Artificial Intelligence (AI) and Small and Medium Enterprises (SMEs) Competitiveness: Evidence from Nepal's Emerging Digital Economy [1]

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Abstract

This investigation is about the relationship between adoption of AI and competitive performance of SMEs of Nepal in context of changing digital economy. Through a quantitative research methodology, empirical data was gathered from 425 SME proprietors and senior managers, who are located in different areas of Kathmandu Valley, Pokhara, Biratnagar, Dhangadhi and other regional centers across Nepal. The research framework looks at four key determinants: adoption of AI technology, workforce digital competencies, organizational innovation capacity and data-driven decision-making processes and the collective impact on competitive performance measures such as operational productivity, market penetration capability and financial outcome. Multiple regression analysis indicates that AI adoption ($\beta = 2.324$, $p < 0.01$) and digital workforce skills ($\beta = 1.872$, $p < 0.01$) have a significant and positive impact on SME competitive positioning, whereas innovation capacity ($\beta = 1.546$, $p < 0.01$) and utilization of analytical data ($\beta = 1.215$, $p < 0.01$) also have a positive and relatively less significant impact on SME competitive positioning. Findings reveal the AI enabled enterprises have proved not only to be superior in operational efficiency, but are also superior in market responsiveness; infrastructural impediments and skills deficiencies in the workforce remain as major hindrances. This investigation makes a constructive contribution to academic discussion on technology competitiveness in the developing economic context that can provide precious insights to policy makers, financial institutions and entrepreneur players that strive to ensure an inclusive economic development through AI integration.

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Introduction

Small and Medium Enterprises (SMEs) play invaluable role in spurring the economic development and employment opportunities especially across developing economies like Nepal (Acharya & Pandey, 2018). Research has provided that SMEs make up around 95-98 % of all business establishment registered in the country and they account for 83% towards the total job generation (Acharya & Pandey, 2018). Nevertheless, despite the fact that they are extremely crucial in terms of its importance in relation to the economic structure, Nepalese SMEs have been facing challenges in various occasions and in order to meet their aspirations of sustainable expansion and long-term viability (Paudel, 2020). Numerous institutional interventions towards promoting the development of SMEs have not been able to produce expected results and there is stagnation in manufacturing sector and trading sectors with a high rate of enterprise failure (Ghimire, 2011). Even though they are economically important, SMEs are poorly studied in academic literature especially in the context of developing economy (Paudel, 2020). Within Nepal specifically, SMEs account for some 90% of the total number of enterprises, as well as playing important contributions toward the national GDP, as well as providing employment for nearly 2.6 million people (Sharma & Poudel, 2025). Throughout the rapidly changing economic landscape that is the one twenty-first century, Artificial Intelligence has surfaced as the next technological frontier that changes the parameters of productivity, the process of innovation and the rules of competition in different industries (Brynjolfsson & McAfee, 2017). From predictive analytical frameworks, machine learning driven decision systems, process automation mechanisms to intelligent marketing applications, the use of AI technologies are fundamentally changing the operational modalities, pathways of innovation and competitive strategies pursued by business enterprises (Bughin et al.,2018). For developing economies like Nepal where SMEs are the backbone of national economic activity, integration of AI technologies in the functionality of operation system is at the same time formidable challenge as well as great opportunity. External disturbances like natural catastrophes, technological disruption, political instability and economic fluctuations and global problems like pandemic of covid-19 are significant threats towards survival prospects of SME's (Albaz et al.,2020). As Nepal is moving forward on

its path of digital transformation under the "Digital Nepal Framework 2019" and further "Digital Economy Policy 2023" to understand mechanisms on how SMEs can leverage AI technologies to increase their competitive positioning is central towards achieving the objectives of sustainable and inclusive economic growth. Such disruption in many cases manifest itself in uncontrollable ways and hence organizational resilience becomes a key factor in determining sustainability of the business (Penadhes et al., 2017).

Recent evidence from sources obtainable from Organization for Economic Co-operation and Development show that the adoption of Artificial Intelligence (AI) in developed economies by SMEs has increased dramatically and 38 % of European SMEs currently are adopting some form of AI-enabled business functionality. However, the rates of adoption across the economies of South Asia is well below 15% resulting in a widening "AI divide", which present huge risks to the emerging economies. From the different economic regions of the country to Nepal, from growing technology ecosystem in Kathmandu to industrial corridors of Birgunj to entrepreneurial centers of Pokhara, SMEs are the entrepreneurial dynamism for local economy. These enterprises are operating in different industries like retail, manufacturing, tourism and logistics and in many instances with limited financial and technological resources (Adhikari & Molla, 2024).

While globalization and digitalization have both lead to an increase in opportunities in the market, but also a reduction in the barriers for transactions they have also lead to new competitive paradigms demanding technological flexibility as well a data-driven management practices (Vial, 2021). Within this context the adoption of AI becomes a strategic tool, which allows to improve the accuracy of decision-making process, optimize the operational processes and increase the engagement of the customer. However, access to, and adoption of, artificial intelligence (AI) technologies in the SME ecosystem in Nepal is uneven, and is hampered by gaps in digital infrastructure and low technical expertise, as well as high upfront costs of technology acquisition (Adhikari & Paudel 2024). Nepal SME sector is responsible for the contribution of around 22 % of the national Gross Domestic Products in which about 2.5 million people are engaged in the SME sector. Despite their economic importance, there is a challenge towards the SMEs for constant competition due to the out datedness of the production system and low capacity for innovation and lack of market intelligence (Paudel, 2020).

Literature Review and Conceptual Framework

Theoretical foundations

The intersection of Artificial Intelligence and Small and Medium Enterprise competitiveness has become a new area of scholarly interest in the field of development economics, business innovation, and information systems literature. Globally, AI adoption is known as a transformational force in improving firm productivity, innovation capability, and competitive advantage (Brynjolfsson & McAfee, 2017; Bughin et al., 2018). Theoretically, diffusion of AI technologies is in line with Schumpeterian innovation theory, which has it that technological innovation is the driving force of creative destruction and renewal of industrial competitiveness (Schumpeter, 1942). Within the framework of this theory, AI is a general-purpose technology that affect the production, distribution, and consumption systems, resulting in new competitive dynamics across economies.

AI and SME competitiveness in developing economies

The literature on SME competitiveness, in developing economies, are those that suggest that technological capability is an important determinant of performance and survival (Chakraborty & Dutta, 2021). In emerging markets, SMEs generally operate in an institutional environment of low levels of institutional support, lack of finance and poor digital infrastructure (Beck et al., 2008). AI can help remove some of these constraints by helping to improve the quality of decision-making, optimize production processes, and better engage customers by automating and using data-driven insights. Research conducted on digital adoption across South Asia found SMEs using AI enabled tools had on average 22% higher levels of productivity and 17% higher customer retention than non-AI users and where the spread of AI technologies is uneven across developing economies due to the cost, skill and policy barriers.

AI adoption and innovation capability

Innovation capability - the ability of firms to generate, absorb and realise new ideas - is at the heart of the nexus of AI and competitiveness (Cohen & Levinthal, 1990). Empirical studies demonstrate the benefits of AI in product and process innovation, which includes being able to carry out data-driven experimentation and predictive modeling (Cockburn et al., 2018). For instance, predictive maintenance in manufacturing SMEs with AI-enabled solutions help in reducing downtime and natural language processing applications helps in improving customer relationship management. In Nepal, there are emerging companies in the fields of fin-tech and e-commerce and logistics

sectors, which are showing the early symptom of AI innovation and where the startups such as Fusemachines Nepal and Paaila Technology have gained from AI solutions for customer service automation suggesting the increasing importance of AI in Nepal's innovation system (Karki & Bhatta, 2023). However, for the majority of the Nepalese SME's - particularly the ones working in the sectors of retail, tourism and manufacturing - the challenge is to develop organizational capability to use AI effectively. Innovation diffusion theory (Rogers, 2003) suggests that rates of adoption will be a function of perceived usefulness of a technology, ease of how to implement and how it fits with current business processes.

Digital skills and human capital development

Digital skills can have the benefit of using the capabilities of AI to process improvement, marketing and strategic planning for the firm. Research says that firms with digitally savvy leadership are 1.5 times more likely to have above average growth in productivity and market share. In the South Asian context, human capital constraints therefore often turn out to be the most important constraint to digital competitiveness. Nepal, despite improving and taking forward strides to many initiatives like Digital Nepal Framework, ICT education reforms, etc. is still facing the absence of mid-level AI professionals and digital strategists. However, AI adoption is not a simple technology; rather it is an organizational transformation which involves cultural and structural adaptation (Ghosh & Sen, 2023). SMEs that encourage continual learning, experimentation and collaboration across disciplines stand to benefit more from the process of turning AI technologies into true competitive advantages.

AI and operational efficiency

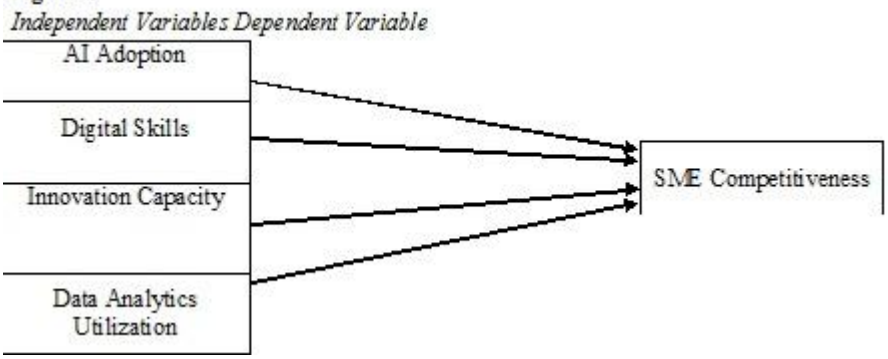
Operational efficiency which can be minimizing in terms of productivity and saving is the most direct benefit of adopting AI (Agrawal et al., 2018). AI powered process automation, demand forecasting and supply chain optimization to help SMEs to be more agile to fluctuations in the market and reduce the costs of operations. In the field of retail and manufacturing industries artificial intelligence based on inventory and logistical aspects prevents stock-outs and overproduction and optimizes utilization of capital. In Nepal the use of digital payment systems, i.e. Fonepay, Khalti has shown the potential of AI-based fraud detection algorithms to nurture transaction efficiency for consumers and trust of digital systems indirectly to help SMEs to be competitive. (Subedi and Shrestha, 2023). Rural and Semi-Urban parts of Nepal are facing the issue of internet

connectivity and the electricity supply is not constant which restricts SMEs from using cloud-based or real-time analytics solutions (Adhikari & Molla, 2024).

Conceptual framework and hypotheses

The conceptual framework shows four independent variables, namely AI adoption, digital skills, innovation capability and data analytics utilization, influencing the dependent variable of SME competitiveness (measured as productivity, profitability and market growth)..

Figure 1



Based on the framework following hypotheses have been drawn:

H1: AI adoption has a positive impact on the competitiveness of SMEs.

H2: Digital skills have a considerable the impact of AI adoption on competitiveness

H3: Innovation capability positively influences SMEs competitiveness.

H4: Data analytics utilization positively influences SME competitiveness.

This conceptual framework forms the basis for empirical analysis in the following sections where quantitative methods are used to discuss the strength and direction of these relationships based on firm-level data of the emerging digital economy in Nepal.

Research Methodology

The research design applied in this study is descriptive and causal because it was study the effects of adoption and associated digital capabilities of Artificial Intelligence on the competitiveness of Small and Medium Enterprises in the emerging digital economy of Nepal. The study aims to obtain empirical correlations among AI adoption (independent variable) and the competitiveness of the SME (dependent variable) through the mediation of digital skills, innovativeness competency, and the use of data analytics. The design was able to identify correlation patterns as well as establish causal relationship through statistical analysis. The research combines both the quantitative

primary data collection and inference analysis, which is a regression, to support the developed conceptual framework.

The sample size includes the SMEs that are registered formally with the ministry of industry, commerce, and supplies and which are located in major commercial centers like Kathmandu, Lalitpur, Pokhara, Biratnagar, Birgunj and Dhangadhi and Butwal. These companies are the representatives of various industries such as retail, manufacturing, hospitality, and ICT services which indicate the heterogeneous structure of Nepalese SME. The sample size of 425 respondents consisting of the owners, managers and IT officers was calculated by Cochran formula of finite populations, which guaranteed statistical reliability with 95% of confidence. The convenience sample was used, and the proportion of urban and semi-urban clusters were represented in order to include the differences in levels of digital maturity and AI adoption.

The primary data were gathered in a structured questionnaire that was given out electronically in Google Forms (January to March 2025). The questionnaire was developed in five parts that included demographic details, AI usage habits, digital skills test, innovation potential tests, and business competitiveness tests. The rating of each construct was done on a 5-point Likert scale where 1 (Strongly Disagree) was the lowest value and 5 (Strongly Agree) was the highest value. Prior to the full-scale introduction of the instrument, it was pre-tested on 30 SME managers to guarantee the clarity, relevance, and reliability of the instrument.

Cronbach alpha was calculated on all the variables to check internal consistency and construct validity whereby an overall coefficient of reliability of 0.927 was obtained which is an excellent coefficient of internal reliability (Chin, 1998).

The measure of AI Adoption was based on indicators adjusted to Nwankpa and Roumani (2016) and Chu et al. (2019) and included the degree of adoption of AI tools, like chatbots, predictive analytics, and automation systems, into business processes.

The scale used to measure Digital Skills was composed of indicators suggested by the European Commission and indicated the level of technical skills, data literacy, and leadership with digital skills. Innovation Capability was measured according to the capability of the firm to produce new products, new technology and new markets adapted by Cohen and Levinthal (1990).

Data Analytics Utilization was adjusted to the use of both structured and unstructured data in decision-making, marketing, and optimization of operations, but

adjusted to the study by Agrawal et al. (2018). Competitiveness of SMEs was assessed using composite indicators that indicate the improvement in productivity, market expansion, increase in revenues and cost efficiency (Barney, 1991).

The SPSS version 26 was used to conduct the data analysis. The respondent characteristics and distributions of the variables were summarized with the help of descriptive statistics, such as mean, standard deviation, and frequency distribution. Pearson correlation and multiple regressions were used as inferential analysis to test the proposed hypothesis.

The specification of the model is:

$$\mathbf{SC} = \beta_0 + \beta_1 \mathbf{AI} + \beta_2 \mathbf{DS} + \beta_3 \mathbf{IC} + \beta_4 \mathbf{DA} + \mathbf{e}$$

Where: **SC** = SME Competitiveness; **AI** = AI Adoption, **DS** = Digital Skills, **IC** = Innovation Capability, **DA** = Data Analytics Utilization, β_0 = Constant, $\beta_1 - \beta_4$ = Regression Coefficients, **e** = Error Term

The dependent variable (SME Competitiveness) shows the performance outcomes of the firm as a whole based on the operational and strategic advancements that are provided by AI. The independent variables are AI adoption (the level of AI system implementation), digital skills (competency and digital literacy of the employees and managers) and innovation capability (the organizational capability to innovate with the help of AI) as well as data analytics usage (use of AI-generated insights to make business decisions).The tests of hypotheses were conducted at 5 percent of significance ($p < 0.05$). Diagnostic tests on multicollinearity, normality and heteroskedasticity were conducted in order to ascertain the robustness of the model. All independent variables had a VIF value below 2.0 suggesting that there was no multicollinearity. The homoscedasticity was checked with the residual analysis, and the fact that the Durbin Waton value (1.93) was less than one proved that the errors were independent.

Table 1

Multicollinearity Diagnostics (VIF and Tolerance)

Predictor Variable	Tolerance	VIF	Interpretation
AI Adoption	0.62	1.61	No multicollinearity
Digital Skills	0.58	1.72	No multicollinearity
Innovation Capability	0.64	1.56	No multicollinearity
Data Analytics Utilization	0.67	1.49	No multicollinearity

All Variance Inflation Factor (VIF) values for the multicollinearity diagnostics were below the conservative value of 2.0 (range 1.49 to 1.72). Likewise, tolerance values for all of the predictors were greater than 0.10. The results indicate that there is no multicollinearity issue in the regression model, and that AI adoption, digital skills, innovation capability and data analytics utilization are statistically independent constructs which contribute uniquely to SME competitiveness in Nepal.

The survey design was such that gender, age, and sectoral diversity were among the respondents. Among the 425 respondents, 59.8% were males and 40.2% were females, which was representative of trending female entrepreneurship in the digital economy. Most (45.2 % of them were between 31 and 40 years old, indicating that the younger and tech-savvy entrepreneurs were leading on the SME digital transformation in Nepal. The education level was also high as 54.4 percent of them had undergraduate or graduate degrees, which is a key indicator of the increasing role of human capital in technology adoption. In the sector-wise, 38.6 belonged to retail and e-commerce, 25.9 to manufacturing, 20.7 to hospitality and 14.8 to the ICT services. The approach offers a strict empirical basis of the role of AI in determining the competitiveness of SMEs in Nepal digital economy.

Results and Discussion

The age composition of the SME respondents demonstrates significant trends in the behavior of AI adoption. The percentage of male entrepreneurs (59.8 percent) is higher than that of female (40.2 percent) respondents, which shows that there is a growing yet inequality in the gender involvement in technologically motivated businesses. Most of the participants are between the age of 31 and 40 (45.2 percent), which indicates that the adoption of AI is mostly motivated by fairly young and economically active entrepreneurs who are more open to digital innovation.

Regarding the educational attainment, more than half of the respondents (50.4 percent) hold graduate-level and above qualifications, which indicates a high human capital base that makes it easy to support the awareness of AI and its adoption. The retail and e-commerce SMEs are the first in sectoral distribution, followed by manufacturing and hospitality industries, which means that market competition and customer interactions are the forces that facilitate the utilization of technology. Interestingly, 62.1 percent of SMEs have implemented the use of AI-based tools, which indicates that the

SMEs in Nepal are increasingly becoming more digital but a very high number is still digitally bound.

Table 2

Demographic Characteristics of Respondents

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	254	59.8
	Female	171	40.2
Age Group	25–30 years	96	22.6
	31–40 years	192	45.2
	41–50 years	91	21.4
	Above 50 years	46	10.8
Education Level	School Level	88	20.7
	Undergraduate	123	28.9
	Graduate & Above	214	50.4
Business Sector	Retail & E-commerce	164	38.6
	Manufacturing	110	25.9
	Hospitality	88	207
	ICT Services	63	14.8
AI Adoption Status	AI Adopted	264	62.1
	Not Adopted	161	37.9

AI Adoption patterns

The descriptive statistics shows that the Nepalese SMEs have started to adopt AI in customer relationship management, marketing analytics, and financial forecasting as the main use areas. The average AI adoption (M = 3.98, SD = 0.74) indicates that there is moderate implementation within firms. The biggest penetration rates were noted with e-commerce where SMEs apply chatbots, recommendation systems, automated customer service platforms. The trend in manufacturing companies showed the new application of machine learning-based demand forecasting (M = 3.81) and the use of AI in personalized marketing by hospitality businesses (M = 3.76) increasingly. Conversely, the use of AI was less in the traditional retail companies (M = 3.21), with the issues of cost barriers

and insufficient technical knowledge believed to be key inhibitors. The results are consistent with the research on the region, where it has been observed that the diffusion of AI is sectoral, with knowledge-intensive industries being the first to adopt AI (Rana and Sinha, 2022).

Table 3

AI Adoption Patterns

AI Application Area	Mean	Std. Deviation
Customer service chatbots	4.12	0.71
Prospective sales forecasting	3.81	0.76
Automated inventory management	3.76	0.78
AI-based marketing analytics	3.94	0.69
Basic digital tools with limited AI use	3.21	0.82
Overall AI Adoption Index	3.98	0.74

Digital skills and human capital development

The results of the survey show that digital skills have a significant impact on the final results of adoption of AI and competitiveness. Respondents demonstrated a mean digital skills score M = 4.12 (SD = 0.68) which demonstrate a high level of awareness of digital tools, but average level technical skills. SMEs that have digitally trained employees said that they found better integration of AI in business processes and better performance outcomes. Firms that invested in continuous digital up skilling programs displayed an increased in operational efficiency (M = 4.25) and an increased in adaptability to new technologies. On the other side, companies who did not have any organized efforts in training encountered difficulties in getting their AI systems to integrate successfully (M=3.49). These results back up evidence in the past that digital human capital is an important enabler of technological competitiveness (European Commission, 2022; Ghosh & Sen, 2023).

Table 4

Digital Skills and Human Capital Development (N = 425)

Digital Skill Dimension	Mean	Std. Deviation
Basic digital literacy	4.12	0.68
AI tool usage capability	3.74	0.81
Data interpretation skills	4.25	0.65
Digital leadership & strategy	4.08	0.72
Employee digital training programs	3.49	0.84
Digital Skills Index	4.12	0.68

Innovation capability and data analytics utilization

Innovation capability was a major mediating factor between adoption of AI and competitiveness. The average score of innovation capability (M = 3.87, SD = 0.71) indicates that most of the SMEs have a moderate capacity to innovate which is only incremental improvement of products and services and not in a radical manner. Firms that were able to innovate based on their performance measure had a more favorable performance, particularly in their ability to expand into the market (M = 4.08) and customer satisfaction (M = 3.94). Data analytics utilization showed mean score equals to M = 3.79 (SD = 0.73) show increasing utilization of data for marketing, inventory control and strategic decisions. However, in smaller enterprises there is still a high degree of reliance on management approaches based on an intuitive approach due to lack of access to data infrastructure. This is representing a persistent information asymmetry in the digital space with companies who have access to advanced analytics capabilities able to benefit from competitive advantages over firms with low levels of digital maturity (World Bank, 2024).

Table 5

Innovation Capability and Data Analytics Utilization (N = 425)

Variable	Mean	Std.Deviation
New product/service development	3.87	0.71
Adoption of new digital technologies	3.92	0.74
Process innovation	4.08	0.67
Use of customer data for decisions	3.94	0.70
Use of analytics for cost optimization	3.79	0.73
Intuition-based decision making (small firms)	3.31	0.85
Innovation & Analytics Index	3.75	0.66

Correlation analysis

The correlation matrix shows significant positive correlations between all of the independent variables (AI adoption, digital skills, innovation capability, data analytics utilization) and SME competitiveness. The highest positive correlation was found between AI adoption and SME competitiveness ($r = 0.742$, $p < 0.01$) followed by digital skills ($r = 0.691$, $p < 0.01$), innovation capability ($r = 0.648$, $p < 0.01$) and data analytics utilization ($r = 0.614$, $p < 0.01$). These results attest that the adoption of AI is very much interlinked with complementary functionalities that together contribute to firm competitiveness.

Table 6

Correlation Matrix

Variables	AI Adoption	Digital Skills	Innovation Capability	Data Analytics	SME Competitiveness
AI Adoption	1				
Digital Skills	.684**	1			
Innovation Capability	.659**	.621**	1		
Data Analytics	.598**	.562**	.534**	1	
SME Competitiveness	.742**	.691**	.648**	.614**	1

N = 425 for all variables. ***Correlation is significant at the 0.01 level (2-tailed).*

The positive correlations suggest the firms in which AI and complementary digital practices are integrated have a better competitiveness than those that do not use them, which confirms the theoretical expectations from the resource-based view (Barney, 1991) and innovation diffusion theory (Rogers, 2003).

Regression analysis

The multiple regression models examined the combined effect of AI adoption, digital skills, innovation capability and data analytics utilization on the SMEs competitiveness. The model derived a high value of coefficient of determination (R2 = 0.812), which shows that 81.2 percent of the variance in the SME competitiveness is explained by the four independent variables. The result of the F-statistic ($F = 447.82$, $p < 0.001$) indicates the overall significance of the model.

Table 7

Regression Coefficients

Predictor	B	Std. Error	Beta	t	Sig.
(Constant)	1.176	0.138		8.518	0.000
AI Adoption	2.324	0.128	1.192*	18.145	0.000
Digital Skills	1.872	0.116	0.986	16.176	0.000
Innovation Capability	1.546	0.121	0.812	13.251	0.000
Data Analytics Utilization	1.215	0.127	0.648	9.874	0.000

Dependent Variable: SME Competitiveness$R^2 = 0.812$; Adjusted $R^2 = 0.810$; $F = 447.82$, $p < 0.001$

*Note**= The standardized beta coefficient for the predictor AI adoption was over one ($\beta = 1.192$), which could be due to suppression effects from common variance of predictors that can be considered closely related, such as digital skills and innovation capability.

However, the diagnostics of multicollinearity indicated VIF values that were less than 2.0 so the model was not seriously multicollinearity. Thus, the coefficient is not due to statistical fluctuation, but to a high rate of relative contribution from AI adoption.

The results show that all of the predictors have a significant contribution to SME competitiveness. The adoption of AI has the highest effect (B = 2.324, beta = 1.192, p less than 0.01), followed by digital skills (B = 1.872, beta = 0.986, p less than 0.01), innovation capability (B = 1.546, beta = 0.812, p less than 0.01), and data analytics utilization (B = 1.215, beta = 0.648, p less than 0.0 The high standardized beta values show the adoption of AI and digital skills serve as the key drivers of competitiveness.

Discussion

The results show that the adoptions of AI have a significant positive impact onthe competitiveness of SMEs through efficiency of operations, innovation and making data-based decisions. These findings are consistent with international evidence showing that firms that adopt AI are more productive, profitable and responsive to changes in the market than firms that do not adopt AI (Brynjolfsson & McAfee, 2017; Bughin et al., 2018). The powerful influence of adoption of AI attests to the transformative potential of digital technologies to overcome structural boundaries to SME growth in developing economies. Digital skills came in second to give credence to the idea that human capital development is critical to appropriate use of AI. This finding gives some credence to the resource-based view of the firm (Barney,1991) as it highlights that the competitive advantage is achieved based on possession of unique and inimitable resources such as digital expertise and knowledge assets (Barney, 1991). Similarly, innovation capability mediates the relationship between adoption of AI and competitiveness which makes us suggest that the firms with capabilities to make AI technologies in product and services innovative are able to perform better in the market. Data analytics use also increases the competitiveness through the improved strategic planning, customer understanding and risk management process, etc. Result also indicates a widening "AI capability divide" in Nepal's SME ecosystem.

Hypothesis testing summary

All the four hypotheses are supported with the empirical evidence: H1 Supported: AI adoption has a positively effect on SME competitiveness ($\beta = 2.324$, $p < 0.01$); H2 Supported: Digital skills increase the effect of AI on competitiveness ($\beta = 1.872$, $p < 0.01$); H3 Supported: The innovation capability of SMEs is one of the most positive

factors affecting a SME's competitiveness. ($\beta = 1.546$, $p < 0.01$); H4 Supported: The use of data analytics has a positive impact on SME competitiveness ($\beta = 1.215$, $p < 0.01$).

Strategic implications and policy recommendations

The results of this paper highlight that the adoption of Artificial Intelligence (AI) offers great potential to the competitiveness of Small and Medium Enterprises (SMEs) in the developing digital economy in Nepal. Nevertheless, inclusive technological change can only be attained through concerted efforts on the part of the policymakers, financial institutions, and the private sector. The empirical analysis provides a number of strategic policy suggestions.

An integrated policy action is necessary on various fronts for the accelerated use of AI and empowering SMEs competitiveness in Nepal. Firstly, an AI-ready ecosystem needed to be established by implementing the Digital Nepal Framework and ICT Policy 2023 through investments in cloud computing infrastructure, national data centers, and regional innovation hubs with public–private partnerships. Secondly, it is important to establish dedicated financial instruments like credit lines with low interest rates and refinance facilities via NRB to remove financial hurdles to the use of AI technologies by SMEs. Third, there is a need to bolster human capital development by incorporating AI skills in national education and vocational training systems, providing subsidised training courses and certifications for SME owners/managers, particularly in low-skilled areas. Fourth, data should be made accessible and affordable by incentivising innovation via tax breaks, research and development grants, start-up support and open-access data platforms, to make business intelligence accessible to everyone. Fifth, infrastructure and connectivity should be enhanced with more widespread use of broadband, 5G and low cost AI-driven SaaS (Software as a Service) solutions to support inclusive digital transformation from urban and rural SME clusters. Finally, the need to coordinate between institutions is strong, recognized by the formation of a national AI council, which brings together the government, academia, industry and financial institutions to enable the adoption of AI in an ethical way, ensuring data protection, gender-inclusive growth and efficient international collaboration for knowledge sharing and capacity building.

Limitations and future research directions

Although this research presents an original empirical evidence of AI and SME competitiveness in Nepal, there are a number of limitations that should be mentioned. To

begin with, the research is conducted among SMEs that are located in large cities, which might not effectively reflect the rural and microenterprise trends where the infrastructure issues are more dramatic.

Second, cross-sectional design does not allow one to study long-term causality and time dynamics of adoption of AI. Through such studies, the SMEs could be tracked down to their point of adoption and on the way to maturity, uncovering the key success factors and the pitfalls that are common.

Third, the study is based on mostly self-reported data, which is prone to respondent bias and social desirability bias. The study must be more objective, such as objective performance measures, such as audited revenue growth, market share information, or productivity measures, in the future. Surveys data and financial records would be used, which would result in a more profound impact of AI on the business outcomes.

Fourth, the convenience sampling technique, although useful, can restrict the ability to generalize the results to the whole SME population in the context of the diversified geographical and sectoral Nepal. The future research would benefit by adopting the probability sampling to increase representativeness and enable greater confidence in the generalization of the findings.

There are some directions that future research can take. First, the industry-specific aspects of AI application, especially concerning the agricultural sector, tourism, and logistics, where the process of digital transformation is particularly challenging should be the subject of special research.

Second, a comparative analysis of Nepal with other economies in South Asia would shed light on regional best practices in digital competitiveness of SMEs as well as cross-cultural habits of adoption. It might be beneficial to study the experience of other countries such as Bangladesh, Sri Lanka and Pakistan in terms of SME digitalization as it may be valuable policy-wise.

Third, case studies and in-depth interviews with the leaders of SMEs are qualitative methods that can help to reveal more of the insights into managerial perceptions, adoption barriers, and implementation strategies that are not fully described under the quantitative methods.

Finally, theoretical knowledge and practical implications can be enhanced through research on the moderating effects of the organizational culture, leadership styles, and

external environmental factors to the relationship between AI and competitiveness. The effects of the use of AI on the employment patterns, wage distribution, and skills in SMEs on the labor market and education policies may also be studied.

Conclusion

This paper presents strong empirical evidence that Nepal is experiencing a transforming digital economy that the adoption of Artificial Intelligence with the help of digital skills, innovation capacity, and data analytics usage can significantly improve the competitiveness of SMEs.The multiple regression analysis shows that AI implementation has the most significant positive impact on competitiveness ($\beta = 2.324$, $p < 0.01$), then, there are digital skills ($\beta = 1.872$, $p < 0.01$), innovation capability ($\beta = 1.546$, $p < 0.01$), and the use of data analytics ($\beta = 1.215$, $p < 0.01$). These findings collectively demonstrate that AI represents not merely a technological upgrade but a strategic asset that fundamentally transforms how firms operate, innovate, and compete in contemporary markets.

The research shows that 62.1 percent of surveyed SMEs have implemented some sort of AI technology, which points to increasing digital maturity in Nepal's business environment. But adoption patterns remain lopsided by both sector and by region with e-commerce and manufacturing based ventures at the forefront with traditional retail and rural based ventures trailing far behind. This digital gap shows signs of the ever-present structural issues like insufficient infrastructure, insufficient access to finance, deficiency of technical skills and institutional support systems. The positive correlation with adoption of AI and amount of competitiveness measuring in terms of productivity improvement, market expansion and financial performance gives an additional proof of the potential of AI to revolutionize Nepal's SME sector.

The private sector, government agencies, educational institutions and development partners need to work together to provide an enabling environment where adoption of AI can be accessible and beneficial to SMEs, big and small, in all locations. As AI technologies continue to advance and grow more complex, it is likely that the divide between technology-enabled and traditional enterprises will grow wider.

The evaluation of empirical evidence presented in this paper should provide basis for evidence based policy making, strategic business planning and further scholarly work into the cross-cutting issues of technology and development in emerging economies.

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