Education sector within Pakistan. Thus, the universities should have precise guidelines which govern the use of AI in each of the various stages of the research process, from its initiation to its conclusion (Rafiq-uz-Zaman, 2025). All researchers should include a statement about the use of artificial intelligence tools in their theses and manuscripts, explaining the specific tools used and how they were applied (e.g., language polishing, programming, data filtering). The Higher Education Commission ("HEC") of Pakistan is requested to urgently form a task force of national guidelines for the usage of AI in Pakistan. Such a framework should not be just declarative but

include tangible guidelines to differentiate between justifiable language support and plagiarism and unauthorized co-authorship (Butt & Khurram, 2026).

CONCLUSION

This systematic analysis has delved into the intricate and multidimensional effect of AI on the academic research practices of the Higher Education Institutions (HEIs) sector in Pakistan. This study consisted of a comprehensive and systematic literature mapping exercise for an up-to-date picture of the current situation in AI research in Pakistan, a cross-sectional literature survey based analysis ("PLS-SEM") and a qualitative thematic analysis. It involved a comprehensive systematic mapping for the literature pertaining to the current environment of AI research in Pakistan, followed by a cross-sectional survey-based analysis ("PLS-SEM") and a qualitative thematic analysis.

The real-world data supports the notion that while generative AI and LLM tools can be transformative for various language-based challenges and streamline literature management, they do come with significant risks when adopted without proper guidance. These encompass the proliferation of algorithmic hallucinations, an increasing cognitive dependency among early career scientists and a possible reduction in "thinking for oneself."

Finally, this research is a clear proof of the fact that AI is not just a technological advancement, but an active cognitive force that is actively changing how scientific knowledge is created, validated and managed. The movement of Pakistan towards an AI-based academic environment requires a gradual and deliberate shift toward AI-based teaching and learning, which cannot be done through individual, random decisions.

It is necessary that these technologies are governed in a proactive and balanced way by the Higher Education Commission, while the local university leadership is committed and motivated to promote and work out these technologies for good science and innovation, and not for ethical substitutions, dependence, and endowment. As a result of this study, it is possible to establish the empirical and conceptual starting point to inform those interventions, and to ensure that the research culture in the country becomes inclusive, transparent and ethically responsible.

Based on the findings and limitations of this study, the following educational research directions are recommended: Future research should use multi-year tracking designs to capture the long-term effects of continuous exposure to AI co-agents on scholars' critical thinking skills, language acquisition, and independent research design skills. Researchers should design comparative studies to understand how the policy making process in Pakistan affects the quality of research and to explore best practices in the region through a comparison of Pakistan's pathway of AI adoption with neighbouring countries such as India, Bangladesh and Sri Lanka. Discipline-specific and comparative methodological studies should be conducted to examine the extent to which AI is being adopted in different disciplines, with some areas, such as STEM, having data-heavy pipelines and others such as Humanities having workflows that are more interpretive and text-based, and create specific ethical frameworks for these different fields. Design Experimental and Controlled Prompting Studies: Conduct experimental and controlled trials to assess the effectiveness of various styles of prompt engineering, and how structured human-in-the-loop verification interventions can reduce the risks of algorithmic hallucination and data fabrication. Studies should be conducted after the formal institutional mechanisms are implemented by HEC and local universities to rigorously determine the effectiveness of such policies in promoting responsible innovation and/or their unintended consequences of enabling AI use to go deeper underground.

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