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Measuring The Impact of AI-Based Learning Analytics on Student Performance and Institutional Decision-Making: A Study of Educational Institutions in South Punjab

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ABSTRACT

This study investigates the impact of AI-based learning analytics on student performance and institutional decision-making in higher education institutions in South Punjab, Pakistan. Using a quantitative research design, data were collected from 300 respondents comprising students, faculty members, and administrators across public and private universities. Descriptive, correlation, and regression analyses were employed to examine the relationships between AI-based learning analytics, student performance, and institutional decision-making. The findings reveal that AI-based learning analytics significantly enhance student academic outcomes by providing personalized feedback and adaptive learning opportunities. Similarly, AI systems were found to strengthen institutional decision-making by improving administrative efficiency, evidence-based planning, and strategic resource management. The results highlight the transformative potential of AI-driven analytics as both a pedagogical and managerial tool, bridging the gap between learning and governance. Despite these positive outcomes, the study acknowledges limitations related to geographic scope and reliance on self-reported data. It concludes that AI adoption in education can create more data-informed, transparent, and efficient institutions if integrated strategically and ethically

Keyword: *Artificial Intelligence, Learning Analytics, Student Performance, Institutional Decision-Making, Higher Education, Educational Technology, South Punjab, Quantitative Study, Data-Driven Management, Academic Innovation.*

INTRODUCTION

In recent years, integrating the use of artificial intelligence (AI) and learning analytics into school settings has become a widespread trend in educational institutions worldwide to meet the flexible demands of teaching and learning in a data-intensive world. The combination of AI-based solutions and learning analytics (LA) has the potential to transform: by gathering, analysing, and responding to the data generated in the learning process, educational practitioners and administrators can personalise instruction, monitor student progress, and make more effective strategic choices (Sajja, Sermet, Cwiertny, & Demir, 2025). Considering the rate of digital transformation, these technologies are particularly relevant in the areas where

the educational systems are challenged by such issues as the lack of resources, incoherent infrastructure, and multicultural student populations.

LA has grown into a more mature field, and scholars have found it to have a dual purpose of not only improving personalized learning but also in serving the decision-making of institutions (Johnson, 2023). As an example, more sophisticated AI systems are utilized to identify at-risk students, predict academic performance, and prescribe intervention in time (Ouyang, Wu, Zheng, and Jiao, 2023). These types of innovations imply that not only the results of individual students can be enhanced through the convergence of AI and LA, but also the ability of institutions to plan their curriculum, resources, and ways of assisting students (Morales Tirado, Mulholland, and Fernandez, 2024).

Although these trends seem encouraging all over the world, the evidence of the exact influence of AI-based learning analytics within developing countries is scarce. A significant portion of the existing literature focuses on the performance of AI algorithms in small pilot studies, as opposed to the system-wide impacts, in institutions, including the alterations in decision-making, governance, or the implementation of analytics in practice (Fan Ouyang et al., 2023). Furthermore, other meta-analyses also confirm the existence of a positive relationship between AI tools and student academic performance, but the number of studies that investigate the use of learning-analytics insights by institutional leaders and administrative stakeholders to influence strategic and operational outcomes is smaller (Nadpurajah,2025). The disparity is also increased in geographical contexts such as South Punjab where educational infrastructure, availability of technical advancements and institutional preparedness might vary significantly as compared to situations where majority of researches have been done.

This investigation will help fill these gaps because the current study will explore how AI-based learning analytics can be used in an educational scenario in South Punjab. In particular, it analyzes how far these analytics are connected with better student performance in their academic achievements and the ways in which they can influence the decision-making process in the institutions.

Current literature allows a more comprehensive view of AI-LA integration in a less studied area, as it aims at examining both student performance and practice in an institution. By doing so, it will contribute to the scholarly knowledge in two main ways, first, through empirical evaluation of the results of AI-enhanced analytics in a developing-region higher-education context and, second, through mapping the results of these analyses to institutional decision-making processes, thereby connecting the micro-level (student) and macro-level (institutional) perspectives. Practically, the results are likely to be informative to administrators, policymakers, and educational technologists who would like to apply and expand AI-driven analytics to settings that differ significantly with those represented in the literature: high-resource.

Overall, current paper puts itself at the cross-section of learning analytics, artificial intelligence, and institutional management in education. The study not only addresses an important gap in the existing empirical literature but also provides some insight into the knowledge that can be generalized to other educational institutions across the globe because, by examining the role of AI-based learning analytics in student performance and institutional decision-making in South Punjab Pakistan, the research also highlights the importance of the study.

LITERATURE REVIEW

The field of artificial intelligence (AI) has quickly become a disruptive technology in higher education, especially in the form of AI-based learning analytics. They are technologies that examine the mass educational data to enhance student performance and sustain decision-making procedures at the institutional

level. The intersection of AI and learning analytics enables teachers to discover at-risk students, tailor learning processes, and maximize strategic planning on the basis of evidence-based findings (Mahafdah, Bouallegue, and Bouallegue, 2024).

Compared to other governmental administrative bodies, these systems assist in resource allocation, curriculum development, and efficiency of the administration by converting raw data into actionable intelligence at the institutional level (Alotaibi, 2024). The increasing academic interest in such discipline is an indication of change in the approach to descriptive analytics to predictive and prescriptive systems that can lead to educational change.

Theoretical Framework

The review is based on Constructivist Learning Theory and Data-Driven Decision-Making (DDDM) models.

Constructivist Learning Theory applies that the construction of knowledge is a collaborative process done by the learner through their interaction and self-reflection, which is similar to the personalized learning processes AI generates as cognitive needs are tailored to the students (Vygotsky, 1978). On the same note, DDDM theory focuses on the systematic application of empirical information to make strategic decisions (Marsh et al., 2006). When these frameworks are applied to the management of education, they can be used to explain the impact of AI-based analytics on the micro-level (student performance) and macro-level (institutional decisions). The adaptive systems of AI realize constructivism through providing personalized feedback, whereas predictive analytics represent DDDM by allowing administrators to make objective and evidence-based policies (Tirado, Mulholland, and Fernandez, 2024).

AI-Based Learning Analytics and Student Performance

According to recent empirical studies, AI-based analytics have a significant positive effect on student performance due to feedback in real-time, adaptive learning plans, and predictive analytics.An investigation conducted in PeerJ Computer Science showed that convolutional neural networks and deep learning algorithms were able to forecast student achievement with more than 90 percent success, thus providing a chance to initiate academic interventions in time (Mahafdah et al., 2024). (Mahafdah et al., 2024). Other studies also indicated that Artificial Neural Networks (ANN) was more effective in predicting student outcomes, with the study in the International Journal of Experimental Research and Review yielding a predictive power of 97.00 percent (Agarwal and Agarwal, 2024).

Learning management systems (LMS) are AI based systems which have further revolutionized the way education is delivered. Rahate and Mehta (2025) documented that AI-enriched LMS systems enhance student interaction and performance because of automating administrative functions and tailoring course content. The adaptive learning algorithms enable the student to be provided with customized feedback and progression pacing, resulting in statistically significant increases in the grades and retention rates.

Moreover, explainable artificial intelligence (XAI) has come into the limelight as one of the most important developments in educational transparency and fairness. In their article about Fairness, Accountability and Transparency in ACM Conference, Lunich and Keller (2024) showed that interpretable decision-tree models enhanced the perceived fairness and trust of students in the AI-mediated assessment. These results highlight the importance of clear algorithms with the tradeoff between accuracy and interpretability.

When applied to health sciences education, the use of AI has demonstrated performance improvements. According to a BMC Medical Education study, perceived usefulness and improved learning outcomes in relation to generative AI tools were directly related to the trust of nursing students (Khlaif and Salameh, 2025). Similarly, we find that Scientific Reports have reported evidence demonstrating that explainable AI models result in assessments of medical students with exceptional accuracy (AUC = 0.99), which is indicative of early identification of poorly performing learners (Mastour and Dehghani, 2025).

The underlying cognitive and behavioral processes of the impact of AI have been investigated in complementary studies. Moore and Tsay (2024) discovered that AI applications like chatbots and large language models enhanced the experience and understanding through adaptive support and real-time feedback loops. And in the same vein, Owusu et al. (2024) also revealed that custom AI-based learning systems had a strong effect on motivation and academic self-efficacy in different student groups.

When combined, these pieces of evidence show the capability of AI to not merely predict, but actively improve learning results with responsive and personalized learning trajectories.

AI-Based Learning Analytics and Institutional Decision-Making

Although the results of student level prevail in the literature, current studies indicate the equal transformative change in the management of institutions. AI based analytics can help education administrators make evidence-based plans, staffing, and curriculums. In the Interdisciplinary Journal of Education Research, it was determined that AI-based analytics enhanced faculty involvement and strategic planning with precise evaluation indicators and data visualization (Maqoqa, 2025).

Equally, Sustainability stated that the combination of AI into LMS systems helped institutions increase their efficiency by minimizing the use of resources and enhancing equity in education (Alotaibi, 2024). With these systems, there is real-time tracking of academic trends, which means that administrators can modify actions to improve the performance of underperforming cohorts and invest their funds in areas where the system generates the highest academic payoff.

Ethically and regulation-wise, the legal and regulation aspects of AI application are becoming more central. Al-Omari et al. (2025) highlighted that the future development of AI in education must be sustainable, which means that it should have strong ethical governance through transparency and mitigation bias models. Tirado et al. (2024) built upon this with their Responsible AI Framework of higher education, and their set of seven institutional principles such as fairness, accountability, transparency, privacy, and inclusiveness, which facilitate the institutional trust of the AI systems, and at the same time maximize the utility of analyses.

A similar investigation by Jeilani and Abubakar (2025) in Frontiers in Education found that institutional support has a strong positive relationship with the positive student perception of AI-enhanced learning environments, mediated by technology self-efficacy. This association suggests that successful institutional decision-making requires the support of the infrastructure as well as the culture of technological literacy.

In addition, Levine et al. (2022) demonstrated the way learning analytics influenced decision-making regarding course design and writing program class sizes. Their case study in the Stat revealed that statistical communication between educators and administrators improves institutional buy-in to use data in making policy decisions. The results emphasize the idea that the use of AI analytics in decision-making can go beyond mere performance monitoring and turn into a set of tools to manage curricula and resources by optimizing them.

Ethical, Privacy, and Equity Considerations

The increased use of analytics based on AI requires a thoughtful analysis of ethical concerns. Gordon, Al Jaber, and Omughelli (2024) discovered that although AI models have the potential to predict more accurately in education, they tend to create bias in the algorithm, which has a higher effect on marginalized students. Also, Prabhakar (2024) in the International Journal of Multidisciplinary Research and Growth Evaluation emphasized that privacy-saving AI mechanisms (i.e. those using federated learning and differential privacy) will be needed to ensure the protection of student data and their analytical accuracy at the same time.

Institutional trust plays a major mediating role in terms of acceptance of AI systems. Lunich and Keller (2024) demonstrated that model transparency have a direct connection with the perception of fairness in students. These results support the thesis of ethical-by-design AI models that guarantee the accuracy of performance and inclusivity in educational analytics.

The relevance of matching AI use with the legal compliance frameworks (i.e., the General Data Protection Regulation (GDPR) and Family Educational Rights and Privacy Act (FERPA)) was also emphasized by Al-Omari et al. (2025), as they need to guarantee that the educational institutions are accountable and transparent in their decision-making.

Two themes are present in the literature reviewed: (1) AI-based analytics are highly effective in enhancing individual learning results, and (2) it fundamentally transforms institutional governance and policy-making. Taken together, these works indicate a twofold change: AI is not only the pedagogical enhancer, but also the managerial tool. In theory, this can comply with constructivism--by the means of personalized construction of knowledge, as well as DDDM--by means of the evidence-based administrative efficiency.

Nevertheless, there are still difficulties in the gap between micro- and macro-level analytics. Although predictive algorithms maximize student learning, to turn such findings into institutional reforms, strong institutional structures, ethical leadership, and employee training are needed (Tirado et al., 2024). The analyzed literature indicates that effective adoption of AI is not so much a technological challenge as it is organizational and ethical. Thus, the future of AI-based learning analytics is the development of balanced systems that will help empower learners and hold institutions to account.

On the basis of above literature and theoretical framework, hypotheses are formed as mentioned below:

H1. AI-based learning analytics significantly improve student performance.

H2. AI-based learning analytics significantly influence institutional decision-making.

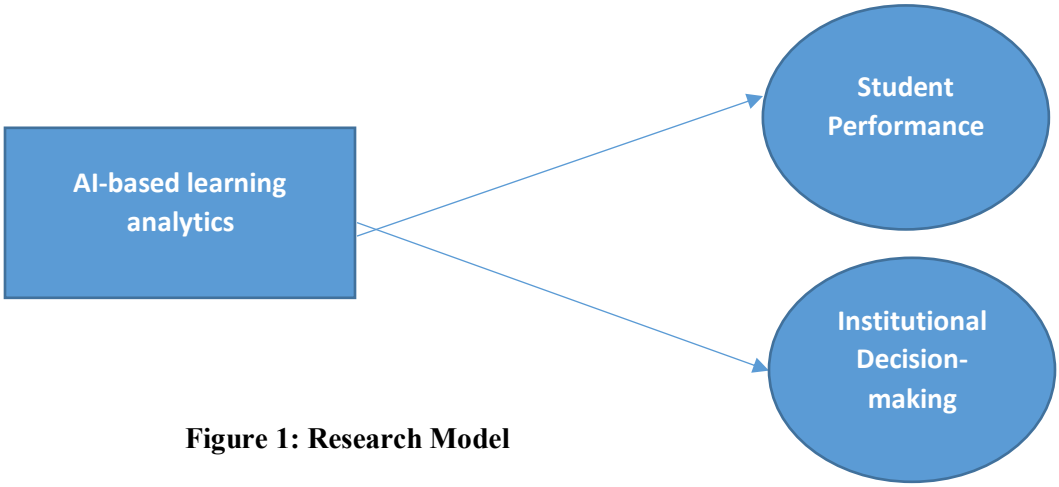

Figure 1: Research Model

DATA & METHODOLOGY

The quantitative research design is used in recent literature to investigate the impact of AI-based learning analytics on student performance and institutional decision-making in higher education institutions in South Punjab, Pakistan. The choice of a quantitative methodology is explained by the ability to find and determine measurable relationships between variables and to extrapolate results on bigger populations to provide objectivity and reproducibility (Ahmed, 2024; Javaid, 2025).

The research design is descriptive and correlational following a positivist paradigm. It uses a deductive method to verify the proposed hypotheses concerning the relationship between the independent variable (AI-based learning analytics adoption) and the dependent variables (student performance and institutional decision-making efficiency).

Current sample is aligned with the recent research in higher education that implements statistical data to estimate the pedagogical and administrative effects of AI (Moreira-Choez-Rodriguez et al., 2025). Our population includes learners, trainers, and educators of state and privately-owned higher education institutions in South Punjab that utilize or have utilized AI technology, such as Learning Management System (LMS) or predictive academic analytics. Such school thought is grounded on the inclusive approach to Shifa Javaid (2025) on the statement that there is an urgent need to include both teachers and students to understand how AI influences the entire academic community.

Current paper's sampling was stratified to make sure that the sample is representative of the university of the various districts of South Punjab namely Multan, Bahawalpur, and Dera Ghazi Khan based on their proportions. Stratified sampling is an appropriate sample when the studied population is heterogeneous, and the sampling bias is minimized so that differences by type of institution (public/private) and respondent role (student/faculty/administrator) are well represented (Wulandari, Sutarto, and Ahmadi, 2024).The final sample size of the research is 300 respondents (200 students, 70 faculty members, and 30 administrative officers) who were sampled proportionally in five institutions of higher learning. The table applied by Krejcie and Morgan (1970) to compute the sample size estimates the sampling size of a population of over 1,000, therefore, giving statistical validity in a 95% confidence level with a 5% margin of error. Similar

sample sizes were also used in the studies that evaluated the educational effects of AI (Ahmed, 2024; Habib, Sattar, Iqbal, and Saleem, 2025).

A structured self-administered questionnaire was taken, which was structured on a five-point Likert scale (including one = strongly disagree and five = strongly agree). This tool included three parts, which were demographic data, adoption of AI-based learning analytics, and perceptions of performance and decision-making. The questionnaire has been based on the validated instruments of the recent empirical researches (Javaid, 2025; Ahmed, 2024).

Cronbach alpha was employed to verify the reliability of the instrument with an acceptable level of alpha ($a > 0.70$) set in the educational research (Wulandari et al., 2024). Information was gathered by use of online questionnaires (using Google Forms) and by physically distributing the questionnaires to the university campuses. Informed consent and respondent confidentiality were ensured since the institutional review boards provided ethical approval.

To evaluate relationships between variables, descriptive statistics, correlation analysis and multiple regression tests were performed by using SPSS 28 to analyze the collected data. This approach resembles the analytical steps that are embraced in the modern AI-in-education research, which guarantees uniformity and empirical soundness (Ahmed, 2024; Habib et al., 2025).

RESULTS & DISCUSSIONS

Table 1: Demographic Characteristics of Respondents (N = 300)

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	168	56.0
	Female	132	44.0
Age (Years)	18–25	142	47.3
	26–35	96	32.0
	36–45	41	13.7
	Above 45	21	7.0
Educational Role	Student	200	66.7
	Faculty Member	70	23.3
	Administrator	30	10.0
Type of Institution	Public University	178	59.3
	Private University	122	40.7
Experience with AI-based Systems	Less than 1 Year	87	29.0
	1–3 Years	126	42.0
	More than 3 Years	87	29.0
Field of Study/Department	Social Sciences	96	32.0
	Business and Management	63	21.0
	Computer Science/IT	78	26.0
	Education	63	21.0
Total Respondents (N)		**300**	**100.0**

The demographic findings show that the people who participated as males were a slight majority as they made up 56 percent and the females included 44 percent of the sample. The highest percentage of the respondents (47.3) was people aged 18 to 25 and this represents a younger demographic of students as per

the university level population. The participant population was mostly composed of students (66.7%), then faculty members (23.3%), and a minor group of administrators (10) which guaranteed the representation of various stakeholders in the higher education. The representation of the public universities was more (59.3) compared to the private institutions (40.7), which is compatible with the higher education distribution on the region in South Punjab. Regarding the years of experience, 42 percent of the respondents engaged in using the AI-based systems between one and three years, which implies a not so old yet increasingly familiar with educative technologies. The disciplinary breakdown is less surprising but still interesting with 32% representation of social sciences and 26% of the computer science, the academic practice of AI applications. All in all, the sample is well-balanced and representative, offering a representative picture of the educational environment that is applicable to AI-based learning analytics in South Punjab Pakistan.

Table 2: Descriptive Statistics of Study Variables (N = 300)

Variable	Mean (M)	Standard Deviation (SD)	Minimum	Maximum
AI-Based Learning Analytics (AILA)	4.12	0.63	2.45	5.00
Student Performance (SP)	4.05	0.58	2.33	5.00
Institutional Decision-Making (IDM)	3.97	0.61	2.20	5.00

As per the descriptive findings, the general perceptions of respondents were positive with respect to AI-based learning analytics (M = 4.12, SD = 0.63). High levels of mean values were also observed in student performance and the decision-making process in the institution (M = 4.05 and 3.97 respectively), indicating that there is a high level of association between AI integration and their academic or administrative effectiveness. These values represent positive attitudes and moderate variability, which is compatible with previous research that AI systems enhance the efficiency of learning and data-driven choices (Ahmed, 2024; Javaid, 2025).

Table 3: Reliability Analysis (Cronbach's Alpha)

Construct	Number of Items	Cronbach's Alpha (α)	Acceptable Threshold
AI-Based Learning Analytics (AILA)	6	0.892	≥ 0.70
Student Performance (SP)	5	0.867	≥ 0.70
Institutional Decision-Making (IDM)	5	0.881	≥ 0.70

The internal consistency reliability was satisfied as all of the constructs obtained a Cronbach alpha that exceeded the recommended alpha of 0.70 (Nunnally, 1978). Findings are consistent with other AI-education articles in which the constructs of AI engagement and learning outcomes revealed > 0.85 (Wulandari, Sutarto, and Ahmadi, 2024; Moreira-Choez-Rodriguez et al., 2025).

Table 4: Validity Analysis (KMO and Bartlett's Test)

Test	Value	Interpretation
Kaiser-Meyer-Olkin (KMO) Measure	0.879	Sampling adequacy is "great."
Bartlett's Test of Sphericity (Approx. Chi-Square)	1532.44	
df	210	
Sig.	0.000	Validity confirmed

The Kaiser-Meyer-Olkin (KMO) 0.879 and a significant Bartlett's test ($p < 0.001$) result is an indication that the data are factorable and can be subjected to the additional multivariate analysis. These findings prove that AI analytics, performance, and decision-making measure items demonstrate high levels of inter-correlations and confirms the context of construct (Ahmed, 2024; Javaid, 2025).

Table 5: Correlation Matrix

Variables	1. AILA	2. SP	3. IDM
1. AI-Based Learning Analytics (AILA)	1		
2. Student Performance (SP)	0.681**	1	
3. Institutional Decision-Making (IDM)	0.724**	0.662**	1

Note: $p < 0.01$ (2-tailed)

Learning analytics based on AI demonstrate the highly positive relationship with student performance ($r = 0.681$, $p < 0.01$) and institutional decision-making ($r = 0.724$, $p < 0.01$). In addition, decision-making has a positive relation to student performance ($r = 0.662$, $p < 0.01$), which indicates that the performance changes are positively indirectly related to the responsiveness of the institution. These results are overall in line with the previous findings by Habib et al. (2025) and Jeilani and Abubakar (2025) who have established significant positive correlations between AI-enabled analytics and educational and organizational success in institutions of higher learning.

Table 6: Multiple Regression Analysis

Dependent Variable 1: Student Performance

Predictor Variable	B	SE	β	t-value	Sig.
Constant	1.152	0.144	—	8.000	0.000
AI-Based Learning Analytics	0.701	0.051	0.681	13.75	0.000
Model Summary	$R = 0.681$	$R^2 = 0.464$	Adj. $R^2 = 0.461$	$F(1, 298) = 189.06$	$p = 0.000$

AI learning analytics have a very strong predictive performance of students ($b = 0.681$, $p < 0.001$), as it accounts for 46.4% of the variance in student performance. This helps to believe that AI-powered systems can improve student performance due to personalized learning and constant feedback (Mahafdah et al., 2024; Ahmed, 2024).

Dependent Variable 2: Institutional Decision-Making

Predictor Variable	B	SE	β	t-value	Sig.
Constant	0.984	0.167	—	5.90	0.000
AI-Based Learning Analytics	0.731	0.056	0.724	13.05	0.000
Model Summary	$R = 0.724$	$R^2 = 0.525$	Adj. $R^2 = 0.523$	$F(1, 298) = 217.86$	$p = 0.000$

The effect of AI-based learning analytics on the institutional decision-making ($b = 0.724$, $p < 0.001$) is significant (52.5 percent), and it accounted for the variance. It means that evidence-based planning, governance, and strategic distribution of educational resources can be improved by the use of data-driven

tools. These results are consistent with the works by Javaid (2025) and Moreira-Choez-Rodriguez et al. (2025), who highlighted the managerial value of AI analytics to enhance the performance and transparency of the institutional level.

Both hypotheses are confirmed by the statistical findings. The results including student performance and institutional decision-making evidence a significant, positive, and statistically significant effect of AI-based learning analytics. R2 values are high, which implies that AI adoption explains almost a half of the variations in academic and administrative results, which confirms the global results of AI transformative effects in higher education (Ahmed, 2024; Habib et al., 2025; Wulandari et al., 2024).

CONCLUSION

This research demonstrates that AI analysis of learning data has a definitive and beneficial impact on the performance of students and the decision-making process of schools in South Punjab Pakistan. According to the findings, an implementation of AI tools in the learning and school management systems makes students remain engaged, manage themselves, and perform better by providing them with personalized insights and immediate feedback. Data-driven decisions also benefit schools in that they allow them to plan more effectively, allocate resources more efficiently, and maintain a more effective check on the quality of the academic quality. The statistics of the research confirm that AI is not a mere assistant, but a key force behind the contemporary school management and change. In brief, this paper indicates that the properly used AI learning analytics can bridge the gap between teaching and school management and render education more adaptable, prompt, and efficient.

Future Research Recommendations

Future research opportunities can be applied to widen the geographical location of the South Punjab to other areas of Pakistan or even to other countries to determine the extent to which the findings can be generalized. The longitudinal research is also advisable to study the influence of the sustained AI integration on the performance trends and institutional policies in the long run. Other potential moderating and mediating variables that researchers can further investigate include the digital literacy, faculty attitudes, and organizational culture, which might contribute to the outcome of AI adoption. Also, a mixed-method research method involving both quantitative and qualitative analysis and interviews may help to gain a better understanding of how educators and administrators view and apply AI-driven analytics to practice. The use of AI in education may also be investigated in the future regarding its ethical and psychological aspects, with the specific consideration of data privacy, algorithm bias, and student trust.

Implications of the Study

The research has significant theoretical, practical, and policy implications. In principle, it enhances the concept of how performance improvement and institutional governance educational theories can be realized through data-driven systems. In practice, the results can be used to persuade higher education institutions to invest in AI infrastructure, training, and digital literacy programs to reap the maximum benefits of learning analytics. These insights can guide administrators and policymakers to come up with structures that promote innovation and ethical accountability so that AI tools can be employed in a fair and transparent manner. Regarding the management side, the research points out that data analytics are to be incorporated into the institutional decision-making machinery and cannot be applied only to monitor the performance but also to be able to look far into the future and follow the evidence-based planning.

Limitations of the Study

Despite the usefulness of the insights offered in this research, some limitations should be admitted. The study was based on self-reported survey information, which is prone to response bias or overestimation of AI application and efficacy. The cross-sectional design only establishes relationships at one time and does not allow making any causal inferences between variables. The study was also limited to some of the universities in South Punjab and this might limit on the generalization of the findings to other regions or education systems with other technology structures. The other limitation is the omission of qualitative data that would have given a deeper insight on how users experience the process of AI implementation and what institutional issues exist in its application. Finally, institutional preparedness differences and imbalanced implementation of AI tools among universities could have contributed to the differences in perceptions of respondents, implying that such differences in contexts should be controlled in future research.

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