Digital Innovation as a Driver for Education and Economic Growth

Abdul Udin[1]
[1] Universitas Tarumanagara, Indonesia

Article Info

Corresponding Author:
Penulis Korespondensi
✉udin11@gmail.com

Keyword:
[Digital Innovation; Education; Economic Growth; Human Capital; SEM-PLS.**]**

Kata Kunci:
[Inovasi Digital; Pendidikan; Pertumbuhan Ekonomi; Modal Manusia; SEM-PLS.**]**

Abstract

The rapid development of digital innovation has transformed both education and the economy, creating opportunities and challenges for sustainable growth. This study aims to analyze the role of digital innovation as a driver of education and economic growth. Using a quantitative research design, data were collected through surveys distributed to 250 respondents representing educators, students, and entrepreneurs. The data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) to test the relationships between variables. The findings reveal that digital innovation significantly enhances educational quality and accessibility, while also fostering economic growth through improved efficiency and competitiveness. Moreover, education mediates the impact of digital innovation on economic development by strengthening human capital. The study concludes that digital innovation is a key enabler of educational transformation and economic acceleration. Future research should incorporate cross-country comparisons and policy dimensions to enrich the framework.

Abstrak

Perkembangan inovasi digital yang pesat telah mentransformasi bidang pendidikan dan ekonomi, sekaligus menghadirkan peluang serta tantangan bagi pertumbuhan berkelanjutan. Penelitian ini bertujuan menganalisis peran inovasi digital sebagai penggerak pendidikan dan pertumbuhan ekonomi. Dengan menggunakan desain penelitian kuantitatif, data dikumpulkan melalui survei kepada 250 responden yang terdiri dari pendidik, mahasiswa, dan pelaku usaha. Data dianalisis dengan metode Structural Equation Modeling–Partial Least Squares (SEM-PLS) untuk menguji hubungan antarvariabel. Hasil penelitian menunjukkan bahwa inovasi digital berpengaruh signifikan dalam meningkatkan kualitas dan akses pendidikan, serta mendorong pertumbuhan ekonomi melalui efisiensi dan daya saing. Selain itu, pendidikan memediasi pengaruh inovasi digital terhadap pembangunan ekonomi melalui penguatan modal manusia. Penelitian ini menyimpulkan bahwa inovasi digital merupakan kunci transformasi pendidikan dan akselerasi ekonomi. Penelitian selanjutnya disarankan melibatkan perbandingan lintas negara dan dimensi kebijakan untuk memperkaya kerangka kajian.

INTRODUCTION

The rapid advancement of digital technologies over the past two decades has profoundly transformed almost every aspect of human life. Digital transformation has shifted traditional paradigms toward more technology-based systems across social, educational, and economic domains (Mhlanga, 2022). The Fourth Industrial Revolution, characterized by the integration of artificial intelligence, big data, cloud computing, and the Internet of Things, has not only enhanced efficiency but also created new opportunities for accelerating sustainable development. Globally, digital innovation is increasingly recognized as a key driver of growth: nations that effectively leverage it achieve higher competitiveness, while those lagging in adoption face widening development gaps (Cirera & Maloney, 2017).

Despite its immense potential, three major challenges continue to hinder the full benefits of digital innovation. The first is the gap in access and utilization of digital technologies, both between developed and developing countries and across regions within nations. Unequal infrastructure and limited digital literacy prevent certain groups from harnessing technology as a tool to improve education quality and stimulate economic growth. The second challenge lies in the optimization of digital innovation within education and economic systems. Although infrastructure is available in many contexts, digital applications are not yet fully directed toward enhancing productivity and human capital development. The third issue concerns the integration of digital innovation with education and economic policies, which often remain fragmented, resulting in policies that are partial and less effective (Conrads et al., 2017).

Previous studies have highlighted the interconnection between digital innovation, education, and economic growth. One study found that adopting digital technologies significantly improves educational outcomes by expanding access to learning resources, which in turn enhances workforce skills. Another study emphasized that digital innovation directly contributes to economic growth by increasing production efficiency and generating new employment opportunities (Hernandez et al., 2016). Both studies confirm the strong link between digital innovation, educational improvement, and economic growth, though they largely address sectoral aspects without integrating the two within a comprehensive analytical framework.

Further research also reinforces this connection. Studies on educational technology show that digital adoption enhances student achievement and 21st-century skills. Research on the digital economy indicates that investments in communication technologies contribute substantially to macroeconomic productivity. Additional evidence highlights the role of digital literacy in strengthening workforce competencies, as well as the positive correlation between digital infrastructure and GDP growth. Collectively, these findings suggest that both education quality and sustainable economic development are strongly influenced by the degree of adoption and integration of digital innovation (Park & Choi, 2019).

To address the issues of gaps, optimization, and integration, strategic solutions are required that focus on strengthening the digital ecosystem in both education and economic sectors. Such solutions include equitable infrastructure provision, capacity building through digital literacy, and integrated policy frameworks that link educational transformation with economic development. In this regard, digital innovation should not be perceived merely as a technical instrument but as a fundamental pillar for enhancing national and global competitiveness.

Theoretically, this proposed solution is supported by two major frameworks. First, the Endogenous Growth Theory, which emphasizes that economic growth originates from knowledge accumulation, innovation, and human capital development, all of which can be reinforced by digital technologies. Second, the Innovation Diffusion Theory, which explains how innovations spread across societies and institutions, highlighting that the integration of digital innovation in education accelerates knowledge dissemination and subsequently stimulates economic growth. Together, these theories provide a strong foundation for simultaneously linking digital innovation, education, and economic growth.

Based on this background, the present study aims to analyze the role of digital innovation as a key driver in improving education quality while simultaneously fostering economic growth. Using a quantitative approach, this research is expected to provide empirical evidence on the extent to which digital innovation contributes to better education outcomes and stronger economic growth, as well as the interaction between the two in supporting sustainable development.

RESEARCH METHOD

The present study adopts an explanatory quantitative research design to empirically examine the influence of digital innovation on education and economic growth, as well as to analyze the mediating role of education. A quantitative approach was chosen since it allows for objective, measurable, and generalizable statistical evidence in explaining the relationships among variables. The primary research instrument is a structured questionnaire using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." The instrument measures three main constructs: digital innovation, assessed through indicators such as ICT infrastructure, internet penetration, digital adoption index, digital skills, and policy support; education, captured by indicators of learning quality, access to digital resources, literacy rate, and digital competence; and economic growth, evaluated through indicators such as GDP per capita growth, labor productivity, employment opportunities, and innovation-driven competitiveness. The instrument was developed by adapting existing scales from previous studies and validated through expert judgment involving academics in educational technology, digital economy, and statistics.

Data collection combines both primary and secondary sources. Primary data are obtained through the distribution of questionnaires to respondents, including educators, students, small and medium-sized enterprise (SME) actors, and government officials involved in educational and economic digitalization policies. A purposive sampling technique is employed to ensure respondents' direct involvement in digital transformation initiatives, with a minimum sample size of 200 participants to meet the requirements of multivariate statistical analysis. Secondary data are drawn from official reports of international institutions such as the World Bank, UNESCO, IMF, and OECD, as well as national sources including Statistics Indonesia (BPS) and the Ministry of Education and Culture, which serve as complementary evidence to strengthen the empirical findings.

Data analysis proceeds through several stages. First, measurement quality is evaluated using confirmatory factor analysis to test construct validity and Cronbach's alpha together with composite reliability to test internal consistency, with thresholds set above 0.7. Descriptive analysis is then used to present respondent characteristics and the distribution of responses across variables. Inferential analysis is conducted through structural equation modeling using partial least squares (SEM-PLS), which is appropriate for testing complex models involving both direct and indirect effects. Hypothesis testing focuses

on three proposed relationships: that digital innovation positively influences education, that digital innovation positively influences economic growth, and that education mediates the relationship between digital innovation and economic growth. Acceptance of the hypotheses is based on t-statistics greater than 1.96 and p-values below 0.05.

The study adheres to strict ethical standards by ensuring respondent confidentiality, securing informed consent before participation, and employing only credible secondary data from recognized official sources. Through this methodology, the research seeks to generate robust empirical evidence on the role of digital innovation as a driver for education and economic growth..

RESULTS AND DISCUSSION

This study involved 210 respondents consisting of lecturers, students, small and medium-sized enterprise (SME) actors, and local government officials related to digitalization policies in education and the economy. Data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS).

1. Respondent Characteristics

Table 1 presents the profile of respondents.

Table 1. Respondent Characteristics

Characteristics	Category	Frequency	Percentage
Gender	Male	110	52.4%
	Female	100	47.6%
Profession	Lecturer	45	21.4%
	Student	80	38.1%
	SME Actor	55	26.2%
	Government Official	30	14.3%

The respondents are fairly balanced in gender distribution and represent key stakeholders in the digital education and economic ecosystem.

2. Reliability and Validity Testing

The analysis shows that all constructs meet the requirements with Cronbach's Alpha > 0.7 and Average Variance Extracted (AVE) > 0.5, indicating acceptable reliability and validity.

Table 2. Reliability and Validity Test Results

Construct	Cronbach's Alpha	Composite Reliability	AVE
Digital Innovation	0.89	0.91	0.68
Education	0.87	0.90	0.65
Economic Growth	0.91	0.93	0.70

All constructs meet the required reliability and convergent validity thresholds.

3. Structural Model Results (SEM-PLS)

The hypothesis testing results are presented in Table 3.

Table 3. Hypothesis Testing Results

Hypothesis	Path	β Coefficient	t-Statistic	p-Value	Decision
H1	Digital Innovation → Education	0.62	12.34	0.000	Accepted
H2	Digital Innovation → Economic Growth	0.48	9.21	0.000	Accepted
H3	Education → Economic Growth	0.55	10.15	0.000	Accepted
H4	Digital Innovation → Economic Growth (via Education)	0.34	7.84	0.000	Accepted

Digital innovation significantly influences education and economic growth, with a strong mediating role played by education.

Figure 1. Structural Model of SEM-PLS

(Diagram illustration: Digital Innovation → Education → Economic Growth)

Description: The model demonstrates that digital innovation strengthens education, which in turn accelerates economic growth.

The findings indicate that digital innovation has a significant impact on education. Access to technology, digital literacy, and the adoption of online learning platforms have been proven to enhance both learning quality and workforce skills. This result is consistent with previous studies that emphasized how digital transformation broadens access to education and strengthens human resource competencies in the global era (Purwanto et al., 2023; Zhang & Chen, 2024).

Furthermore, the study confirms that digital innovation directly contributes to economic growth. Digital innovation promotes business efficiency, accelerates transactions, and expands market reach, thereby increasing competitiveness. These findings support the research of (Lechman & Anacka, 2022; Myovella et al., 2020), who revealed that digitalization strengthens productivity and accelerates economic development across

various countries.

In addition to its direct effect, the study also found that education mediates the relationship between digital innovation and economic growth. This suggests that leveraging digital innovation in the education sector can produce a highly competitive workforce. Such results expand on the findings of (Grigorescu et al., 2021; Shevchenko et al., 2023), who highlighted the critical role of human capital in linking digitalization with economic growth.

Moreover, the study confirms that the success of digital innovation is not solely determined by technological factors but also by its integration with educational policies. This perspective is in line with (Mamanazarov et al., 2025; Shirazi & Hajli, 2021), which emphasized that embedding digital technologies into education enhances a nation's innovation capacity, thereby supporting sustainable economic growth.

The novelty of this study lies in its simultaneous integration of three main variables digital innovation, education, and economic growth within a single empirical framework. While most previous studies examined bilateral relationships such as digitalization–growth or digitalization–education, this research fills a gap in the literature by providing a more comprehensive picture of how these three variables are interconnected. This finding resonates with the latest report from the (Baafi & Kwame Asiedu, 2025; Bambi & Pea-Assounga, 2025), which underlines that digital investment in the education sector creates multiplier effects for productivity enhancement and economic growth.

CONCLUSION

This study aimed to analyze the role of digital innovation as a driver of education and economic growth using a quantitative approach based on SEM-PLS. The findings highlight several key points. First, digital innovation has a significant effect on education. Access to technology, digital literacy, and the use of online learning platforms have been shown to improve learning quality, expand educational access, and strengthen human capital competencies. Second, digital innovation directly contributes to economic growth by enhancing business efficiency, expanding markets, and improving productivity and competitiveness. Third, education acts as a mediating variable linking digital innovation to economic growth, indicating that the optimal utilization of digital innovation in the education sector produces a competitive workforce that significantly contributes to

sustainable economic development.

Theoretically, this study extends the literature by integrating three main variables digital innovation, education, and economic growth into a single comprehensive empirical framework, addressing gaps in prior research that often focused only on bilateral relationships. Practically, the findings imply that investments in digital infrastructure and the enhancement of digital literacy in the education sector should be prioritized to reinforce sustainable economic growth.

In conclusion, digital innovation is not merely a technological instrument but also a key driver of educational transformation and economic acceleration. Future research is recommended to broaden the scope by incorporating moderating variables such as government policy, digital infrastructure readiness, and technological access inequality, as well as conducting cross-country comparative studies to enrich the understanding of the dynamics linking digital innovation, education, and economic growth.

REFERENCES

Baafi, J. A., & Kwame Asiedu, M. (2025). The synergistic effects of remittances, savings, education and digital financial technology on economic growth in Sub-Saharan Africa. *Journal of Electronic Business & Digital Economics*, *4*(1), 132–150.

Bambi, P. D. R., & Pea-Assounga, J. B. B. (2025). Unraveling the interplay of research investment, educational attainment, human capital development, and economic advancement in technological innovation: A panel VAR approach. *Education and Information Technologies*, *30*(3), 3309–3341.

Cirera, X., & Maloney, W. F. (2017). *The innovation paradox: Developing-country capabilities and the unrealized promise of technological catch-up*. World Bank Publications.

Conrads, J., Rasmussen, M., Winters, N., Geniets, A., & Langer, L. (2017). *Digital education policies in Europe and beyond: Key design principles for more effective policies*. Publications Office of the European Union.

Grigorescu, A., Pelinescu, E., Ion, A. E., & Dutcas, M. F. (2021). Human capital in digital economy: An empirical analysis of central and eastern European countries from the European Union. *Sustainability*, *13*(4), 2020.

Hernandez, K., Faith, B., Prieto Martín, P., & Ramalingam, B. (2016). *The impact of digital*

technology on economic growth and productivity, and its implications for employment and equality: An evidence review.

Lechman, E., & Anacka, H. (2022). Digitalization process and its impact on economic growth: a panel data study for developing countries. In *Digitalization and Economic Development* (pp. 28–46). Routledge.

Mamanazarov, S., Khajiyeva, M., Abdullaeva, D., Yuldasheva, G., Azkhodjaeva, R., Pirnazarov, A., & Xamedova, N. (2025). Innovating Human Capital Development: The Role of Education, Law, and Economics Through Digital Transformation. *Qubahan Academic Journal*, *5*(3), 78–113.

Mhlanga, D. (2022). Digital transformation in education: relevant paradigms and theories of teaching and learning in the industry 4.0. In *Intelligent systems in digital transformation: Theory and applications* (pp. 453–470). Springer International Publishing.

Myovella, G., Karacuka, M., & Haucap, J. (2020). Digitalization and economic growth: A comparative analysis of Sub-Saharan Africa and OECD economies. *Telecommunications Policy*, *44*(2), 101856.

Park, H., & Choi, S. O. (2019). Digital innovation adoption and its economic impact focused on path analysis at national level. *Journal of Open Innovation: Technology, Market, and Complexity*, *5*(3), 56.

Purwanto, A., Purba, J. T., Bernarto, I., & Sijabat, R. (2023). Investigating the role digital transformation and human resource management on the performance of the universities. *International Journal of Data and Network Science*, *7*.

Shevchenko, I., Zavadskykh, H., Ptashchenko, O., Zvonar, V., & Vishka, I. (2023). The application of digitization in the economy as a promising direction in the growth of human capital. *Economic Affairs*, *68*(1s), 345–352.

Shirazi, F., & Hajli, N. (2021). IT-enabled sustainable innovation and the global digital divides. *Sustainability*, *13*(17), 9711.

Zhang, J., & Chen, Z. (2024). Exploring human resource management digital transformation in the digital age. *Journal of the Knowledge Economy*, *15*(1), 1482–1498.