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Bridging the Digital Divide: Artificial Intelligence in the Administration of Public and Private Elementary Schools

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ABSTRACT

The impact of Artificial Intelligence (AI) on public and organizational life has been so profound that it has begun to affect how schools are managed; however, empirical evidence on the administrative uses of AI remains scarce, especially in developing countries. The study aimed to investigate the level of AI adoption in the administration of public and private elementary schools in District Kasur, Pakistan, and to compare the two sectors in terms of adoption levels, perceived benefits, and challenges. Mixed methods were used, and a structured five-point Likert questionnaire was used with 250 respondents (125 teachers from public schools and 125 teachers from private schools), which included school administrators, head teachers, IT coordinators, and senior teachers, as well as semi-structured interviews with 10-15 teachers who were school administrators. The quantitative data were analyzed using descriptive statistics and an independent-samples t-test, while the interview data were analyzed thematically to triangulate with the survey data. Findings showed that the private schools had significantly higher AI adoption than the public schools ($t = 3.85$, $p = .001$) and their perception of benefits ($t = 3.42$, $p = .002$), while the two sectors had similar challenges ($t = 1.24$, $p = .217$), most importantly funding issues, limited technical training, and concerns around data privacy. This study indicates that the implementation of AI in primary school management is unevenly distributed, with greater willingness to adopt AI and the availability of resources as key factors. Policy implications, practice implications and directions for further research are discussed.

Keywords: *Artificial Intelligence, school administration, elementary education, public schools, private schools, educational technology*

INTRODUCTION

The twenty-first century has seen the development of technology and its influence in almost every aspect of public life, including education. Artificial Intelligence (AI) — a set of computational systems that can learn, reason and make decisions (Russell & Norvig, 2020) — has garnered special focus among emerging technologies for its ability to revolutionize the teaching and learning process and institutional management. Although there has been a significant amount of research on the administrative use of AI for personalized learning and intelligent tutoring, comparatively little research has investigated its administrative applications, despite the fact that school administration is the backbone that supports the teaching and learning process (Zawacki-Richter et al., 2019).

School administration encompasses a range of responsibilities, including student enrollment and record-keeping, tracking attendance, scheduling, resource allocation, financial planning, communication with parents and staff, and performance monitoring (Holmes et al., 2022). Typically, these activities have been performed manually or with simple digital technology, which can be inefficient, error-prone, and costly for administrative staff. These daily chores can be optimized by AI-powered systems, enabling predictive analysis based on institutional data and increased transparency and evidence-based decision-making, as seen in some studies (Luckin et al., 2016; Lamb & Weiner, 2021). Therefore, AI in school management is not yet ubiquitous.

Resource-rich institutions, such as private schools that have greater financial and management independence, could be better positioned to pioneer the creation of AI-based systems than public schools may be due to infrastructure, resources and policy limitations (Woodruff et al, 2023; Sposato, 2025). This inequality is likely to be especially profound in low-income countries such as Pakistan where there may not be access to the internet, resources or digital literacy within the school setting. To build equitable and sustainable technology policies for elementary school we must understand what is happening in AI today, and where the gaps are.

This study addresses this need by exploring the role of AI in Public and Private Elementary Schools of District Kasur (Kasur) Pakistan. In particular, it examines to what extent core administrative actions are already being automated, the perceived advantages and disadvantages of taking advantage of it and the potential for meaningful differences between the public and private sector. The study will provide empirical and context-specific evidence that will contribute to the policy, leadership, and educational technology design efforts of those looking to support responsible and inclusive AI use in elementary education.

LITERATURE REVIEW

AI in Educational Administration: An Overview

Generally, the use of AI in education includes computational systems that can process data, recognize patterns, perform predictive analysis, automate repetitive tasks, and interact with humans in natural language (Aggarwal et al, 2023). While most of the conversation around AI in education has focused on adaptive learning and intelligent tutoring systems (Roll & Wylie, 2016; Zhang & Aslan, 2021), there has recently been an increase in literature that has begun to acknowledge its administrative potential, including in the student information system, scheduling and resource allocation, admissions, performance dashboards, and parent comms platforms (Ahmad et al, 2022). The ability to adopt AI in classrooms is often discussed in a socio-technical manner, emphasizing that the technical ability of an AI system is not solely determining, but also its capacity to function within the context of organizations, staff, and institutional culture (Mishra et al, 2022; Bano et al, 2022).

Applications of AI in School Administrative Functions

There are a number of applications that recur in literature. The first is that AI-based student information systems help schools keep records, clean the data, and identify students needing academic or behavioral assistance early on (Baker & Inventado, 2016; Lamb & Weiner, 2021). Secondly, AI-driven chatbots and notification systems have streamlined regular communication between the school, parents, and teachers, providing 24/7 access (Winkler & Söllner, 2018; Labadze et al., 2023). Third, AI-driven optimization tools support in creating a timetable, allocating facilities, managing fees and billing, thereby easing administrative staff's manual workload (Woodruff et al, 2023; Mishra et al, 2022). Fourth, predictive analytics can help school leaders to predict student enrolment patterns, identify students at risk and make more informed budget and resource planning decisions (Aggarwal et al, 2023; Jarke & Breiter, 2019). Last

but not least, AI systems have now started to assist teachers in their performance monitoring and professional development because they can alleviate the administrative burden of attendance logging and report generation (Yu & Lu, 2021).

Benefits of AI Adoption in School Administration

The literature overwhelmingly demonstrates that the use of AI improves administrative efficiency, accuracy and transparency (Holmes et al., 2022; Sposato, 2025). Commonly reported benefits are: less time spent on repetitive tasks, better accuracy in record keeping, quicker and more informed decision making and better communication with parents and stakeholders (Luckin et al., 2016; Cope et al., 2021). AI is claimed to help automate repetitive tasks, allowing administrators to concentrate on strategic planning, pedagogical support, and relationship-building, which are tasks requiring specific human judgment (Holmes et al, 2022).

Challenges and Ethical Concerns

Despite all these advantages, there are still some issues that researchers are pointing out. One of the most common concerns is data privacy and security, as AI technologies in educational settings may have access to student information (Xu, 2022; Williamson, 2021; Jobin et al., 2019). Lack of technical expertise and professional development of school staff also pose barriers to effective use of AI (Woodruff et al, 2023; Roshan & Iqbal, 2024), as do inadequate infrastructures, such as unreliable internet connectivity and outdated hardware in under-resourced settings (Selwyn, 2019; Dede, 2023). Other issues include staff resistance to change due to fear that the human touch might be lost in a school's decision-making process, over-reliance on automated decision-making, and algorithmic bias (Schiff, 2022; Perrotta & Selwyn, 2020).

Public–Private Disparities in AI Adoption

There is also a common finding in literature that private institutions, which have more resources to allocate for AI adoption, are more likely than public institutions, which are usually government funded and dependent on bureaucratic processes for procurement, to do so (Bo, 2025; OECD, 2021; Demartini et al, 2020). This pattern also poses equity issues because if AI is adopted on the basis of the current inequities in the availability of resources, it has the potential to deepen the inequities of public and private education (Ahmad et al., 2022). In developing countries, such as Pakistan, the findings indicate that teachers are generally positive about the integration of AI into education, but their adoption is inconsistent and hindered by factors like infrastructure and training limitations (Alhajri et al, 2021; Bano et al, 2022).

Theoretical Framework

There are three theoretical lenses that this research builds on. The Technology Acceptance Model (TAM) is used to explain the adoption behavior, with a focus on perceived usefulness and perceived ease of use, issues that can affect administrators' willingness to use AI tools in their daily work.First, the Technology Acceptance Model (TAM) explains the adoption behavior by highlighting the perceived usefulness and perceived ease of use, which can affect administrators' willingness to use AI tools in their daily work.The first is the Technology Acceptance Model (TAM) which explains adoption behavior in terms of perceived usefulness and perceived ease of use, which may impact administrators' hesitancy to integrate AI tools into their everyday work.The first is the Technology Acceptance Model (TAM) which helps to understand adoption behavior in terms of perceived usefulness and perceived ease of use, which can affect administrators' reluctance to use AI tools in their daily activities. Second, Diffusion of Innovations theory suggests that AI adoption is social, as it relies on a specific set of resources, culture and communication channels within the people and institutions that adopt it, which explains why there is a varied adoption of AI across schools. Third, a socio-technical systems approach to AI adoption considers AI to be a result of

the interaction between the technological component, people and organization processes rather than a simple technical phenomenon (Mishra et al, 2022). These frameworks complement each other and help inform the study's comparative, mixed-methods perspective on how and under what circumstances public and private elementary schools are using AI.

Research Gap

The research literature related to the use of AI in education is growing quickly, but the empirical studies that focus on instructional uses of AI, like adaptive learning and intelligent tutors, are much more numerous than studies that are specific to the administrative aspect of AI in education (Zawacki-Richter et al., 2019). Furthermore, few studies directly compare the adoption of AI in public and private schools, both quantitatively and qualitatively, and even fewer studies have been conducted in the context of elementary education in Pakistan. This study fills this gap by providing an empirical comparison of the adoption of AI in public and private elementary schools, perceived benefits, and challenges on a developing-country context.

Statement of the Problem

Schools struggle to deal with more demanding administrative tasks and challenges – ranging from keeping students' records to communicating with parents, teachers and students, to planning, budgeting and making decisions – while having fewer resources and limited time. Conventional administrative processes can be time-consuming, repetitive, and susceptible to human mistakes, affecting efficiency and student results. AI technologies have tremendous potential in their ability to streamline these processes, but there are still major challenges in their effective integration in elementary schools, especially public schools, such as: lack of infrastructure, lack of teachers' professional development, policy ambiguity, and concerns around data use. The main question in this study is then, how can public and private elementary schools efficiently, equitably, and sustainably use AI in their administration? If there is no systematic evidence of current adoption patterns, benefits, and barriers, it is easy to spend money on technologies that are not being used, don't match institutional needs, and actually exacerbate inequities across sectors.

Research Objectives

The overarching aim of this study is to examine the role of Artificial Intelligence in the administration of public and private elementary schools. The specific objectives are to:

The purpose of this study is to investigate the contribution of AI as a tool for governance of public and private elementary schools. The objectives are to:

- Examine how AI technologies can be used in current elementary school administration;
- Understand the perspectives and attitudes of school administrators and staff on the use of AI;
- Identify the challenges and problems in schools transitioning to AI in administration; and
- Compare the level of AI adoption in administrative activities between public and private elementary schools.

Research Questions and Hypotheses

The study was guided by the following research questions:

RQ1: How are AI technologies currently being used in school administrative tasks?

RQ2: What are the views and attitudes of school administrators and staff toward using AI in administration?

RQ3: What are the obstacles in the way schools implementing AI for administrative purposes?

RQ4: What is the difference in the way that AI is applied in administrative tasks in public versus private elementary schools?

Significance of the Study

This study contributes in a number of ways. The results provide valuable insights for school leaders and educators regarding the potential of AI to improve administrative efficiency and alleviate workload, and the anticipated challenges associated with implementing AI in schools. The results of comparative evidence of the differences between public and private can inform funding policies, investments in infrastructure, and equitable policies for digital transformation developed by public and private policy makers and educational planners. The study highlights the critical needs and constraints of school administrators, helping to inform the development of contextually relevant, user-friendly AI solutions, especially for resource-limited public schools. Lastly, the study examines the comparatively understudied administrative aspect of AI in eeducation andprovides a starting point for subsequent research into the long term and equity impacts of AI leading school.

METHODOLOGY

Research Design

The study used mixed-methods comparative description design that has been applied in the field of research. The research design used in this study is mixed methods design with comparative description approach, which is a combination of structured quantitative survey and semi-structured qualitative interview. The descriptive component provided an overview of the current status of AI use in elementary administration, and the comparative component allowed for a systematic comparison of the differences between public and private schools. The study was conducted in a pragmatic research paradigm, which enabled methodological pluralism in capturing both measurable patterns of adoption and the contextual meanings attached to the use of AI by school administrators (Creswell & Plano Clark, 2024).

Population and Sampling

The population included the administrators, head teachers, IT coordinators and senior teachers who are involved in administrative activities in public and private elementary schools of district Kasur, Pakistan. A multi-stage sampling process was used, which involved first the stratification of schools by type (public and private); then, simple random sampling of a proportional number of schools was conducted within each stratum; and finally, within each selected school, the respondents who had direct administrative responsibilities were purposively selected. A final quantitative sample consisted of 250 respondents (125 public and 125 private schools) with 10-15 administrators selected for semi-structured interviews to provide a contextual depth to the quantitative results.

Research Instruments

Two instruments used. Demographic information and six thematic sections were collected using a structured questionnaire using a 5-point Likert scale (from Strongly Disagree (1) to Strongly Agree (5): AI awareness, student data management, communication and coordination, school infrastructure and operation, teacher support, and ethical/privacy concerns). The administrators were asked about their experiences, the perceived advantages, obstacles, and expectations for the future use of AI in more depth using a semi-structured interview guide. The questionnaire was pretested in five schools and pretested by educational technology and research-methodology experts before administration.

Validity and Reliability

Content validity was obtained by the expert evaluation, and construct validity was obtained by the conceptual dimensions of the questionnaire aligned with the conceptual dimensions identified in the literature (efficiency, decision-making, communication, equity and ethics). Cronbach's alpha was used to test internal consistency, with a coefficient of .70 or more being considered acceptable. Triangulation of quantitative and qualitative results was carried out to enhance the credibility and interpretive value of the results.

Data Collection Procedure

Permission given by relevant educational authorities and school principals in a formal manner prior to data collection. Questionnaires were sent out both physically and electronically (via Google Forms) to encourage high response rates; interviews were conducted face-to-face or online with the participant (about 30-45 minutes each) based on the participant's availability. Before consenting to participate, all participants were informed of the purpose, voluntary nature and confidentiality of the study.

Data Analysis Techniques

Data was presented quantitatively and was coded and analyzed in SPSS (version 29). The study employed the mixed-method design which is comparative description design and applied in research. This study uses a method of mixed methods design in the form of a combination of structured quantitative survey and semi-structured qualitative interview research design. Descriptive statistics (means, frequencies, and percentages) were used to describe the patterns of responses and independent samples t tests compared responses to questions about level of adoption, perceived benefits, and challenges across public and private schools. Qualitative interview data were analysed thematically, adopting Braun and Clarke's six-phase approach to the analysis: familiarization, coding, theme generation, theme review, defining and naming themes, and reporting, and NVivo (version 14) was used to manage the coding process. The quantitative data and the qualitative data then were triangulated to arrive at a holistic interpretation of the role of AI in administration.

Ethical Considerations

The study conformed with standard ethical research principles such as informed consent, voluntary participation, confidentiality of responses and protection of participant and institutional data. All procedures and protocols for ethical clearance were carried out before data collection and participants could refuse to participate in the study without any consequences.

Data Analysis and Interpretation

The quantitative results of the study are summarized in this section, showing data related to the respondents' demographics, their level of AI adoption, benefits and challenges they experienced, and a comparative statistical analysis of public and private schools. The quantitative findings are supported and triangulated with qualitative interview data.

Demographic Profile of Respondents

Table 1 shows that the majority of respondents (70%) were married students. Table 1 indicates that most of the respondents (70%) were married students. The sample was skewed towards individuals with direct administrative responsibility, with 32% (n = 80) of the respondents being school administrators, 24% (n = 60) head teachers, 20% (n = 50) IT coordinators, and 24% (n = 60) senior teachers. The distribution of professional experience was even, with 125 respondents from public schools compared to 125 from private schools, and with a majority (44%) having 6 to 10 years of professional experience, followed by 28% with 1 to 5 years and 28% with 11 to 15 years experience — meaning that the respondents were generally experienced enough to have opinions on both well-established and emerging administrative practices.

Table 1 ***Distribution of Respondents by Role and Experience***

Category	**Frequency**	**Percentage (%)**
School Administrators	80	32.0
Head Teachers	60	24.0
IT Coordinators	50	20.0
Senior Teachers	60	24.0
Experience: 1–5 years	70	28.0
Experience: 6–10 years	110	44.0
Experience: 11–15 years	70	28.0

Note. N = 250 (125 public school and 125 private school respondents).

Level of AI Adoption in School Administration

The mean scores for the six administrative functions for the adoption of AI are presented in Table 2, by type of school. Adoption rates for the student data management and predictive decision support were the highest and lowest respectively (M = 4.2 and M = 3.2 respectively). Private schools consistently outperformed public schools in all evaluated functions, with the greatest difference between the two in terms of predictive decision support (public M = 2.5 vs. private M = 3.9) and communication tools (public M = 3.2 vs. private M = 4.6).

Table 2 Level of AI Adoption in School Administration by School Type

Administrative Function	Public M	Private M	Overall M	Interpretation
Student data management	3.9	4.5	4.2	High usage
Attendance and scheduling	3.6	4.4	4.0	Moderate–high
Communication (AI chatbots, apps)	3.2	4.6	3.9	Moderate–high
Performance analytics	3.0	4.2	3.6	Moderate
Financial and resource management	2.8	4.0	3.4	Moderate
Predictive decision support	2.5	3.9	3.2	Emerging adoption

Note. Ratings based on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

The findings are consistent with previous research (Bo, 2025; OECD, 2021; Demartini et al, 2020), indicating that private schools are more likely to be early adopters of AI integration and that public schools are more likely to follow and implement AI at a slower pace, due to funding and infrastructure.

Perceived Benefits of AI in School Administration

Table 3 summarizes the respondents' perception of the benefits of AI. Predictive planning for admissions and budgeting (M = 3.5) was the lowest overall-rated benefit, likely because it is a newer benefit, and real-time access to student records (M = 4.4) and enhanced administrative efficiency (M = 4.4) were the top overall-rated benefits. All benefits were rated as more favorable by the private school respondents than their public-school counterparts.

Table 3 Perceived Benefits of AI in School Administration by School Type

Perceived Benefit	Public M	Private M	Overall M	Interpretation
Improved administrative efficiency	4.1	4.7	4.4	Very high
Enhanced decision-making accuracy	3.8	4.5	4.2	High
Better communication and transparency	3.9	4.6	4.3	High
Reduction in workload	3.6	4.3	3.9	Moderate to high
Real-time access to student records	4.0	4.8	4.4	Very high
Predictive planning (admissions, budget)	2.9	4.1	3.5	Moderate

The quantitative patterns were confirmed in interviews. The time savings from the manual sorting of data were enormous, as one private school administrator explained, after using an AI dashboard to predict enrollment patterns and allocate resources more efficiently. A public-school head teacher also indicated that even some of the smaller, AI-powered attendance and grading applications had less paperwork and better accuracy but were not always properly trained.

Challenges in Implementing AI

Table 4 shows the challenges perceived in implementing AI. The most prevalent problems overall, and especially in public schools, were rated as lack of funding (M = 4.2), limited technical skills and training (M = 4.1), and infrastructure deficiency (M = 4.0). Data privacy and ethical issues, however, were rated equally in both sectors (public M = 3.8; private M = 3.9); therefore, this challenge does not appear to be sector specific.

Table 4 Challenges in Implementing AI by School Type

Challenge	Public M	Private M	Overall M	Interpretation
Lack of funding	4.6	3.8	4.2	Major challenge

Limited technical skills / training	4.5	3.7	4.1	Major challenge
Infrastructure deficiency	4.4	3.6	4.0	Major challenge
Data privacy and ethical concerns	3.8	3.9	3.9	Moderate challenge
Resistance to change	3.9	3.5	3.7	Moderate
Policy and regulatory barriers	4.2	3.6	3.9	Moderate–high

These results were confirmed with interview information. A public-school administrator noted that schools desired to implement AI tools, but that funding for the infrastructure was not "enough". However, a private school teacher commented that parents and staff were concerned that AI would be used in decision-making instead of human judgment, citing a global trend of parents and staff being worried about relying too much on AI (Schiff, 2022).

Comparative Analysis: Public versus Private Schools

Independent-samples t tests were used to see if any differences observed between public and private schools were significant. Private schools scored higher than public schools on level of AI adoption, $t(248) = 3.85$, $p = .001$ and perceived benefits, $t(248) = 3.42$, $p = .002$, as indicated in Table 5. However, when it comes to challenges faced, $t(248) = 1.24$, $p = .217$, there was no significant difference in the degree to which challenges are encountered, with both private and public schools facing similar challenges.

Table 5 Independent-Samples t-Test Comparing Public and Private Schools

Variable	**T**	**p**	**Interpretation**
Level of AI adoption	3.85	.001	Significant (private > public)
Perceived benefits	3.42	.002	Significant (private > public)
Challenges encountered	1.24	.217	Not significant

Note. df = 248 for all comparisons; $p < .05$ considered statistically significant.

Supplementary Qualitative Insights

Interviews revealed five themes that help to understand and interpret the quantitative findings: (a) AI as a driver of administrative transformation, as participants described how AI freed them to engage in strategy rather than paperwork; (b) inequality in access to technology between public and private schools; (c) a need for ongoing professional development, if schools were not to rely on AI in ways that were suboptimal; (d) concern with ethics and privacy issues related to data protection and algorithmic accountability; and (e) cautious expectations with regard to the future of the use of AI in creating more integrated, data-informed "smart schools. The above reported statistical patterns correspond closely with these themes and help to explain them.

DISCUSSION

The results of this research corroborate AI as an emerging, though not uniform, power in elementary school administration. As found in previous studies (Luckin et al., 2016; Sposato, 2025), there was a strong correlation between the use of AI and actual administrative benefits, such as efficiency, accuracy, and instant access to information. The size of the uptick in adoption and perceived benefits, however, was starkly different, with perceived benefits and rates of adoption being much greater in private schools than in public schools, consistent with the observation that those with more resources are more inclined to be leading adopters of educational technologies (Bo, 2025; OECD, 2021; Demartini et al, 2020).

Moreover, there is no significant difference on the part of the public of perceived challenges, showing that challenges to the use of AI are not unique to the public sector, but systemic (e.g., funding, training, infrastructure, and privacy concerns about data). The finding offers a nuance to the prevailing perception of the private schools' relatively easy access to technology and indicates that private schools are simply more likely to figure out a way to overcome the typical challenges inherent in implementation technology because they are relatively free of institutional constraints and have greater financial flexibility. This is consistent with the socio-technical viewpoint, which considers organizational capability to be as important as technology for AI implementation success (Mishra et al, 2022).

These themes are further explored in the qualitative themes. The sectors see a need to be structurally prepared and have ethical guidelines, and the public, overall, are positive of the use of AI in education, as well as the ethical issues of using AI in education and algorithmic bias and data privacy (Xu, 2022, Jobin et al., 2019). In general, the results indicated an increase in the use of AI in the administration of elementary schools, albeit not completely uniform, and policies need to be designed with a specific purpose to facilitate its evolution beyond the mechanism of organic diffusion.

CONCLUSION

The purpose of this study was to explore the role of Artificial Intelligence in the management of the public and private elementary schools and to see if there were any significant differences between the two. The information indicates that AI is no longer a mere pipe dream but a real-world tool impacting numerous aspects of their job, including attendance monitoring, record management, communication, and resource management. Progress is being seen in both public and private schools, but the degree of progress and the apparent value of implementing the tools is greater at the private school level, likely in part because private schools have more flexibilities in funding and administration, and in training, as public schools still face funding, infrastructure, and training challenges. Notably, the challenges are common to both sectors, suggesting that obstacles to the use of AI are not sector specific. The findings suggest that AI holds great promise for boosting the effectiveness of administrative decision-making and enhancing teaching and

learning in elementary schools, but this advancement should be done equitably and requires strategic investments in infrastructure, training, and ethical oversight across public and private education systems.

Implications

Implications for Policy

Policymakers should develop strategies for integrating AI that make clear the disparity in the capabilities of public versus private schools, with a particular focus on providing funding to update public schools' infrastructure, cloud-based data systems, and other areas that need it. To ensure AI use in education does not outpace governance, robust data-protection regulations and national guidelines on ethical AI use in education are required.

Implications for Practice

School leaders should promote AI literacy for administrators, but not as a replacement for human decision-making, and encourage hybrid use of AI with human input. To prevent the over-dependency on automated processes and maintain the relational and context-dependent aspects of school leadership, ongoing monitoring of AI-driven decisions is necessary.

Implications for Research

Future research should build on this area of inquiry by examining how the adoption of AI affects teaching and learning outcomes over time in longitudinal studies, by comparing the reported effects across regions or countries to determine if there are significant differences in generalizability, and by examining the indirect effects of administrative AI use on the teaching and learning aspects. Further studies are necessary in relation to ethical frameworks that can be developed to regulate AI usage in low-resource educational environments.

Limitations and Directions for Future Research

The current study has some limitations and should be interpreted with caution. First, the results might not be generalizable to other areas or countries since data collection was geographically limited to District Kasur. Second, there is a risk of social-desirability or response bias, due to the use of data from the survey and the interviews, but this concern was reduced somewhat by triangulation with qualitative data. Third, depending on the speed of change, some conclusions about specific tools or adoption rates could become outmoded fairly rapidly. Future studies should therefore include multi-regional or cross-national designs and use longitudinal data to examine changes in adoption patterns and include a study of the long-term impact of administrative AI use on student learning outcomes, teacher workload, and school-level equity, respectively.

REFERENCES

Aggarwal, D., Sharma, D., & Saxena, A. B. (2023). Adoption of artificial intelligence (AI) for development of smart education as the future of a sustainable education system. *Journal of Artificial Intelligence, Machine Learning and Neural Network*, *3*(6), 23-28.

Ahmad, S. F., Alam, M. M., Rahmat, M. K., Mubarik, M. S., & Hyder, S. I. (2022). Academic and administrative role of artificial intelligence in education. *Sustainability*, *14*(3), 1101.

Alhajri, R., Al-Hunaiyyan, A., Alghannam, B., & Alshaher, A. (2021). Gender differences in the perception of a student information system. *International Journal of Advanced Computer Science and Applications*, *12*(2).

Baker, R. S., & Inventado, P. S. (2016). Educational data mining and learning analytics: Potentials and possibilities for online education. *Emergence and innovation in digital learning: Foundations and applications*, 83-98.

Bano, S., Zowghi, D., & Richardson, I. (2022). Digital transformation in education: A systematic literature review. *Computers & Education: Artificial Intelligence*, *3*, 100063.

Bo, N. S. W. (2025). OECD digital education outlook 2023: Towards an effective education ecosystem. *Hungarian Educational Research Journal*, *15*(2), 284-289.

Cope, B., Kalantzis, M., Searsmith, D., & Abdul-Mageed, M. (2021). Artificial intelligence for education: Knowledge and its assessment in AI-enhanced learning environments. Educational Philosophy and Theory, 53(12), 1229–1245. https://doi.org/10.1080/00131857.2020.1792362

Creswell, J. W., & Plano Clark, V. L. (2024). Designing and conducting mixed methods research (4th ed.). SAGE Publications.

Dede, C., & Lidwell, W. (2023). Developing a next-generation model for massive digital learning. *Education Sciences*, *13*(8), 845.

Demartini, C. G., Benussi, L., Gatteschi, V., & Renga, F. (2020). Education and digital transformation: The "riconnessioni" project. *IEEE Access*, *8*, 186233-186256.

Holmes, W., Sutherland, E., & Joseph, S. (2022). Artificial intelligence and the future of teaching and learning. *British Journal of Educational Technology*, *53*, 778-796.

Jarke, J., & Breiter, A. (2019). The datafication of education. *Learning, Media and Technology*, *44*(1), 1-6.

Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. *Nature machine intelligence*, *1*(9), 389-399. https://doi.org/10.1038/s42256-019-0088-2

Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: systematic literature review. *International journal of Educational Technology in Higher education*, *20*(1), 56.

Lamb, A. J., & Weiner, J. M. (2021). Technology as infrastructure for change: district leader understandings of 1: 1 educational technology initiatives and educational change. *Journal of Educational Administration*, *59*(3), 335-351. https://doi.org/10.1108/JEA-10-2020-0220

Luckin, R., & Holmes, W. (2016). Intelligence unleashed: An argument for AI in education.

Mishra, M., Gorakhnath, I., Lata, P., Rani, R., & Chopra, P. (2022). Integration of technological pedagogical content knowledge (TPACK) in classrooms through a teacher's lens. *International journal of health sciences*, *6*(S3), 12505-12512.

OECD. (2021). Digital education outlook 2021: Pushing the frontiers with AI, blockchain, and robots. OECD Publishing. https://doi.org/10.1787/589b283f-en

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development.

Perrotta, C., & Selwyn, N. (2020). Deep learning goes to school: Toward a relational understanding of AI in education. *Learning, media and technology*, *45*(3), 251-269. https://doi.org/10.1080/17439884.2020.1686017

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International journal of artificial intelligence in education*, *26*(2), 582-599. https://doi.org/10.1007/s40593-016-0110-3

Roshan, S., Iqbal, S. Z., & Qing, Z. (2024). Teacher training and professional development for implementing AI-based educational tools. *Journal of Asian Development Studies*, *13*(2), 1972-1987.

Russell, S., & Norvig, P. (2020). Artificial intelligence: a modern approach, 4/E.

Schiff, D. S. (2022). *Setting the agenda for AI: actors, issues, and influence in United States artificial intelligence policy* (Doctoral dissertation, Georgia Institute of Technology).

Selwyn, N. (2019). *Should robots replace teachers: AI and the future of education*. John Wiley & Sons.

Sposato, M. (2025). Artificial intelligence in educational leadership: a comprehensive taxonomy and future directions. *International Journal of Educational Technology in Higher Education*, *22*(1), 20.

Williamson, B. (2021). Automated knowledge discovery: tracing the Frontiers, infrastructures, and practices of education and data science. In *Digital Disruption in Teaching and Testing* (pp. 45-59). Routledge.

Winkler, R., & Söllner, M. (2018). *Unleashing the potential of chatbots in education: A state-of-the-art analysis. Academy of Management Proceedings, 2018 (1), 15903*.

Woodruff, K., Hutson, J., & Arnone, K. (2023). Perceptions and barriers to adopting artificial intelligence in K-12 education: A survey of educators in fifty states.

Xu, J. (2022). A person-centered approach to teacher motivation towards information technology: integrating achievement goal and expectancy-value perspectives. *Educational technology research and development*, *70*(2), 397-417.

Yu, S., & Lu, Y. (2021). *An introduction to artificial intelligence in education*. Singapore: Springer.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators? *International journal of educational technology in higher education*, *16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0

Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and education: Artificial intelligence*, *2*, 100025. https://doi.org/10.1016/j.caeai.2021.100025