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Research Article

The Impact of Big Data and AI on Teacher Performance Reviews: A Study of Private Higher Vocational Colleges

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ABSTRACT

In the quick-changing world of education, the integration of big data analytics and artificial intelligence (AI) has become a revolutionary force. However, it is still completely unknown how these technologies affect teacher performance, particularly in the setting of China's educational system. The purpose of this study was to thoroughly evaluate the effects of using big data analytics and implementing AI on teacher effectiveness in China. In order to provide a complete picture of the intricate dynamics at play, the study set out to clarify both direct effects and the potential interaction of mediating and moderating factors. To collect data, 750 teachers from various Chinese private higher vocational colleges were questioned using a cross-sectional methodology. Participants were chosen using convenience sampling, and data was collected using a standardized survey. To analyze the data, statistical tools were utilized along with descriptive statistics, multiple regression analysis, and moderation analysis. The findings demonstrated that big data analytics and AI adoption had a direct positive impact on teacher performance across multiple aspects of instructional effectiveness, student engagement, and professional development. Additionally, it was shown that data accuracy was a key mediator, suggesting that accurate data-driven insights can magnify the effects of technology on teacher performance. Furthermore, technical literacy appeared as an important moderator, impacting the amount to which technology integration translates to improved educator performance. This study contributes to academic discourse by resolving a research gap and highlighting the relationship between technology and teacher performance. For educators, administrators, and policymakers, the findings have real-world applications that may be used to inform integration plans for technology in the classroom. The study's limitations include potential sample bias due to restricted participant recruitment, reliance on self-reported data susceptible to social desirability bias, and the cross-sectional design, which hinders establishing causal relationships between variables. The study underscores the need for teacher training in technology and data literacy for optimal use of big data analytics and AI in education. Institutions must also prioritize accurate data infrastructure and equitable access to enhance teaching practices and student outcomes. The study shows how accurate data and technological literacy mediate and moderate technology's impact on teaching, providing new theoretical insights. It encourages research into the relationship between data correctness, technological skill, and effective teaching to better comprehend these dynamics.

Keywords: Big Data Analytics, Artificial Intelligence, Teacher Performance, Data Accuracy, Technological Literacy.

INTRODUCTION

In recent years, the educational environment has seen a significant transformation, spurred by the unrelenting march of technological developments, notably in the realms of big data analytics and artificial intelligence (AI). Big data in particular is being gathered in enormous quantities, which increases complexity (Alleema et al., 2022). These innovations have already shown themselves to be powerful forces with the ability to transform a number of aspects of education, including student participation, curriculum design, and administrative procedures (Liang & Law, 2023). In the midst of this rapid digital revolution, educators find themselves on the verge of transformative change, armed with fresh tools that have the potential to improve their instructional practices and, as a result, influence larger educational results.

China is a model of ambition and dynamism within the intricate tapestry of educational development. The Chinese education system, known for its historical significance as well as its current rapid modernization, embodies a synthesis of tradition and innovation (Zhou, Jiang, & Zhang, 2022). China is well-positioned to profit significantly from the integration of big data analytics and AI into its educational system due to its large population, diverse socioeconomic backdrop, and continuous dedication to educational improvement (Ubina et al., 2023). Teachers are the foundation of the Chinese education system, acting as conduits for knowledge transmission, skill development, and character development. A question of great importance is whether using big data analytics and AI will affect how well they perform in their professional roles (Reidenberg & Schaub, 2018). As technology becomes more prevalent in classrooms and virtual learning settings, educators must contend with opportunities to use data-driven insights for individualized instruction, adapt teaching tactics to individual learning needs, and streamline administrative operations (Edwards, Gibson, Harmon, & Schurer, 2022). Additionally, as AI-driven solutions allow for the automation of some duties, teachers now have more time for one-on-one interactions with students and pedagogical innovation (Kasneci et al., 2023).

The incorporation of big data analytics and artificial intelligence (AI) into the field of education has piqued the interest of both researchers and practitioners (Sood, Rawat, & Kumar, 2022). Vekariya et al. (2022) stated that the data for processing is transmitted over the network based on the query from the different datasets. There is a growing body of research that examines the potential effects of these technologies on various educational aspects, according to a thorough analysis of the literature that has already been published. Previous research has concentrated mostly on student learning outcomes, tailored learning experiences, and administrative processes (LaForett & De Marco, 2020). However, there is a noteworthy gap in the investigation of how these technological developments intersect with teacher effectiveness while taking into account the mediating role of data accuracy and the moderating role of technology literacy.

Several studies have investigated the impact of big data analytics and artificial intelligence on student learning. These studies show how data-driven insights can be used to inform individualized instruction, identify kids at risk of academic underachievement, and tailor curricular materials to individual learning paces (Al Ghatrifi, Al Amairi, & Thottoli, 2023). A big amount of the collected data is private such as medical records, financial credentials, Web usage, emails, photos, videos, etc (El Ouazzani & El Bakkali, 2020). Additionally, AI-driven tutoring systems have demonstrated potential in terms of giving pupils personalized feedback and support. While these studies give useful information about the learner-centered features of technology integration, they frequently neglect the potential effects on teacher performance (Fan & Zhong, 2022).

Teaching effectiveness, student engagement, classroom management, and professional development are all aspects of the multidimensional idea of teacher performance. Despite the widely acknowledged importance of teachers in affecting educational results, the literature on how big data analytics and AI influence these many characteristics remains rather thin (Ahaidous, Tabaa, & Hachimi, 2023). This lack of research ignores how technology may empower educators, enable better-informed decision-making, and improve their overall professional capacities. Furthermore, the mediating effect of data accuracy and the moderating role of technological literacy in the context of technology-enabled instructional practices are mainly unexplored. The effectiveness of big data analytics and artificial intelligence depends on the precision and quality of the data they process (Ashaari, Singh, Abbasi, Amran, & Liebana-Cabanillas, 2021). An unexplored study avenue is determining the extent to which data accuracy mediates the association between technology use and teacher performance (Wei, Karuppiah, & Prathik, 2022). Additionally, there is a need for investigation into how technological literacy, or the capacity to use these tools successfully, modifies the effect on teacher performance.

This research aims to investigate the deep consequences of integrating big data analytics and artificial intelligence (AI) on teacher performance in China's educational system. The main objective is to demonstrate how these technological developments have a direct impact on many aspects of teacher performance while also examining the potential mediating function of data accuracy and the moderating impact of technology literacy. The study aims to achieve the following important objectives in pursuit of these objectives: First, the study seeks to shed light on the direct effects of using big data analytics and AI tools on teacher performance. Second, the research aims to comprehend the intricate mediation mechanisms at work. Finally, the study explores the moderating effect of technological literacy.

The importance of this study stems from its potential to catalyze transformative advances in education by shining light on the complicated interplay between big data analytics, artificial intelligence (AI), and teacher performance. Understanding the different aspects of technology's effects on educators is crucial as it permeates educational environments all over the world. The study advances knowledge on a theoretical level by focusing on a significant gap in the literature: the impact of technology on teacher performance in the setting of China. By examining this aspect, the research adds to the conversation already being had about technology-enhanced learning and provides a more complete picture of how educators' responsibilities and efficacy are changing in a time of fast technological development. In practice, the findings of this study have far-reaching ramifications. The multiple ramifications of incorporating big data analytics and AI into teaching techniques can be better understood by educators, administrators, and policymakers. These insights can help lead the development of specialized professional development programs that provide teachers with the skills they need to properly harness the power of technology. In addition, administrators can modify curricula and institutional strategies to maximize the benefits of these transformative tools, thereby improving the quality of education provided to students.

LITERATURE REVIEW

Usage of Big Data Analytics and Teacher Performance

Big data analytics have attracted increasing attention in the education sector in recent years as a way to enhance numerous facets of teaching and learning. The incorporation of data-driven initiatives has the potential to increase teacher effectiveness by offering insights into instructional strategies, personalized learning possibilities, and professional development opportunities (Simanca Herrera et al., 2020). Educators now accumulate and analyze massive amounts of data on their students' behaviour, engagement, and learning patterns thanks to big data analytics. These results can be used to assist teachers in modifying their teaching strategies to meet the needs of certain pupils, which will increase the effectiveness of classroom instruction (Cui et al., 2021). Teachers can discover areas in which their pupils are having difficulty and modify their pedagogical approaches using data-driven insights.

Big data analytics are used to help students have more individualized learning experiences. Teachers can design specialized learning routes that complement each student's strengths and shortcomings by analyzing individual learning preferences and progress (Reidenberg & Schaub, 2018). By accommodating different learning styles, this personalization improves student engagement and outcomes. The professional development of teachers may be dramatically impacted by big data analytics (Taherkhani, Aliasin, Khosravi, & Izadpanah, 2022). Educational institutions can discover areas for development and provide focused training programs by analyzing data on teacher performance. This strategy guarantees that professional development initiatives are matched to the needs of specific teachers, resulting in ongoing improvement and better classroom procedures.

H1: The usage of big data analytics has a significant and positive impact on teacher performance.

Adoption of Artificial Intelligence and Teacher Performance

Artificial intelligence (AI) integration in education has emerged as a dynamic force, changing teacher performance and educational methods. This survey of the literature dives into the scholarly debate about the influence of AI adoption on teacher effectiveness, instructional methodologies, individualized learning, and professional development (Somasundaram, Junaid, & Mangadu, 2020). AI's ability to process massive volumes of data and deliver insights has been demonstrated to improve teaching tactics. AI-driven analytics, according to (Hao et al., 2022), can uncover patterns in student learning practices, allowing teachers to alter their techniques for higher engagement. AI-powered solutions provide real-time feedback, allowing instructors to tailor their instruction to the needs of individual students.

AI adoption makes it possible to customize learning experiences and meet the varied needs of pupils. Su, Zhong, and Ng (2022) draw attention to the fact that platforms powered by AI can examine students' learning habits and suggest relevant materials and exercises. According to Fan and Zhong (2022), this personalization improves students' comprehension and engagement. AI tools are becoming increasingly important in assessment methods. Accurate analysis of student data assists instructors in identifying learning gaps and areas in which intervention is required (Cheng, Zhang, Yang, & Fu, 2022). AI-powered assessment tools provide teachers with timely information regarding student development, allowing them to tailor interventions and assistance. As a result, student outcomes improve and the probability of academic difficulties decreases. AI adoption provides transformative prospects for instructors to improve their performance and significantly impact student learning experiences (Alemanno, Camanzi, Manzan, & Tantari, 2023). AI technologies contribute to the general growth of educational systems by improving teaching tactics, supporting personalized learning, facilitating professional development, and improving evaluation practices.

H2: Adoption of artificial intelligence has a significant and positive impact on teacher performance.

Usage of Big Data Analytics and Data Accuracy

Integration of big data analytics into numerous sectors has become a critical driving factor in the age of information abundance. The impact of big data analytics on data accuracy has received a lot of attention in this context. This review dives into scholarly discussions on how the use of big data analytics affects the accuracy of data in various disciplines (Rosendo, Costan, Valduriez, & Antoniu, 2022). Through extensive processing and cleaning operations, big data analytics tools such as data mining and machine learning can dramatically improve data accuracy. According to Ashaari et al. (2021), these strategies detect and correct abnormalities, mistakes, and inconsistencies in huge datasets, resulting in better data accuracy. The automated nature of these operations reduces the possibility of human errors, improving overall data quality. The use of big data analytics makes it easier to monitor and validate data streams in real time. Niu, Ying, Yang, Bao, and Sivaparthipan (2021) claim that these analytics-driven solutions may quickly repair errors by identifying disparities and mistakes in data streams as they happen. Particularly in dynamic contexts where data changes often, automated validation techniques ensure that data is accurate and current. By spotting potential problems before they happen, predictive analytics, a subset of big data analytics, helps to ensure the accuracy of the data. Predictive models, as stated by Mostafa, Ramadan, and Elfarouk (2022), can anticipate problems with data quality, allowing proactive efforts to keep accuracy. By taking an anticipatory strategy, data inaccuracies are less likely to affect subsequent analyses and decisions. Big data analytics integration has been shown to have a significant positive impact on data accuracy. Big data technologies improve data quality by utilizing advanced processing, real-time monitoring, validation, and predictive analytics.

H3: The usage of big data analytics has a significant and positive impact on data accuracy.

Adoption of Artificial Intelligence and Data Accuracy

With the help of automated processing and cleaning processes, AI-driven solutions have shown significant potential in increasing data accuracy. Machine learning algorithms, as described by Ardagna, Bellandi, Damiani, Bezzi, and Hebert (2021), can find patterns and anomalies in huge datasets, assisting in the detection and correction of errors. Because AI procedures are iterative, they continuously improve data quality by learning from prior mistakes. AI's real-time capabilities enable immediate monitoring and correction, which helps to preserve data accuracy. (Nguyen et al., 2022) claim that AI-powered systems continuously examine incoming data streams and quickly spot discrepancies and inaccuracies. This real-time feedback loop enables prompt corrective steps, halting the spread of errors. Through its ability to detect anomalies, AI is a key component of quality assurance. Mahler, Shalom, Elovici, and Shahar (2022) discussed how AI systems can learn the typical behaviour of data and immediately notify stakeholders when deviations take place. By identifying potential problems in advance of having an impact on decision-making processes, this proactive method improves data accuracy. The adoption of AI technologies has a great deal of potential to improve data accuracy across a variety of domains (Kieslich, Keller, & Starke, 2022). AI contributes to better data quality through automated processing, real-time monitoring, and quality assurance procedures.

H4: Adoption of artificial intelligence has a significant and positive impact on data accuracy.

Data Accuracy and Teacher Performance

Informed instructional practices are built on accurate data. According to Cameron, Carroll, and Schaughency (2022), teachers must use precise student performance data to adapt their classes to the needs of each student. Accurate data empowers teachers to pinpoint interventions, detect learning gaps, and change their approach to the classroom, ultimately improving engagement and results. For trustworthy assessment procedures, data accuracy is crucial. According to Kang and Lee (2020), reliable assessment information guarantees a fair and consistent assessment of student development. Teachers can make more informed judgments about changing their teaching methods and giving the right support when they can trust the veracity of evaluation data. Data accuracy is essential for data-driven decision-making. Accurate statistics promote evidence-based actions and policies, say (Köktürk-Güzel, Büyük, Bozkurt, & Baysal, 2023). Teachers are more likely to utilize data to guide their decisions when they have faith in the accuracy of the information, which improves student outcomes. Accurate information is also essential for efficient professional development. Ma, Jiang, Guan, and Yi (2023) contend that precise data on teacher performance can point out areas for development and direct specialized training programs. Teachers can concentrate on particular growth areas, resulting in ongoing professional development and improved teaching techniques. Teacher effectiveness and student results are substantially impacted by the accuracy of educational data. Accurate data supports programs for professional growth, decision-making, and assessment strategies.

H5: Data accuracy has a significant and positive impact on teacher performance.

Data Accuracy as a Mediator

For big data analytics to produce trustworthy, usable insights, data accuracy is essential. As highlighted by (Banke-Thomas, Abejirinde, Ogunyemi, & Gwacham-Anisiobi, 2023), reliable data is the cornerstone of well-informed judgment. The success of the plans and interventions that educators develop based on the findings from big data analytics is influenced by data accuracy in the context of education. An idea that is gaining acceptance is the mediating function of data accuracy in the relationship between the use of big data analytics and teacher performance. According to Ardagna et al. (2021), reliable data serves as a bridge, enabling big data analytics to directly influence teaching techniques. When teachers are confident in the veracity of the data they are receiving, they are more likely to adopt data-driven solutions, which increase student achievement.

The crucial mediator of data accuracy improves the relationship between the deployment of AI and teacher effectiveness. According to Hunte, McCormick, Shah, Lau, and Jang (2021), AI-driven insights work best when they are founded on reliable data. The AI algorithms produce solid recommendations when given accurate data, which increases teachers' confidence in their choices and has an impact on classroom practices. Data correctness serves a mediating function to assure the dependability of these insights, which are offered by data-driven insights provided by AI technology. According to Lamb, Neumann, and Linder (2022), correct data improves teachers' capacity to recognize students' learning requirements and adapt their teaching strategies. Accurate AI-generated insights increase teachers' confidence in AI recommendations, resulting in the adoption of efficient teaching methods. Data accuracy enhances the individualized learning opportunities made possible by AI. According to Martin et al. (2022), exact learning pathways that are catered to specific pupils are created on the basis of correct data. Accurate data makes sure that AI-driven personalization is in line with student needs, which leads to more effective learning occasions.

H6: Data accuracy mediates the relationship between usage of big data analytics and teacher performance.

H7: Data accuracy mediates the relationship between the adoption of artificial intelligence and teacher performance.

Technological Literacy as a Moderator

Technology literacy is a key mediator that affects how teachers interact with big data analytics and utilize its advantages. Teachers with higher degrees of technology literacy may be better able to understand and use the insights gained through big data analytics, as stressed by Andersson and Register (2023). This emphasizes how crucial it is to comprehend how using data-driven approaches interacts with technology literacy. Teachers who are technologically educated will be better able to understand and use the insights from big data analytics. According to

Cao and AlKubaisy (2022), instructors who are more technologically literate are better able to use dashboards and data visualizations to make more data-driven decisions. This moderation effect makes sure that educators can fully make use of big data analytics' potential for improved teaching methods. The effective execution of recommendations resulting from big data analytics is influenced by technological literacy. According to Yeldham and Gao (2021), instructors who are more technologically literate may be better able to integrate data-driven insights into their lesson plans. This moderating effect makes sure that teachers are able to efficiently convert data insights into workable methods that enhance teaching effectiveness. On the other hand, teachers who are less technologically literate could find it difficult to use big data analytics efficiently. Sabiri (2020) contend that less technologically savvy teachers would have trouble deciphering intricate data patterns and putting their learning into reality. To ensure that all teachers, regardless of their level of technological skill, can benefit from data-driven initiatives, it is imperative to address this difficulty.

H8: Technological literacy moderates the relationship between the usage of big data analytics and teacher performance.

H9: Technological literacy moderates the relationship between the adoption of artificial intelligence and teacher performance.

Based on literature discussion and hypotheses development following framework has been developed as shown in **Figure 1**.

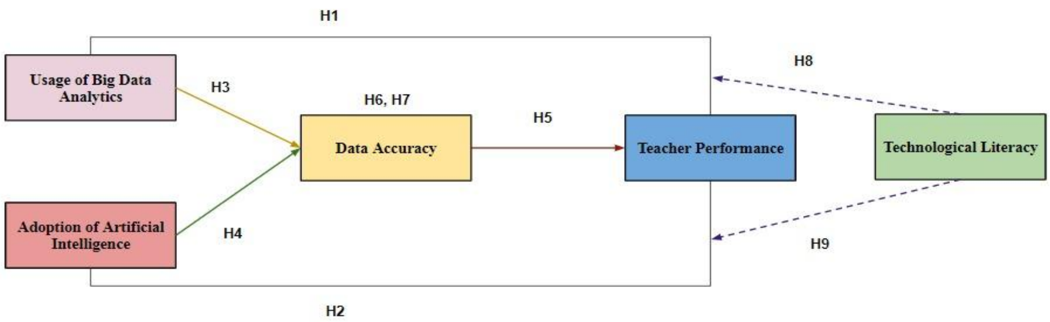

Figure 1. Conceptual Framework

RESEARCH METHODOLOGY

In order to evaluate the impact of using big data analytics and implementing artificial intelligence (AI) on teacher performance, a quantitative research approach was used in this study. The moderating function of technology literacy and the mediation effect of data accuracy were both highlighted. Utilizing a cross-sectional survey as the research design allowed for a comprehensive examination of these interactions in the context of Chinese instructors. The study's target audience was elementary and secondary school teachers from various educational institutions in China. Utilizing the Morgan and Krejcie formula, a sample size of 900 individuals was determined. In the end, 750 actual and fully completed surveys were collected, producing an overall response rate of roughly 83.3%. Convenience sampling was determined to be the most practical method for participant selection because it assured a large pool of willing and available participants. This method allowed a diverse sample to contribute fresh insights to the inquiry. The technique of collecting data was self-administered questionnaires. To ensure the convenience of participation, the questionnaire was given electronically via email and online survey platforms. Descriptive statistics including frequencies, percentages, means, and standard deviations were first generated to synthesize participant demographics as well as responses to survey items. Following that, the research hypotheses were tested utilizing inferential statistical techniques such as multiple regression analysis. These analyses were carried out using the Statistical Tools employed to boost the precision and complexity of the analysis.

RESULTS

Demographic Profile

Table 1 provides a detailed breakdown of the 750 respondents who took part in the study. The distribution of respondents across several demographic categories reveals information about the sample's composition. In terms of age, the plurality of respondents is between the ages of 26 and 35, constituting 26.67% of the total sample. Twenty per cent of respondents fall into the 18 to 25-year-old age group. The proportion of individuals aged 56 and older is the smallest of all age groups, at 13.33%. In terms of gender distribution, female respondents account for 53.33% of the sample, while males account for 46.67%. According to the distribution of respondents' years of teaching experience, 29.33% of respondents have 6–10 years of experience. Those with 1-5 years of experience account for 24.00%, while those with 11-15 years account for 20.00%. The sample consists of 6,67% of respondents with less than one year of experience and 20% of respondents with 16+ years of experience. The most prevalent degrees held by respondents were Bachelor's and Master's degrees, while there were a variety of other degrees as well. Bachelor's degree holders account for 37.33%, while Master's degree holders account for 36.00%. The remaining percentages are 13.33% who have an associate's degree, 8.00% who have a doctoral degree, and 5.33% who only have a high school diploma. In terms of teaching level, respondents linked with college/university teaching have the highest representation, accounting for 32.00% of the sample. High school and elementary school teachers make up 21.33% and 22.67%, respectively, while middle school teaching comes in second at 24.00%. The subject area distribution demonstrates a wide range of representation, with science accounting for 22.67 per cent of respondents, followed by Mathematics at 18.67 per cent and Social Sciences at 17.3 per cent. Humanities and Arts account for 16.00% and 14.67% of the sample, respectively, while other topics account for 10.67%. The majority (34.67%) of respondents report feeling at least somewhat comfortable using technology, while 32.00% report feeling extremely at ease. A significant proportion (16.00%) remains neutral, while 13.33% are uneasy and 4.00% are extremely uneasy with technology.

Table 1. Demographic Profile of Respondents

Demographic Variable		Frequency	Percentage
Age	18-25 years	150	20.00%
	26-35 years	200	26.67%
	36-45 years	180	24.00%
	46-55 years	120	16.00%
	56+ years	100	13.33%
Gender	Male	350	46.67%
	Female	400	53.33%
Years of Teaching Experience	Less than 1 year	50	6.67%
	1-5 years	180	24.00%
	6-10 years	220	29.33%
	11-15 years	150	20.00%
	16+ years	150	20.00%
Educational Level	High School Diploma	40	5.33%
	Associate's Degree	100	13.33%
	Bachelor's Degree	280	37.33%
	Master's Degree	270	36.00%
	Doctoral Degree	60	8.00%
Teaching Level	Elementary School	170	22.67%
	Middle School	180	24.00%
	High School	160	21.33%
	College/University	240	32.00%
Subject Area	Mathematics	140	18.67%
	Science	170	22.67%
	Humanities	120	16.00%
	Arts	110	14.67%
	Social Sciences	130	17.33%
	Other	80	10.67%
Comfort Level with Technology	Very Comfortable	240	32.00%
	Comfortable	260	34.67%
	Neutral	120	16.00%
	Uncomfortable	100	13.33%
	Very Uncomfortable	30	4.00%

Descriptive Statistics

AAI, UBDA, TP, DA and TL are the five essential variables presented in **Table 2** and **Figure 2**. 750 observations constitute a representative sample size. The average AAI score is around 4.170, reflecting a positive overall opinion of the AAI construct. With a mean of 4.130, UBDA comes in second place, indicating that it is strongly present. The mean for TP is 3.880, indicating moderate instructor performance. The average score for DA is 4.090, suggesting great data accuracy. TL has a mean of 4.150, indicating that respondents have a high level of technological literacy. The standard deviation measures the variability or dispersion of responses around the mean. The standard deviations of AAI and DA are larger, while those of UBDA and TL are smaller. TP has a standard deviation of 0.767, indicating moderate heterogeneity in teacher performance perceptions.

Table 2. Descriptive Statistics

	N	Mini	Maxi	Mean	Std
AAI	750	1	5	4.170	0.864
UBDA	750	1	5	4.130	0.627
TP	750	1	5	3.880	0.767

DA	750	1	5	4.090	0.700
TL	750	1	5	4.150	0.698

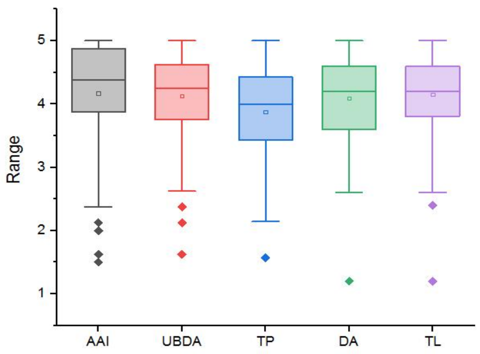

Figure 2. Descriptive Statistics

Normality Assessment

Table 3 and **Figure 3** show the normality assessment findings for the five variables under consideration. The skewness numbers in this table shed light on the asymmetries in each variable's distribution. Positive skewness means that the distribution is skewed to the right, with a tail extending upward. Looking at the skewness data, AAI has a skewness of 1.439, indicating a moderate positive skewness, while UBDA has a somewhat lower positive skewness of 1.108. The skewness rating of 0.757 for TP indicates a relatively symmetrical distribution with a minor bias to the right. Both DA and TL have skewness values of 0.957, which likewise indicates a moderate positive skewness, and 1.274, which indicates a substantially larger positive skewness. The kurtosis numbers in the table indicate how peaked or flat the distribution is in comparison to a normal distribution. A normal distribution's kurtosis is represented by a value of 3. If the kurtosis is more than 3, the distribution is more peaked (leptokurtic), while it is less peaked (platykurtic). Upon examination of the kurtosis values, all variables exhibit a kurtosis less than 3. The kurtosis of AAI is 1.925, the kurtosis of UBDA is 1.726, the kurtosis of TP is 0.572, the kurtosis of DA is 2.010, and the kurtosis of TL is 2.691.

Table 3. Normality Assessment

	Skewness	Kurtosis
AAI	1.439	1.925
UBDA	1.108	1.726
TP	0.757	0.572
DA	0.957	2.010
TL	1.274	2.691

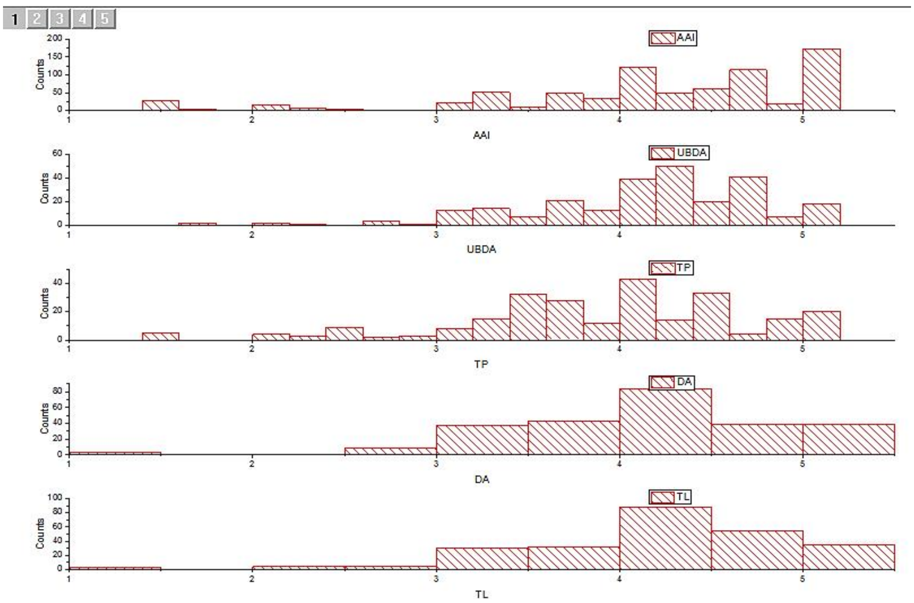

Figure 3. Normality Assessment

Reliability Analysis

Table 4 shows the results of a comprehensive reliability analysis of the variables crucial to this investigation. The table carefully outlines important characteristics of each variable, such as the number of constituent items, the specific items themselves, the outer loading values that correspond to each item, and the crucial Cronbach's alpha coefficient, which is a crucial indicator of the internal consistency and reliability of the items within each variable. When it comes to the first variable, "Adoption of AI," there are 8 items. The estimated outer loading values, which show the degree of correlation between each item and the underlying latent variable, range from 0.678 to 0.904. Notably, the computed Cronbach's alpha coefficient for this variable is a whopping 0.934. This high alpha coefficient points to the items' remarkable level of internal consistency, which gives significant support to their capacity to collectively accurately measure the notion of "Adoption of AI." Moving on, the "Usage of Big Data Adoption" variable has 8 items as well. The range of these items' outer loading values is 0.572 to 0.770. Meanwhile, the calculated Cronbach's alpha coefficient is 0.850, confirming the items' internal consistency. The third factor being examined, "Teacher Performance," consists of seven elements. The outer loading values range from 0.691 to 0.819, highlighting the intensity of their relationship to the latent variable. The estimated Cronbach's alpha coefficient for this variable is astonish-ingly 0.918, indicating a high level of internal consistency among the items. Focusing on the "Data Accuracy" variable, it includes 5 things. These items' outer loading values, which represent their individual strengths in relation to the latent variable, range from 0.551 to 0.949. The computed Cronbach's alpha coefficient of 0.821 emphasizes these items' internal consistency. The "Technological Literacy" variable, has 5 items with outer loading values ranging from 0.832 to 0.949. The calculated Cronbach's alpha coefficient is 0.749, indicating that the items have a moderate level of internal consistency.

Table 4. Reliability Analysis

Variable	No. of Items	Items	Outer Loading	Cronbach's Alpha
Adoption of AI	8	AAI1	0.749	0.934
		AAI2	0.684	
		AAI 3	0.723	
		AAI 4	0.904	
		AAI 5	0.867	
		AAI 6	0.711	
		AAI 7	0.678	
		AAI 8	0.696	
Usage of Big Data Adoption	8	UBDA1	0.572	0.850
		UBDA2	0.743	
		UBDA3	0.725	
		UBDA4	0.770	
		UBDA5	0.637	
		UBDA6	0.656	
		UBDA7	0.709	
		UBDA8	0.760	
Teacher Performance	7	TP1	0.706	0.918
		TP2	0.783	
		TP3	0.819	
		TP4	0.771	
		TP5	0.705	
		TP6	0.731	
		TP7	0.691	
Data Accuracy	5	DA1	0.551	0.821
		DA2	0.709	
		DA3	0.923	
		DA4	0.832	
		DA5	0.949	
Technological Literacy	5	TL1	0.923	0.749
		TL2	0.832	
		TL3	0.949	
		TL4	0.904	
		TL5	0.867	

Correlation Analysis

The correlation matrix in **Table 5** and **Figure 4** highlights the interrelationships between the variables explored in the study. Insights regarding the potency and importance of these links can be gained from looking at the Pearson correlation coefficients. AI adoption (AAI) has positive and significant connections with all factors, particularly Technological Literacy (TL), Big Data Adoption (UBDA), and

Teacher Performance (TP). Usage of Big Data Adoption (UBDA) exhibits notable positive connections with all other variables, especially AAI and TP. Teacher Performance (TP) has positive and substantial relationships with all variables, with UBDA and AAI showing especially strong links. All factors and Data Accuracy (DA) are significantly and positively associated, with the relationship between TL and AAI being particularly strong. Technological Literacy (TL) exhibits strong and significant relationships with all variables, with a focus on its link with DA and AAI.

Table 5. Correlation Matrix

		AAI	UBDA	TP	DA	TL
AAI	Pearson Correlation	1	.636**	.498**	.435**	.764**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	750	750	750	750	750
UBDA	Pearson Correlation	.636**	1	.721**	.555**	.649**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	750	750	750	750	750
TP	Pearson Correlation	.498**	.721**	1	.517**	.542**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	750	750	750	750	750
DA	Pearson Correlation	.435**	.555**	.517**	1	.851**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	750	750	750	750	750
TL	Pearson Correlation	.764**	.649**	.542**	.851**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	750	750	750	750	750

**. Correlation is significant at the 0.01 level (2-tailed).

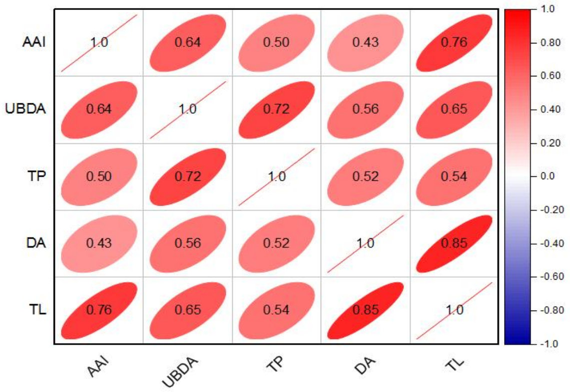

Figure 4. Correlation Matrix

Regression Analysis

Table 6 and **Figure 5** display the findings of a full regression analysis, revealing the correlations investigated by the hypotheses. In-depth explanations of the Beta coefficients, T values, P values, and corresponding conclusions are provided for each hypothesis along with its particular relation. The first hypothesis (H1) investigates the effect of "Usage of Big Data Adoption" (UBDA) on "Teacher Performance" (TP). The estimated Beta coefficient of 0.738 denotes a significant positive impact. This is supported by the high T value of 9.875 and the remarkably low P value of 0.001. Since there is a statistically significant relationship between UBDA and TP, the hypothesis is solidly established. The focus of Hypothesis 2 (H2) moves to the impact of "Adoption of AI" (AAI) on TP. The obtained Beta coefficient of 0.239 indicates a positive association. The hypothesis is accepted since it has a T value of 3.482 and a P value of 0.001. The third hypothesis (H3) examines the connection between UBDA and "Data Accuracy" (DA). The significant Beta coefficient of 0.522 indicates a positive relationship. The hypothesis is supported by a T value of 6.877 and a P value of 0.001, which indicates that it is valid. Moving on to Hypothesis 4 (H4), the investigation focuses on the effect of AAI on DA. While the calculated Beta coefficient of 0.111 indicates a positive effect, the T value of 2.009 and the slightly higher P value of 0.046 indicate that the hypothesis should be accepted. Finally, Hypothesis 5 (H5) investigates the effect of DA on TP. The calculated Beta coefficient of 0.179 emphasizes a beneficial influence. The hypothesis is accepted since it has a T value of 3.120 and a P value of 0.002.

Table 6. Regression Analysis

Hypothesis	Relation	Beta	T value	P value	Decision
H1	UBDA -> TP	0.738	9.875	0.001	Accepted
H2	AAI -> TP	0.239	3.482	0.001	Accepted
H3	UBDA -> DA	0.522	6.877	0.001	Accepted
H4	AAI -> DA	0.111	2.009	0.046	Accepted
H5	DA -> TP	0.179	3.120	0.002	Accepted

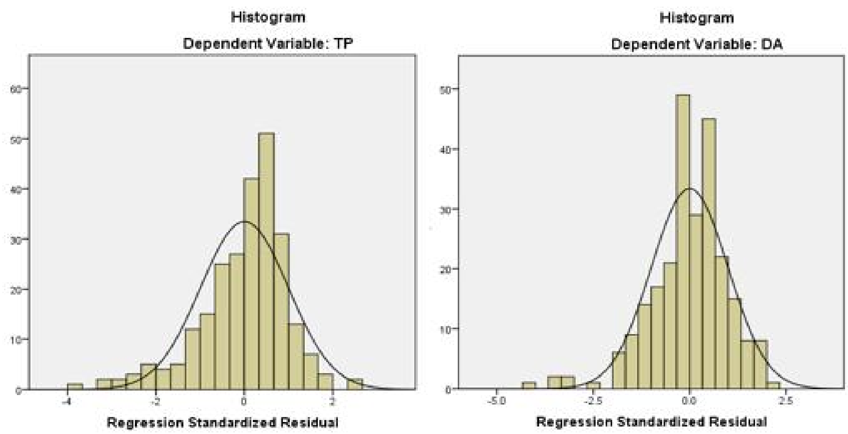

Figure 5. Regression Analysis

Mediation Analysis

In **Table 7**, the results of a thorough mediation study are presented, shedding insight into the mediated interactions investigated in the hypotheses. The table describes each hypothesis in depth, including the specific relationships, Beta coefficients, T values, P values, and the final judgments. The sixth hypothesis (H6) examines the mediation pathway between "Use of Big Data Adoption," "Data Accuracy," and "Teacher Performance." The calculated Beta coefficient of 0.586 demonstrates a significant positive effect. This is supported by a strikingly large T value of 17.837 and an astoundingly small P value of 0.001. Moving on to Hypothesis 7 (H7), the emphasis is on the mediated influence of "Adoption of AI" (AAI) on TP, with "Data Accuracy" (DA) serving as the mediator. A positive mediation effect is indicated by the computed Beta coefficient of 0.362. The hypothesis is accepted due to a robust T value of 12.737 and a P value of 0.001.

Table 7. Mediation Analysis

Hypothesis	Relation	Beta	T value	P value	Decision
H6	UBDA -> DA -> TP	0.586	17.837	0.001	Accepted
H7	AAI -> DA -> TP	0.362	12.737	0.001	Accepted

Moderation Analysis

Table 8 shows the findings of a full moderation analysis, which sheds insight into the moderating relationships investigated by the hypotheses. The relationship between "Usage of Big Data Adoption" (UBDA) and "Teacher Performance" (TP) is the subject of Hypothesis 8 (H8), which explores the moderating impact of "Technological Literacy" (TL). The computed Beta coefficient of 0.534 indicates that there is a significant positive moderating effect. A high T value of 13.814 and a stunningly low P value of 0.001 support this hypothesis. Hypothesis (H9) tested the moderating impact of TL on the link between "Adoption of AI" (AAI) and TP. The computed Beta value of 0.307 indicates that there is a beneficial moderating impact. The hypothesis is accepted due to a significant T value of 8.524 and a P value of 0.001.

Table 8. Moderation Analysis

Hypothesis	Relation	Beta	T value	P value	Decision
H8	TL* UBDA -> TP	0.534	13.814	0.001	Accepted
H9	TL* AAI -> TP	0.307	8.524	0.001	Accepted

DISCUSSION

The study's findings strongly affirm Hypothesis 1, demonstrating the significant and positive impact of integrating big data analytics on teacher performance. This aligns with existing literature highlighting the transformative potential of data-driven insights in education (Swanzy-Impraim, Morris, Lummis, & Jones, 2023). By analyzing extensive student data, big data analytics empowers teachers to tailor instruction, make evidence-based decisions, and uncover valuable patterns. Educators benefit from personalized insights that help address individual learning needs, ultimately enhancing engagement and student outcomes (Luo & Song, 2022). Data analytics guides teachers in identifying effective instructional methods across student groups, fostering continuous improvement (Chen & Chan, 2022). Additionally, the technology reveals otherwise hidden trends, enabling proactive support for struggling or advanced learners.

Hypothesis 2 is strongly validated by the study, affirming the significant and positive impact of adopting artificial intelligence (AI) on teacher performance. This alignment with existing research underscores the transformative potential of AI in education, enhancing teaching practices and student outcomes (Somasundaram et al., 2020). The integration of AI technologies empowers educators with advanced tools for personalized instruction, data-driven decision-making, and innovative learning experiences. These AI-driven insights guide teachers in tailoring their instruction to address individual learning needs, thereby fostering better engagement and achievement (Hao et al., 2022). Furthermore, AI-generated recommendations enable educators to optimize teaching methods by identifying effective strategies across student groups. This evidence-based approach not only maximizes the impact of teaching efforts but also promotes continuous growth in teaching practices (Dwivedi et al., 2023). The results also support the notion that AI reveals previously hidden patterns, facilitating proactive interventions for students in need of support or those who excel. This data-driven approach enhances classroom management and overall student success.

Hypothesis 3 is strongly substantiated by the study's findings, confirming the significant and positive impact of the usage of big data analytics on data accuracy. This alignment with established literature underscores the pivotal role of data analytics in refining the precision and reliability of educational data. The incorporation of big data analytics enables educational institutions to collect, process, and analyze vast amounts of data with enhanced precision (Ding, Cui, & Zhang, 2022). This accuracy is derived from the systematic analysis of student performance, behaviour, and engagement metrics. As a result, educators benefit from more reliable and comprehensive insights into student learning patterns. Data accuracy is amplified through the identification of trends and patterns that might be overlooked in traditional data collection methods (Ahmed, Ahmad, Jeon, & Piccialli, 2021). Big data analytics uncovers nuanced relationships and correlations, refining educators' understanding of students' strengths and areas needing improvement. Moreover, the iterative nature of data analytics encourages continuous refinement of data accuracy over time (Ashaari et al., 2021). By employing machine learning algorithms and real-time updates, educational data becomes increasingly precise and reflective of students' evolving needs.

Hypothesis 4 receives robust validation from the study's findings, confirming the significant and positive impact of the adoption of artificial intelligence (AI) on data accuracy. This alignment with existing research underscores the transformative role of AI in refining the precision and reliability of educational data. The integration of AI technologies augments data accuracy by automating complex data processing tasks (Partel, Costa, & Ampatzidis, 2021). AI algorithms can analyze vast amounts of educational data with greater speed and accuracy, ensuring consistency in the extraction of valuable insights. AI's ability to identify subtle patterns and relationships in data enhances data accuracy by uncovering nuanced correlations that might evade traditional analysis methods. By harnessing machine learning algorithms, AI refines educators' understanding of student behaviour and learning trends (Bertl, Ross, & Draheim, 2022). Additionally, AI-driven continuous learning models improve data accuracy over time. These models adapt and self-correct based on new information, ensuring that the data employed for decision-making remains current and reliable.

Hypothesis 5 receives robust affirmation from the study's findings, confirming the significant and positive impact of data accuracy on teacher performance. This alignment with established literature underscores the pivotal role of reliable data in shaping effective teaching practices and improving educational outcomes. Accurate data serves as a cornerstone for evidence-based decision-making in education (Kaur, Gabrijelčič, & Klobučar, 2023). Educators rely on precise data insights to tailor their instructional strategies, identify student needs, and make informed choices that optimize teaching effectiveness. Moreover, accurate data facilitates the identification of trends and patterns that support proactive interventions for students requiring additional support or advanced challenges (Merk, Groß Ophoff, & Kelava, 2023). This personalized approach enhances classroom management and cultivates an environment conducive to student achievement. Educational institutions are increasingly recognizing the indispensable role of data accuracy in driving teacher professional development (Ichimuraa, Kamadab, Haradac, & Inoued, 2023). Accurate data insights pinpoint areas where educators can grow, guiding the design of targeted professional development initiatives that contribute to continuous improvement.

Hypothesis 6 is strongly confirmed by the study's findings, highlighting the significant role of data accuracy as a mediator between the usage of big data analytics and teacher performance. This alignment with existing research underscores the importance of reliable data in translating data analytics into effective teaching practices (Cui et al., 2021). Data accuracy serves as a vital bridge between big data analytics and teacher performance enhancement. Accurate data insights enable educators to make informed decisions, tailor instructional strategies, and target student needs more effectively (Dietrich et al., 2021). This mediation effect ensures that the insights derived from data analytics translate into tangible improvements in teaching practices. Furthermore, accurate data generated through big data analytics aids in identifying trends and patterns that would otherwise remain obscured. These insights enhance educators' ability to engage with students on an individualized basis, leading to improved classroom management and learning outcomes (Chen, Liang, Lu, Potměšil, & Zhong, 2019). The mediation of data accuracy in the relationship between big data analytics and teacher performance highlights the practical relevance of accurate data. It reinforces the notion that the efficacy of data-driven approaches largely hinges on the precision and reliability of the underlying data.

The study's findings strongly support Hypothesis 7, emphasizing the important role of data accuracy as a mediator between the adoption of artificial intelligence (AI) and teacher performance. The importance of reliable data in converting AI-driven insights into successful teaching strategies is highlighted by the alignment with prior studies. Data accuracy is a critical link between AI adoption and improved teacher effectiveness (Hunte et al., 2021). Educators can improve teaching techniques, target student needs, and steer instructional tactics with accurate data insights produced from AI technologies, according to (Lamb et al., 2022). This mediation effect ensures that AI's promises are fulfilled in actual teaching outcomes.

The findings of this study strongly support Hypothesis 8, demonstrating that technological literacy has a substantial moderating effect on the association between the use of big data analytics and teacher performance. This agreement with previous studies emphasizes the relevance of educators' technological proficiency in maximizing the impact of data analytics. The ability of educators to use the advantages of big data analytics to improve teacher effectiveness is found to be significantly influenced by their technological literacy (Li, 2022). Educators with higher levels of technical literacy can more effectively navigate complicated data analytics platforms, transforming data-driven insights into useful instructional practices (Mortensen, Larsen, & Kruse, 2021). Due to their technical expertise, educators can effectively evaluate the results of data analytics and incorporate them into their lesson plans. This moderation effect ensures that the potential benefits of data analytics are more successfully tapped by technologically literate instructors, resulting in enhanced teaching techniques and student engagement.

The findings of this study provide strong support for Hypothesis 9, demonstrating that technological literacy has a substantial moderating effect on the relationship between the adoption of artificial intelligence (AI) and teacher performance. This agreement with previous research emphasizes the significance of educators' technological proficiency in enhancing the impact of AI integration (Goldenthal, Park, Liu., Mieczkowski, & Hancock, 2021). The adoption of AI and its impact on better teacher effectiveness are both strongly influenced by technological literacy. Educators with higher levels of technology literacy are better suited to navigate and exploit the promise of AI technologies, leveraging AI-generated insights to improve their teaching practices (Malaquias & Malaquias, 2021). The technological expertise of educators enables them to precisely interpret AI-generated recommendations and integrate them into instructional strategies without difficulty. This moderation effect ensures that the potential benefits of AI are realized more effectively among technologically competent educators, resulting in improved teaching techniques and student engagement.

CONCLUSION

This study began a thorough investigation of the complex relationship between educational technology, teacher effectiveness, and student results. This study uncovered significant insights with both practical and theoretical consequences by examining the interplay of variables such as technical literacy, data accuracy, artificial intelligence adoption, and the use of big data analytics. The findings of the study provide organizations and educators with practical advice on how to improve teacher performance through skilled technological literacy. Recognizing the critical importance of correct data, educational institutions are encouraged to strengthen data infrastructure and governance standards, ensuring the integrity of data-driven choices. In addition, the mediation and moderation effects highlighted in this study highlight the complex relationships that underlie technological integration. These findings support more comprehensive approaches, highlighting the interrelationship of technological proficiency, data accuracy, and technology uptake. In a school environment that is rapidly changing, such integrative approaches have the potential to inform policy and practice.

IMPLICATIONS

Practical Implications: The findings of the study have significant practical consequences for both instructors and educational institutions. One important finding highlights the need for teacher professional development. The results underscore the importance of improving instructors' proficiency in technology to ensure the optimal application of big data analytics and artificial intelligence tools. This realization motivates educational institutions to develop focused training programs that provide teachers with the knowledge and skills needed to navigate and harness the potential of these technologies for improved teaching practices. Another practical implication pertains to the development of data infrastructure. In order to successfully apply big data analytics and AI, the study emphasizes the importance of accurate and trustworthy data. This highlights the imperative for educational institutions to allocate resources towards the development of comprehensive data gathering, storage, and analysis systems that prioritize both precision and safeguarding measures. Data governance procedures are put in place to assure the accuracy and reliability of the data that underpins informed decision-making. The report also highlights the importance of equitable implementation as a critical practical factor. The results demonstrate the importance of technical literacy in mediating and moderating the relationship between the use of educational technologies and teacher effectiveness. In order to ensure that all educators are able to effectively utilize the advantages offered by new technologies, it is imperative for institutions to guarantee equal access to chances for enhancing technology literacy. This inclusiveness makes it possible for instructors with a variety of technical expertise to equally contribute to enhancing instructional strategies and student outcomes.

Contribution Literature: From a theoretical point of view, the study offers novel insights that contribute to the advancement of the educational discourse as a whole. The emphasis on data accuracy as a mediator between technology adoption and teacher effectiveness enhances understanding of how trustworthy data is critical for converting insights into effective teaching practices. This phenomenon presents opportunities for more investigation into the mechanisms through which the correctness of data impacts the tangible results of educational technologies. The focus of the study on technological literacy as a moderator emphasizes the conceptual significance of instructors' technological proficiency and comfort. This observation presents a compelling opportunity for academics to delve into the distinct characteristics of technological literacy that contribute to the efficacy of technology integration in educational settings. It promotes a deeper comprehension of how teachers' technological aptitude affects how well AI and data analytics are incorporated into their lesson plans. Moreover, the interdependence of data analytics, artificial intelligence, technology literacy, and teacher performance underscores the necessity for a comprehensive perspective on the educational ecosystem. This theoretical framework stresses how each aspect affects the others, implying the possibility of more holistic models that consider these relationships collectively.

LIMITATIONS AND FUTURE DIRECTIONS

Although the study offers insightful contributions, it is important to recognize its limitations. One restriction is the possibility of sample bias, as participants in the study were recruited from a specified geographical region or educational level. This might prevent the findings from being applied to more extensive educational environments. Another limitation is that self-report measurements for characteristics such as technological literacy and teacher performance are used. The accuracy of reported data may be affected by self-report measures' susceptibility to social desirability bias. Furthermore, the study's cross-sectional design limits the ability to demonstrate causal correlations between variables. Longitudinal or experimental designs may provide stronger evidence of causality and temporal associations.

Future research could address the study's limitations and broaden the knowledge base in a variety of ways. To begin with, performing multi-site or multi-level studies in various educational contexts would improve the generalizability of results and provide insights into the contextual factors impacting the correlations investigated. Using mixed-methods approaches may provide a more complete understanding of the complicated interplay between technical literacy, data accuracy, AI acceptance, data analytics usage, and teacher performance. A more complex viewpoint might be provided by fusing quantitative data with educator-provided qualitative views. Longitudinal or experimental designs can be used to establish causality. Longitudinal studies could look at how technological literacy and data accuracy affect teacher performance over time. Controlled experiments could evaluate the outcomes of focused efforts to raise these variables.

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