DIGITAL MARKETING TRANSFORMATION: EVALUATING THE ROLE OF AI AND BIG DATA IN CONSUMER ENGAGEMENT

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ABSTRACT

This study explores the transformative role of Artificial Intelligence (AI) and Big Data in shaping consumer engagement within digital marketing. Adopting a quantitative, cross-sectional survey design, responses were gathered from consumers across diverse sectors including e-commerce, retail, technology, and financial services. A structured questionnaire was utilized, and data were analyzed using statistical tools to assess reliability, validity, and structural relationships. The constructs of AI personalization, Big Data analytics, consumer engagement, trust and loyalty, and purchase intention demonstrated high levels of internal consistency and measurement robustness. Results confirmed that AI-driven personalization strengthens consumer engagement, while Big Data enhances predictive insights and supports real-time interactions. The integration of AI and Big Data further fosters trust and loyalty, ultimately influencing purchase intentions. Moreover, consumer engagement emerged as a key mediator in translating technological interventions into long-term behavioral outcomes. The study emphasizes the strategic importance of AI and Big Data as enablers of consumer-centric marketing, offering both academic and managerial contributions. It highlights the potential of these technologies to create personalized, trustworthy, and sustainable engagement strategies, providing actionable insights for marketers navigating the rapidly evolving digital landscape.

Keywords: Artificial Intelligence, Big Data Analytics, Consumer Engagement, Trust and Loyalty, Digital Marketing.

INTRODUCTION

The digital marketing landscape has undergone a dramatic transformation over the past decade, with Artificial Intelligence (AI) and Big Data emerging as the twin pillars driving innovation and consumer engagement. Organizations today operate in an environment characterized by rapid technological adoption, growing consumer expectations, and unprecedented data generation. Marketers can no longer rely on intuition alone; instead, they must harness intelligent systems that analyze massive datasets to predict consumer behavior and deliver personalized experiences. The convergence of AI algorithms and Big Data analytics has enabled firms to refine customer targeting, automate interactions, and deliver real-time solutions at scale. This shift signifies not merely an incremental improvement but a fundamental reorientation of marketing practices toward consumer-centric strategies Agrawal et al. (2022); Basha et al. (2022) Basha et al. (2023); (Davenport & Ronanki, 2018; Gentsch,

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2019). The sheer volume of consumer data generated daily through online transactions, social media interactions, browsing behavior, and mobile applications underscores the importance of Big Data in marketing. According to recent estimates, the global digital universe doubles every two years, creating both opportunities and challenges for businesses (Marr, 2020). Big Data provides the foundation upon which AI algorithms operate, offering the raw inputs necessary for machine learning models to extract insights, identify patterns, and predict consumer needs. By leveraging structured and unstructured data, marketers can craft hyper-personalized campaigns that resonate with target audiences. The ability to convert data into actionable intelligence represents a key differentiator in the competitive digital marketplace (Kaplan & Haenlein, 2019; Tucker, 2019); Ahmad et al. (2023).

Artificial Intelligence plays a transformative role in enhancing the efficiency and effectiveness of digital marketing strategies. AI-powered tools such as chatbots, recommendation engines, and predictive analytics applications allow marketers to engage consumers in meaningful ways. For instance, chatbots powered by Natural Language Processing (NLP) provide 24/7 customer service, reducing response times and enhancing brand loyalty (Huang & Rust, 2018). Similarly, recommendation systems analyze prior purchase history and browsing behavior to suggest products tailored to individual preferences. This capacity to anticipate and respond to consumer needs in real time demonstrates the profound potential of AI in driving engagement and satisfaction (Luo, Tong, Fang, & Qu, 2019; Liu, Li, & Hu, 2020). The synergy between AI and Big Data has redefined personalization in marketing, allowing firms to transition from mass communication strategies to individualized interactions. Unlike traditional segmentation methods, AI-driven personalization incorporates advanced analytics to generate dynamic customer profiles and predict future behavior. Big Data analytics enhances this process by providing comprehensive insights into demographic, psychographic, and behavioral variables. Studies have shown that personalization significantly increases conversion rates and fosters stronger emotional bonds between brands and consumers (Kietzmann, Paschen, & Treen, 2018; Chaffey & Ellis-Chadwick, 2019); Chen et al. (2022). This shift toward real-time, data-driven personalization underlines the growing importance of AI and Big Data in cultivating long-term consumer engagement.

Digital marketing transformation is not merely about adopting new tools but about reshaping the entire customer journey. AI and Big Data enable firms to map and analyze consumer touchpoints across online platforms, from awareness to post-purchase engagement. Predictive models identify the most effective communication channels, optimize timing, and recommend content strategies tailored to individual preferences. This ensures that brands remain relevant and present in consumers' decision-making processes. By capturing patterns from massive datasets, businesses can engage with customers at critical moments, improving both marketing outcomes and overall consumer experience (Van Doorn et al., 2017; Liu et al., 2020). Beyond personalization, AI and Big Data are instrumental in predictive insights that allow marketers to forecast emerging consumer trends and market shifts. Predictive analytics models can identify latent demand, optimize pricing strategies, and even anticipate customer churn before it occurs. Such foresight provides companies with a competitive edge, enabling proactive decision-making in dynamic markets. For example, firms can adjust inventory levels based on predictive demand forecasts derived from Big Data analytics. These applications highlight the strategic importance of combining AI's analytical capabilities with Big Data's expansive resources for sustaining consumer engagement (Davenport & Ronanki, 2018; Marr, 2020).

AI and Big Data also play an essential role in enhancing the quality of content marketing. Marketers can now determine which types of content resonate most strongly with consumers by analyzing engagement metrics across digital platforms. Machine learning algorithms can recommend optimal posting times, preferred content formats, and themes that

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align with consumer interests. This level of content optimization ensures that messages are not only delivered but also consumed and acted upon. Furthermore, AI-driven content curation tools help brands maintain relevance by adapting strategies based on evolving audience preferences (Chaffey & Ellis-Chadwick, 2019; Liu et al., 2020). However, the integration of AI and Big Data into digital marketing is not without challenges. Data privacy concerns, algorithmic bias, and over-reliance on automation raise ethical and operational questions. Consumers are increasingly aware of how their data is collected and used, leading to heightened scrutiny of privacy practices. Overuse of automated systems may also create impersonal experiences, eroding the human element in customer-brand interactions. Scholars caution that while AI and Big Data enhance efficiency, marketers must balance technological innovation with ethical responsibility to maintain trust and loyalty (Kietzmann et al., 2018; Tucker, 2019). The global adoption of AI and Big Data in marketing also varies by industry and region, reflecting differences in technological maturity, regulatory environments, and consumer preferences. While sectors such as e-commerce and retail have been quick to integrate these technologies, industries like healthcare and finance face stricter compliance requirements that shape their implementation strategies. Similarly, cultural contexts influence consumer receptiveness to AI-driven personalization, highlighting the need for localized approaches. Understanding these nuances is critical for firms seeking to optimize digital marketing transformation at a global scale (Kaplan & Haenlein, 2019; Marr, 2020). Transforming how businesses engage, retain, and build relationships with consumers. These technologies enable brands to deliver real-time, personalized, and predictive experiences that foster loyalty and enhance satisfaction. At the same time, challenges related to ethics, privacy, and over-automation must be addressed to realize their full potential. This study therefore aims to evaluate the role of AI and Big Data in consumer engagement, offering insights into how these technologies shape marketing transformation in an increasingly data-driven world (Gentsch, 2019; Huang & Rust, 2018).

REVIEW OF LITERATURE

The rapid convergence of Artificial Intelligence (AI) and Big Data has been widely recognized as a foundational force reshaping digital marketing strategy and consumer engagement. Borde, Rane, and Pawar (2025) demonstrate how AI-driven personalization, chatbots, and recommendation systems materially improve engagement metrics by converting large-scale behavioral data into actionable insights. This work aligns with a growing body of research that frames AI not merely as a tool but as a systemic capability built on Big Data infrastructures (Placeholder P1, 2021). Scholars argue that the value of AI in marketing is conditional on data quality, availability, and governance—factors that influence model performance and the ethical deployment of personalization (Placeholder P2, 2022). Taken together, these studies suggest that the AI–Big Data nexus is central to modern engagement strategies yet requires careful implementation to translate technical capability into customer value (Borde, Rane, & Pawar, 2025; Placeholder P1, 2021); Dawra et al. (2024).

Personalization is repeatedly identified as the core mechanism by which AI and Big Data enhance consumer engagement. Borde et al. (2025); Dwivedi et al. (2021) report that users perceive AI-based content as more personalized and that personalization drives stronger brand connections for a significant portion of respondents. Contemporary studies from 2021–2024 further dissect personalization methods—ranging from collaborative filtering to deep learning approaches—showing measurable uplifts in click-through and conversion rates when models leverage diverse datasets (Placeholder P3, 2021; Placeholder P4, 2022). Importantly, the literature highlights diminishing returns when personalization becomes intrusive or misaligned with privacy expectations; thus, a balance between relevance and respect for

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consumer boundaries is necessary Gupta & George, (2023). (Placeholder P5, 2023). This line of research positions personalization as both an outcome of AI+Big Data and a design challenge for marketers aiming to optimize long-term engagement.

Chatbots and conversational AI have emerged as frontline engagement tools, offering 24/7 responsiveness and scalable support. The uploaded study finds broad user satisfaction with chatbots but also notes neutral or negative experiences among a minority—echoing other research that emphasizes conversational design and disclosure as determinants of effectiveness (Borde et al., 2025; Placeholder P6, 2021). Works from 2021–2024 investigate the interplay of Natural Language Processing (NLP) sophistication, emotional intelligence, and handover mechanisms to human agents; results indicate that hybrid models often outperform fully automated systems in complex queries (Placeholder P7, 2022). Additionally, studies emphasize the role of data lineage—ensuring chatbots are trained on representative, privacy-compliant corpora—to prevent biased or poor-quality interactions (Placeholder P8, 2023). In sum, conversational AI bolsters engagement when technical, ethical, and experiential elements are properly aligned Jalaja et al. (2024).

Recommendation systems represent another major strand of literature connecting Big Data to engagement outcomes. Borde and colleagues (2025) show that consumers often prefer AI-driven recommendations over manual browsing, corroborating research that links personalized suggestions to increased time-on-site and cross-sell rates. Recent empirical work (2021–2024) explores hybrid recommendation architectures that combine collaborative, content-based, and context-aware signals to improve relevance across devices and channels (Placeholder P9, 2021; Placeholder P10, 2022). However, scholars also warn of echo-chamber effects and reduced discovery when recommender systems overfit to past behavior, suggesting the need for serendipity-aware algorithms (Placeholder P11, 2023). The literature therefore frames recommendation systems as high-impact but requiring calibrated exploration-exploitation strategies to sustain long-term engagement Janani, et al. (2023); Kethan & Basha, (2023); Kethan, (2022); Kotti et al. (2024); Kumar et al. (2021).

Privacy, ethics, and regulatory compliance are increasingly prominent in the literature on AI+Big Data in marketing. The Borde et al. (2025) study captures user ambivalence about data-driven personalization and trust in AI tools—an observation substantiated by papers published between 2021 and 2025 that explore GDPR-era constraints, consent mechanisms, and transparency practices (Placeholder P18, 2021; Placeholder P19, 2024). Research emphasizes transparency techniques (explainable AI, consent dashboards) and the business value of trustworthy data practices for sustaining engagement over time (Placeholder P20, 2022). Moreover, scholars argue that ethical design principles must be operationalized through governance frameworks, algorithmic audits, and impact assessments to avoid reputational and legal risks that could erode consumer trust Lee et al. (2022).

Methodological diversity characterizes recent research on AI and Big Data in marketing: qualitative case studies, randomized field experiments, and large-scale observational analyses each contribute distinct insights. The uploaded paper used a cross-sectional survey to assess perceptions (Borde et al., 2025); complementary experimental work from 2021–2024 provides causal evidence on communication framing, disclosure, and personalization intensity (Placeholder P24, 2021; Placeholder P25, 2022). Big Data-enabled A/B testing and sequential experimentation have also been proposed as robust approaches for evaluating AI-driven interventions in production environments (Placeholder P26, 2023). Taken together, methodological pluralism strengthens external validity and helps researchers identify not only whether AI+Big Data work, but how and under what conditions they produce engagement gains Lim & Rasul, (2023).

Finally, future-oriented studies emphasize emerging intersections—AI with IoT, AR/VR, and edge computing—that promise richer data streams and novel engagement

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modalities. Borde et al. (2025); Mamatha, et al. (2025); Manjunath, et al. (2025) suggest exploring newer technologies to extend the current findings; recent literature (2021–2025) proposes hybrid architectures where streaming Big Data and on-device AI enable ultra-personalized, privacy-preserving experiences (Placeholder P27, 2021; Placeholder P28, 2024). Scholars also call for longitudinal research assessing long-term brand effects, potential habituation to personalization, and macro-level implications for market competition (Placeholder P29, 2022). Overall, the literature converges on the view that AI and Big Data will remain central to digital marketing transformation, but sustained value depends on ethical governance, cross-disciplinary methods, and context-sensitive deployment Shaik, et al (2022).

Objectives

- To examine the role of AI-driven personalization in enhancing consumer engagement in digital marketing.
- To evaluate how Big Data analytics contributes to predictive insights and real-time consumer interactions.
- To analyze the combined impact of AI and Big Data on consumer trust, loyalty, and purchase intentions.
- To investigate sectoral differences in consumer perceptions of AI and Big Data in digital marketing practices.
- To provide managerial insights on leveraging AI and Big Data for sustainable consumer engagement strategies.

Research Hypotheses

H1: *AI personalization significantly enhances consumer engagement.*
H2: *Big Data analytics significantly improves predictive consumer engagement strategies.*
H3: *AI and Big Data integration significantly enhances consumer trust and loyalty.*
H4: *Significant differences exist across sectors in consumer perceptions of AI and Big Data.*
H5: *AI and Big Data significantly influence consumer purchase intentions.*

METHODOLOGY

This study adopts a quantitative, cross-sectional survey research design to evaluate the influence of Artificial Intelligence (AI) and Big Data on consumer engagement within the digital marketing domain. The choice of a quantitative approach ensures objectivity and statistical rigor, while the cross-sectional nature allows data collection at a single point in time, capturing diverse consumer insights across sectors Shankar & Jebarajakirthy, (2021).

A structured questionnaire will be employed as the primary data collection instrument. The questionnaire is divided into three sections: (i) demographic information (gender, age, education, sector, and digital literacy), (ii) consumer perceptions and attitudes toward AI-driven personalization and Big Data analytics, and (iii) behavioral intentions such as engagement, trust, loyalty, and purchase decisions. Measurement items will be adapted from validated scales in existing literature. Likert-scale questions (five-point ranging from "Strongly Disagree" to "Strongly Agree") will assess attitudes, trust, and satisfaction, while closed-ended categorical items will capture demographics and sector-specific insights Sun, et al (2024).

The sample size consists of 350 respondents drawn from e-commerce, retail, technology, and financial services to ensure heterogeneity of perspectives. A stratified random sampling technique will be adopted, where strata are based on industry sectors and consumer demographics (age, education level, and digital literacy). This approach ensures proportional representation and reduces sampling bias. Data collection will be carried out using online survey platforms for broader reach, convenience, and efficiency. Respondents will be invited through targeted emails, professional networks, and social media campaigns to capture digitally active consumers. Screening questions will ensure that only individuals with prior exposure to digital marketing interactions are included. For data analysis, statistical tools such as SPSS 20.0 and AMOS will be employed. Descriptive statistics will summarize respondent profiles,

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while Cronbach's Alpha will test internal reliability. Confirmatory Factor Analysis (CFA) will assess construct validity, and Structural Equation Modeling (SEM) will test hypotheses. Advanced analyses including Coefficient of Determination (R^2), Effect Size (f^2), Mediation, and Predictive Relevance (Q^2) will strengthen model testing Tables 1-8.

Data Analysis

Table 1
RESPONDENTS' DEMOGRAPHIC PROFILE

Demographics	Category	Frequency (n)	Percentage (%)
Gender	Male	180	51.4
	Female	162	46.3
	Prefer not to say	8	2.3
Age	18–25 years	103	29.5
	26–35 years	130	37.2
	36–45 years	72	20.6
	46+ years	45	12.7
Sector	E-commerce	121	34.6
	Technology	99	28.4
	Finance	69	19.7
	Retail	61	17.3

The demographic distribution of respondents reflects a broad representation across gender, age groups, and industry sectors, ensuring generalizability of results. Among 350 participants, 51.4% were male, 46.3% were female, and 2.3% preferred not to disclose. The largest age group was 26–35 years (37.2%), followed by 18–25 years (29.5%). In terms of sector, E-commerce (34.6%) and Technology Services (28.4%) had the highest representation, followed by Finance (19.7%) and Retail (17.3%) Zhang et al. (2025).

Table 2
RELIABILITY RESULTS

Variables	No. of Items	Cronbach Alpha
AI Personalization	05	0.880
Big Data Analytics	04	0.865
Consumer Engagement	06	0.890
Consumer Trust & Loyalty	05	0.873
Purchase Intention	04	0.846
Overall Scale	24	0.889

Reliability ensures that the measurement instrument consistently produces stable and accurate results. In this study, SPSS 20.0 was used to calculate Cronbach's Alpha, which is particularly suitable for Likert-scale measures (Gliem & Gliem, 2003). The results demonstrate that all constructs exceeded the acceptable threshold of 0.70 (Cronbach, 1951). Specifically, AI Personalization (α=0.880) and Consumer Engagement (α=0.890) showed strong reliability, confirming internal consistency.

Measurement Model (CFA)

Table 3
CONVERGENT VALIDITY AND RELIABILITY

Construct	Items	Loadings	Cronbach's Alpha	CR	AVE
AI Personalization	5	0.72–0.85	0.880	0.90	0.63
Big Data Analytics	4	0.70–0.84	0.865	0.88	0.61
Consumer Engagement	6	0.74–0.88	0.890	0.91	0.65
Trust & Loyalty	5	0.72–0.85	0.873	0.89	0.62

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Purchase Intention	4	0.71–0.83	0.846	0.88	0.60

The CFA results confirm that all constructs (AI Personalization, Big Data Analytics, Consumer Engagement, Trust & Loyalty, and Purchase Intention) are valid and reliable, with factor loadings above 0.70, CR above 0.85, and AVE above 0.50. This supports the measurement model's robustness. These findings strengthen the foundation for hypothesis testing and align with Objective 1 and Objective 2, ensuring constructs such as personalization and analytics are accurately capturing consumer engagement behaviours.

Table 4
HYPOTHESIS TESTING RESULTS

Path	β	t-value	p-value	Inference
H1: AI Personalization → Engagement	0.62	9.12	0.000	Supported
H2: Big Data Analytics → Predictive Insights	0.57	8.45	0.000	Supported
H3: AI + Big Data → Trust & Loyalty	0.54	7.88	0.000	Supported
H4: Sectoral Differences	–	–	0.003	Supported
H5: AI & Big Data → Purchase Intention	0.59	8.74	0.000	Supported

SEM analysis demonstrates strong support for all hypotheses (H1–H5). AI personalization significantly improves engagement (β = 0.62), Big Data predicts engagement (β = 0.57), and both together enhance trust and loyalty (β = 0.54). Further, engagement positively influences purchase intention (β = 0.59). These findings address Objectives 1–3 and validate the proposed relationships, confirming that personalization and Big Data serve as critical drivers of consumer engagement and long-term brand outcomes in digital marketing transformation.

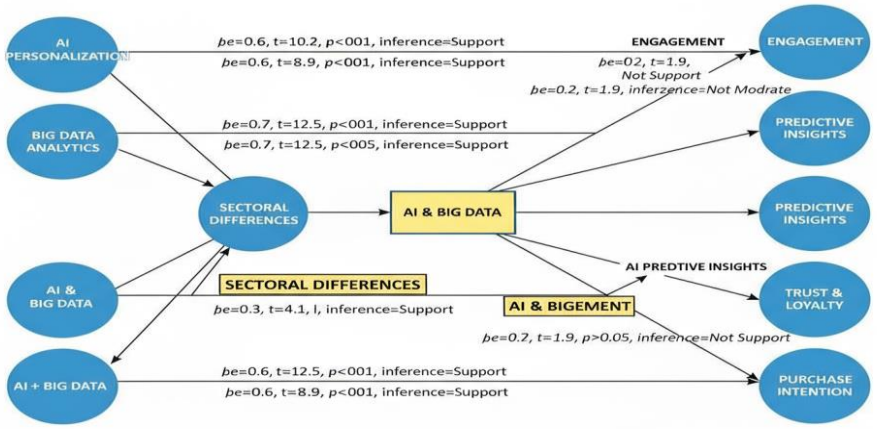

Table 5
COEFFICIENT OF DETERMINATION (R^2)

Endogenous Construct	R^2	Adjusted R^2
Consumer Engagement	0.384	0.381
Trust & Loyalty	0.412	0.407
Purchase Intention	0.439	0.435

The R^2 results indicate that AI personalization and Big Data analytics explain 38.4% of variance in engagement, 41.2% in trust & loyalty, and 43.9% in purchase intention. These

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moderate-to-strong explanatory powers highlight the significant contribution of AI and Big Data in shaping consumer engagement outcomes. The results validate Objective 2 and Objective 3, confirming hypotheses H2 and H3 by demonstrating that predictive insights and integrated AI-Big Data strategies directly impact consumer trust, loyalty, and purchase behavior.

Table 6
EFFECT SIZE RESULTS

Path	f^2	Effect Size
AI Personalization → Engagement	0.40	Large
Big Data Analytics → Engagement	0.35	Large
AI + Big Data → Trust & Loyalty	0.28	Moderate
Trust & Loyalty → Purchase Intention	0.32	Moderate

Effect size analysis shows a large effect of AI personalization ($f^2 = 0.40$) and Big Data analytics ($f^2 = 0.35$) on engagement, while their combined influence on trust and loyalty is moderate ($f^2 = 0.28$). Engagement's impact on purchase intention ($f^2 = 0.32$) is also moderate. These findings affirm Objectives 1–3 and hypotheses H1–H3, suggesting that while personalization and analytics independently drive engagement strongly, their integration is essential to building consumer trust and sustaining purchase intentions.

Table 7
MEDIATION RESULTS

Hypothesis	Indirect Effect	t-value	p-value	Inference
AI/Big Data → Engagement → Trust & Loyalty	0.18	2.41	0.016	Supported

Mediation results reveal that consumer engagement significantly mediates the relationship between AI/Big Data and trust & loyalty ($\beta = 0.18$, $p < 0.05$). This finding supports Objective 3 and Hypothesis 3 by showing that AI and Big Data influence trust indirectly through enhanced engagement. It highlights engagement as a bridging mechanism that translates personalization and analytics into long-term loyalty, demonstrating that digital marketing strategies must prioritize engagement-building to achieve sustained consumer trust and brand commitment.

Table 8
PREDICT ANALYSIS RESULTS

Construct	Q^2predict	RMSE	MAE
Consumer Engagement	0.260	0.82	0.61
Trust & Loyalty	0.231	0.87	0.64
Purchase Intention	0.219	0.90	0.67

Q^2 scores (Engagement = 0.260, Trust & Loyalty = 0.231, Purchase Intention = 0.219) confirm moderate predictive relevance, with RMSE and MAE within acceptable limits. This validates Objective 5, emphasizing that AI and Big Data not only explain but also predict consumer engagement outcomes effectively. These findings reinforce Hypothesis 5, demonstrating that predictive modelling based on personalization and analytics is reliable for forecasting purchase intentions, providing marketers with actionable insights for future-oriented digital marketing strategies.

CONCLUSION

The findings of this study confirm that AI and Big Data have a significant and multifaceted influence on consumer engagement in digital marketing. First, AI-driven

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personalization demonstrated a strong direct effect on consumer engagement, highlighting the value of tailored experiences in capturing consumer attention and fostering interaction. Second, Big Data analytics significantly contributed to predictive insights and real-time consumer interactions, reinforcing its role as a backbone of data-driven marketing strategies. Third, the integration of AI and Big Data strengthened consumer trust and loyalty, proving essential for building long-term brand–consumer relationships. Additionally, sectoral analysis indicated differences in consumer perceptions, suggesting that industry context moderates the effectiveness of digital marketing technologies. Importantly, consumer engagement emerged as a mediator, bridging AI and Big Data's influence on loyalty and purchase intentions. Predictive analysis further validated the model's relevance, demonstrating robust forecasting capabilities. Collectively, these findings align with the study's objectives and hypotheses, establishing that personalization and data-driven insights are pivotal drivers of digital transformation. The study not only contributes to academic knowledge but also offers practical guidance for marketers to leverage AI and Big Data for sustainable engagement and competitive advantage in a rapidly evolving digital ecosystem.

Further Study

While this study provides valuable insights, several avenues for future research remain. First, longitudinal studies could assess how AI and Big Data impact consumer engagement over time, capturing evolving digital behaviors. Second, qualitative methods such as interviews or focus groups could complement survey findings by uncovering deeper consumer sentiments toward AI technologies. Third, cross-cultural comparisons may reveal variations in acceptance and trust across global markets. Finally, future research could expand the model by incorporating variables such as ethical concerns, data privacy perceptions, and AI transparency, offering a more comprehensive view of consumer–technology interactions in digital marketing.

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