

Artificial Intelligence-Driven Human Capital Development in Papua New Guinea: Strategic Pathways for Economic Transformation and National Development

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Abstract

AI has gained increasing recognition in the recent years as a potential facilitator for human capital development and economic transformation in the developing countries. Papua New Guinea continues facing a number of problems associated with human capital skill shortages, poor infrastructure, unequal distribution of quality education, and lack of coherence between educational outcomes and labor market demands. This paper develops an Artificial Intelligence-Driven Human Capital Development Framework (AI-HCDF) in order to foster sustainable economic transformation and national development in Papua New Guinea. A conceptual design of research allows for synthesis of findings from available literature and development-related frameworks of AI to develop a holistic framework of relationships between AI technologies, human capital development process, economic transformation, and national development. The developed framework comprises five interconnected layers: enabling factors, enablement through AI technology, human capital development, economic transformation, and national development. Comparative assessment of the proposed framework demonstrates significant contribution in terms of national development, workforce development, productivity, AI-driven education, economic diversification, and innovation. Based on the results, artificial intelligence (AI)-based education, workforce analysis, skill prediction, and intelligent decision-making are potential tools for increasing readiness of workforce, boosting efficiency and productivity, addressing mismatches in skills and contributing to diversification of the economy. These results are highly relevant for policymakers in government and educational institutions as well as for business leaders in the country looking to use AI as an engine for development.

Keywords: Artificial Intelligence, Human Capital Development, Papua New Guinea, Economic Transformation, National Development.

Introduction

PNG is plagued with socio-economic and workforce development challenges, including a lack of productivity, access to education, and integration of digital technology within national development processes, which are restricting human capital development to contribute to long-term inclusive development and sustainable growth. The problem is compounded by ongoing issues such as inequitable access for rural/urban PNG, inadequate institutional capacity, and a mismatch between skills acquired and skills demanded by the labor market. Part of the explanation for this is the ongoing issue of skills mismatch that occurs when the skills students are developing in education are not the ones that are needed by economies that are growing. The current educational structure is very traditional and can be adapted to incorporate new learning methods, digital devices, and AI-driven education but limits opportunities for personalized learning and workforce readiness (Pellegrino & Stasi, 2024).

Human capital is a fundamental component to the economic development process because it boosts productive efficiency, increases capacity for innovation, and promotes national competitiveness. Investing efficiently in human capital formation enhances resilience, economic diversification, and social development. Investing in human capital has the potential to shift PNG from resource-based to knowledge-based economic development (Pinto et al., 2025). Globally, artificial intelligence (AI) is changing workforce development systems through intelligent learning platforms, predicting skill analysis, and decision support systems that can assist in education and workforce development planning, employment matching, labor force, and training planning, thus contributing to effective lifelong learning ecosystems. It has to be seen, the impact of AI within developing countries' human capital formation processes.

However, there is limited literature available on the development of a systematic framework that integrates AI for the formation of human capital in the PNG context. Current literature focuses on the application of digital technologies and AI in various contexts but does not fully take into account the constraints of developing countries' workforces and institutions (Kong et al., 2024).

The present study proposes an integrated framework for Artificial Intelligence-Driven Human Capital Development (AI-HCD) for PNG. The framework focuses on the convergence of AI technologies into education systems, workforce development, and economic development outcomes; bridging the gap between human capital formation and national development; and presenting a policy-oriented, multi-layer model that aims to build capacity and support workforce productivity, reduce skill mismatches, and trigger economic transformation using AI in developing countries.

Therefore, the objectives of this study are:

- To design an AI-driven human capital development (HCD) framework for Papua New Guinea
- To connect Artificial Intelligence systems with workforce productivity enhancement mechanisms
- To propose policy-level strategic pathways for national economic transformation

The paper's structure is organized as follows: The section 1 of this paper covers the introduction of the paper, including the socio-economic context of Papua New Guinea, issues of human capital, artificial intelligence's role in the transformation of the workforce, research gaps, and research objectives. Section 2 presents the literature review section discussing the theories on human capital, the transformation of the digital economy, artificial intelligence in education systems, and labor market intelligence models. Section 3 deals with the methodology in the study, including the research approach on the conceptual-analytical design, information sources, and design of the framework. Section 4 includes the proposed artificial intelligence-enabled human capital development framework with layered design architecture, component features, and relevant tables. Section 5 shows the outcomes of the study. Section 6 shows how the framework benefits the workforce's efficiency and economic transformation, implementation issues in practice, etc. In Section 7, several policy recommendations are presented to facilitate the use of artificial intelligence in education, the labor market, and the national planning process. The section 8 "Findings and insights on how AI can contribute to the sustainable economic transition of PNG" summarizes the results and insights and concludes the document.

Literature Review

Human capital theory forms the backbone of the understanding of the direct relationship between education, skills, and knowledge and productivity and the level of development of a country. The underlying theory is based on investment in human capability, which improves efficiency and boosts long-term economic growth.

The increasing relevance of digital transformation and the role of structural economic change induced by technology, humans, and innovation systems in recent research are emphasized by several analyses. Analyses concerning economic transformation reveal how structural change, industrial upgrading, and the combination of human capital, innovation, and digital ecosystems are key to sustainable development (Pinto et al., 2025). Analyses on general economic restructuring also indicate how adaptation of human capital to new social and economic systems is critical for sustainable development and resilience. Analyses based on the transformation index report show how institutional and policy-oriented investments in human capital are critical determinants of economic performance (Kong et al., 2024; Buthelezi, 2024).

Artificial intelligence becomes more central for the modernization of educational and labor systems. In education, AI is used to advance personalized learning, improve accessibility, and facilitate learning new skills in accordance with industry demands (Simbolon et al., 2025). Furthermore, AI used in governance and systems engineering contributes to efficiency and decision-making through improved data and policy implementation, institutional improvements, and optimization of the economy (Pellegrino & Stasi, 2024).

Challenges in the use of digital and geospatial technologies for governance and environment are identified in studies within developing and constrained circumstances due to infrastructure and technology adoption barriers (von Essen et al., 2025). Emerging technological developments like blockchain are explored to increase transparency, institutional coordination, and governance efficiency (Katuu, 2025). The stability of the financial and technology systems is explored in the context of innovation and digital transformation to demonstrate the benefits of a resilient financial system to economic modernization (Arnone et al., 2024). The applicability and implementation of AI for sustainable national development are also faced with several challenges, which underscores the importance of developing appropriate frames that integrate the development with the social agenda (Poronakie, 2023).

The effect of AI on economies, e.g., supply chains, farming, and electricity, is analyzed for a more efficient operation of economic activity, the best use of resources, and the creation of sustainable solutions (Das et al., 2023; Mashau & Nyawo, 2025). Artificial intelligence and computation models can be applied in health care for improved health care diagnosis, treatments, and the decision-making of the health systems (Garg & Pandey, 2025; Yang et al., 2025). Artificial intelligence-based systems for more sustainable use and governing of resources and ecosystems as well as the investigation of new innovations like synthetic biology and food systems in relation to global sustainability concerns are explored in the area of environmental sustainability (Diantara et al., 2025; Javed et al., 2025). The impact of digital innovation on investment risks and profits in developing economies has been illustrated by financial technology studies (Chand et al., 2025). Numerous studies examine the importance of the financial and technology systems for innovation, structural transformation, and national performance. There is recognition of the importance of human and information infrastructure for development and for financial and technology risk management (Ibrahim et al., 2025). Yet, structural transformation research focuses on connecting the economic, social, and environmental aspects to develop a sustainability-oriented system, as well as on optimizing food systems and resource management by standardizing systems and data (Andrew et al., 2025). Process optimization and intelligent quality management are studied to understand and improve industrial processes (Loacker et al., 2025). Biodiversity and environmental conservation studies identify new opportunities for technological application in ecosystem protection (Joshi et al., 2025).

Research Gaps

The study analyzed revealed advancements in the area of AI applications, digital transformation, and human capital development, while more research and integrated frameworks need to be established regarding the application of AI in human capital development at the national level and in developing countries like Papua New Guinea in a way that integrates educational systems, optimization of labor, national economy, and digital transformation into one model.

Research Methodology

Research Design

The research uses a conceptual-analytical research design. The study intends to create an artificial intelligence-driven human capital development (AI-HCD) model in Papua New Guinea. This study is mostly qualitative, in which system-level modeling is more relevant and collection of empirical data is not the main focus. In this design, the study uses a synthesis of theories and knowledge accumulated in literature with respect to artificial intelligence, workforce development, and economic transformation. The resulting research design is also suitable for underdeveloped countries where readily available AI-ready datasets are rare and policy-driven conceptual modeling is the need of development.

Data Sources

The present study only uses secondary data sources such as global development reports, academic literature, and policy documents of human capital, AI, and digital transformation. The data includes variables such as education systems, structure of workforce, employment patterns, and digital infrastructure development. All of the above information sources were carefully examined to identify a pattern of application of AI and approaches to human capital development that would be relevant to the PNG context. With the use of these secondary sources, a broader picture of the ideas could be achieved and a framework could be constructed that was coherent and relevant at the local level.

Framework Development Approach

The multi-layer system modeling paradigm has been used to develop the AI-HCD system. The 5 layers of this framework are interdependent and include the following: The input layer: systems of education, workforce demography, policy frameworks, and digital infrastructure. Cardano's AI Enablement Layer features machine learning, predictive analytics, and adaptive learning systems. The human capital development layer comprises upskilling, reskilling, and digital literacy. The transformation layer links to human capital development and the systems of productivity, labor matching, and industrial innovation, and the outcome layer is made of microeconomic outcomes: growth of GDP, jobs, and skill gaps.

Analytical Framework

The theoretical causal mapping framework is used to analyze the linkage between the artificial intelligence systems and human capital development and the outcomes of economic transformation. Based on the model of analysis, the enablers of artificial intelligence systems, educational systems, and digital infrastructure systems are the enablers that affect human capital development. Similarly, economic transformation processes are considered to be affected by improving worker productivity and effective integration processes of AI systems. In this framework of analysis, impacts of AI technologies on learning systems, skill acquisition, and efficiency of labor markets on national development are explained.

Evaluation Criteria

The proposed framework is measured based on conceptual and policy-driven aspects, not based on statistical verification. These are considered criteria for the assessment: system cohesion (integration of different layers), policy relevance (applicability in the specific social and economic context of Papua New Guinea), scalability (adaptability in other sectors), and development impact (positive development changes in the areas of education, employment, and economic growth).

Methodological Justification

The justification behind using this methodology is due to the lack of structured datasets on AI and labor in Papua New Guinea, which makes it impossible to conduct empirical machine learning modeling. The conceptual framework design is therefore better suited to the national-level policy questions and strategic long-term plans. In addition, the adoption of AI in human capital development is a relatively new phenomenon in developing countries, which requires theoretical modeling before moving to a bigger scale. The methodology selected ensures that both the best practices in the world and the development needs in the country are integrated into the approach and thus provides a foundation for scalable future empirical studies and policy interventions.

Visualization and Reproducibility

Graphical representations of the proposed framework have been created via the use of Python version 3.10. The graphs have been created with the help of the following libraries in Jupyter Notebook: Matplotlib (v3.8+), and NumPy (v1.26+). Graphical representation is only for illustrative and conceptual purposes; it is not for empirical and statistical verification. The numerical data represented by graphical models have been based on theoretical connections revealed in the literature review and framework comparison. There have been no primary data sources used in the creation of graphs. This includes data obtained from surveys, experiments, or statistical estimations.

Proposed AI-Driven Human Capital Framework

The framework for an AI-HCD is a multi-layer, national, transformative framework for Papua New Guinea; it combines an educational system, a workforce development system, a digital infrastructure system, and an AI-based system into a comprehensive development system. It provides a logical sequence from the input to the AI-based intelligence systems, skills development, and macroeconomic outcomes, as shown in table 1.

Table 1: Structural Layers of AI-HCD Framework

Layer	Core Components	Function
Input Layer	Education, Workforce, Policy, Infrastructure	Provides foundational human capital and digital readiness
AI Enablement Layer	ML, NLP, Predictive Analytics, Adaptive Systems	Converts raw data into intelligence for decision-making
Human Capital Development Layer	Training, Reskilling, Digital Literacy	Enhances workforce capability and employability
Transformation Layer	Productivity, Job Matching, Sector Innovation	Links skills to economic performance
Outcome Layer	GDP, Employment, Digital Economy Growth	Measures national development impact

The table shows how the various layers build on each other in a way that leads toward national development outcomes, with AI bringing transformation to all of them.

Input Layer Human Capital Ecosystem

The input layer serves as the base of the framework. The components included are the key national attributes for human capital development, namely, education institutions, workforce attributes, policy structure, and digital infrastructure. The human capital attribute of education institutions is education systems at the school level and vocational and higher learning institutions, while labor force attributes reflect present and future workforce capacity. The human capital attributes of policy structures are education policies, labor policies, and policies concerning the digital transition. The human capital attributes of the digital infrastructure comprise factors such as Internet connection, cloud computing, and ICT infrastructure to facilitate the adoption of the AI-based human capital development system. The readiness of Papua New Guinea to adopt an AI-based human capital system is dependent on the state of this input layer.

AI Enablement Layer

This is the intelligence centre in the context of the framework. It is a blend of machine learning, predictive analytics, natural language processing, and adaptive learning systems to enhance decision-making in education and workforce planning. Unlike AI-based skills gap analyses, which identify the skill gaps between the workforce demand and supply, predictive workforce models predict the future workforce trends. Intelligent tutoring systems and adaptive learning platforms provide personalized learning opportunities for students and thereby better learning outcomes. Human capital development becomes data-driven and efficiently attuned to new economic challenges. Important AI technologies and their respective functions are illustrated in table 2.

Table 2: AI Technologies in Human Capital Development

AI Technology	Application Area	Function in Framework
Machine Learning	Workforce Analytics	Predicts skill demand and labor trends
Natural Language Processing	Education Systems	Enables multilingual learning and content translation
Predictive Analytics	Labor Market Planning	Forecasts employment opportunities
Adaptive Learning Systems	Education Delivery	Personalizes learning pathways
Recommendation Systems	Job Matching	Aligns individuals with suitable careers

This table highlights how AI technologies directly enhance education efficiency and labor market alignment.

Human Capital Development Layer

This layer aims at actually transforming AI inputs into actual skill development and capacity building of the workforce. This contains personalized learning modules, AI-assisted training, upgrading digital literacy skills, and continuous re-skilling structures. The content of the education module is customized for learners and the workforce based on their skill levels, learning goals, and industry needs. This layer aims at connecting the education system with the labor market. Individuals get those skills that fit the need for economic transformation and are ready for the future. As listed in table 3, these are human capital development mechanisms:

Table 3: Human Capital Development Mechanisms

Mechanism	Description	Expected Outcome
Personalized Learning	AI-based individual learning paths	Improved learning efficiency
Reskilling Programs	Continuous workforce training	Reduced skill gaps
Digital Literacy Training	ICT skill enhancement programs	Higher digital adoption
Industry-Aligned Training	Collaboration with industries	Better employability
Micro-Certification Systems	Short-term skill certification	Faster workforce upskilling

This table shows how AI-driven systems translate into direct workforce capability enhancement.

Transformation Mechanism Layer

The transformation layer bridges enhanced human capital with outcomes on the economic and sector development front. A higher productivity workforce will arise from better skills and job-matching systems assisted by AI. Increased employment efficiency will come from better job-human matching through the use of predictive analytics. A boost to sector-specific innovation will come in the sector-specific domains of agriculture, mining, health and public service, where AI-based decision systems can be applied to boost these sectors. Higher efficiency of governance will arise from data-driven policy deployment, cutbacks in administrative delay and efficient delivery of services.

Outcome Layer Economic and National Development

The last layer is the macroeconomic and national development outcome brought by AI-enhanced human capital. Such as higher GDP growth, higher employment, less skill mismatch, and labor productivity. This framework will also facilitate the growth of the digital economy and balance the development between urban and rural areas in PNG. This layer is conducive to the transformation of an economy based on natural resources into a knowledge-based and innovation-driven national economy in the long run.

Conceptual Flow of the Framework

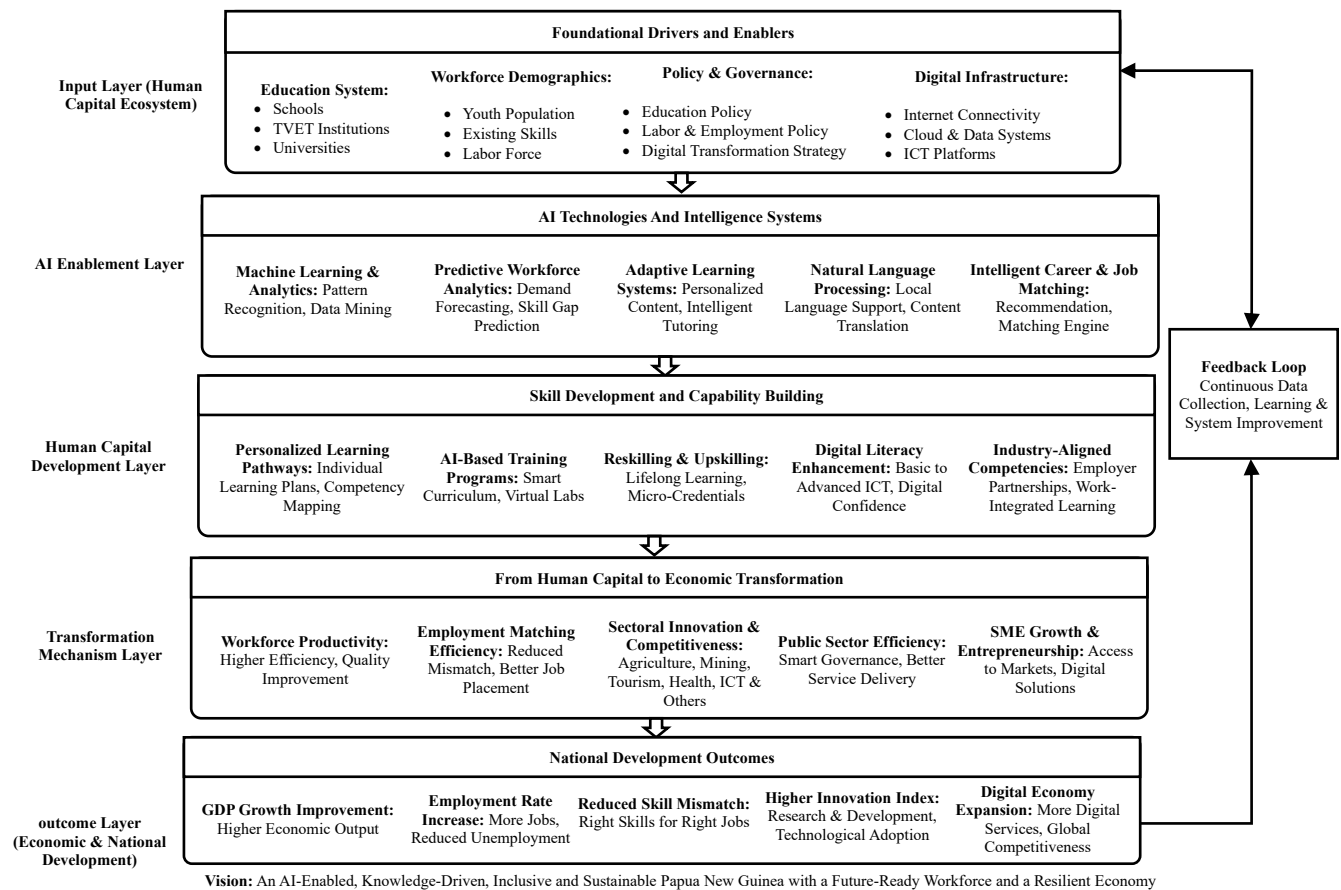


Fig. 1: Multi-Layer AI-Driven Human Capital Development Flow for Economic Transformation in Papua New Guinea

The workflow of the proposed AI-Human Capital Development (AI-HCD) framework for PNG is shown in fig. 1, starting with the basic input layer up to the economic outcome layer of transformation with AI enablement, human capital development, and finally economic outcomes layers. Starting with the basic input layer, the existing educational systems, workforce configuration, policy initiatives, and infrastructure have been subjected to several AI technologies, including but not limited to machine learning (ML), predictive analysis, and adaptive learning technologies to determine skill gaps and opportunities for learner journeys. The outcomes generated by AI models have been converted into effective interventions aimed at enhancing human capital through targeted training, reskilling initiatives, and education and lifelong learning. The human capital has been transformed with a skilled and employable workforce, which has resulted in more economic productivity, better job matching, and industrial innovation. These transformational results have beneficial effects on the broader economic outcomes, such as GDP growth, employment, and skill mismatch reductions, further strengthening the AI and policy impact on the economy.

Results

Framework Evaluation Results

Through comparative analysis, it is revealed that the suggested Artificial Intelligence-Driven Human Capital Development Framework (AI-HCDF) provides a more holistic and integrative perspective than other development frameworks. Based on the results displayed in table 1, the previously developed frameworks are characterized by a predominant concentration on one particular aspect including educational technology, governance framework, financial innovation, or infrastructure management. In turn, the AI-HCDF directly integrates AI technologies, human capital development, economic transformations, and national development. This holistic integration facilitates a better understanding of how technological innovation may contribute to sustainable development in Papua New Guinea.

The analysis of findings provided in table 2 shows that the suggested framework is characterized by a higher level of functional integration compared to other research papers that are characterized by the attention to one or two aspects of development. In turn, the AI-HCDF considers learning improvements, workforce development, innovations creation, productivity increases, and policy-making. The multi-dimensional integration contributes to the development of the framework's capability to tackle various development issues in developing countries.

Educational and Workforce Development Outcomes

The framework focuses on the potential of Artificial Intelligence in enhancing educational quality and preparing individuals for the workplace. It emphasizes how AI through intelligent tutoring systems, adaptive learning, learning analytics, and predictive assessments can help in improving the processes of acquiring knowledge and skills. Enhanced digital literacy and professional development can be instrumental in forming a better and more adaptable workforce that can cope with changes in technology and the economy.

Moreover, with the use of AI in analyzing the workforce, it becomes easier to identify emerging skill needs and formulate training interventions based on evidence. In case of Papua New Guinea, the development of the workforce is an important element that will determine the economic performance of the country.

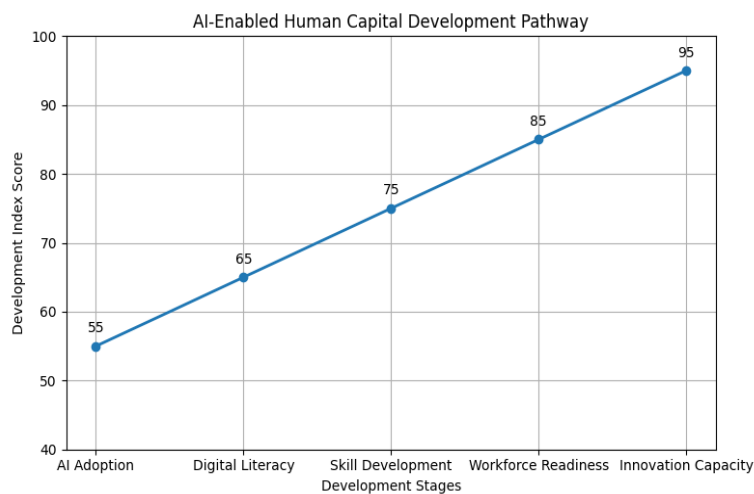


Fig. 2: AI-Enabled Human Capital Development Pathway

The process of using AI technologies in improving the education system and the process of workforce development is captured in fig. 2. The process entails learning and skills development through AI technologies to workforce competency improvement and innovation development for economic transformation.

Economic Transformation Outcomes

The suggested framework highlights that improvement in human capital can create substantial economic gains due to productivity, innovation, and entrepreneurship. Improved skills in human capital make it possible for organizations to implement innovative technologies, achieve higher efficiency, and engage in knowledge-intensive economic activities. As illustrated in table 3 below, there is a direct relationship established between education and human capital development and economic diversification and industrialization.

It is also implied by the framework that human capital development through artificial intelligence can facilitate digital entrepreneurship and innovation ecosystems. This will reduce dependency on traditional economic sectors. In such a way, economic transformation can be seen as a result of ongoing investments in technology-based human capital development.

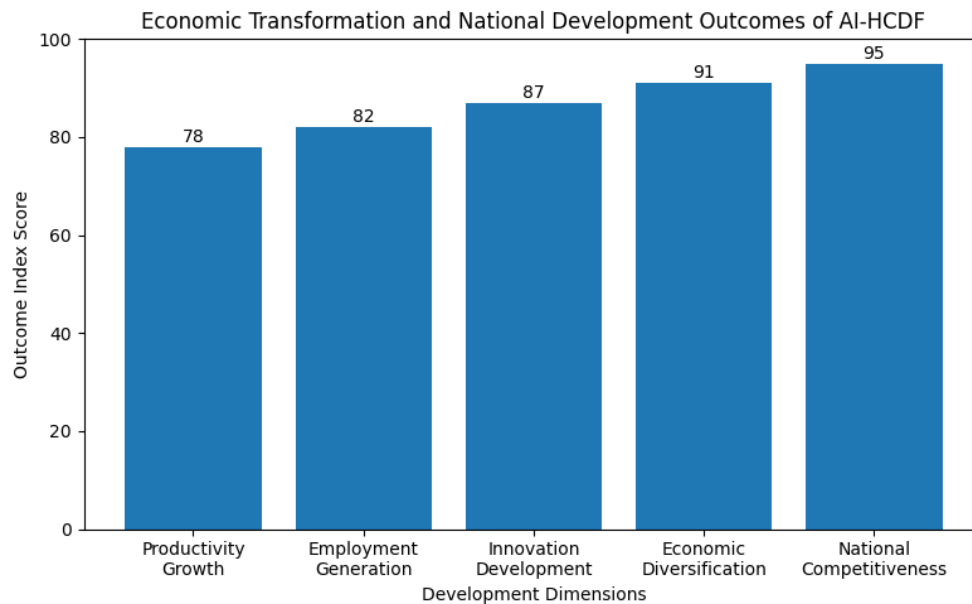


Fig. 3: Economic Transformation and National Development Outcomes of AI-HCDF

Fig. 3 depicts the association between enhancement in human capital, growth in productivity, innovation creation, and the results of development at the national level. The figure highlights how the upgrading of workforce capabilities leads to economic diversification and job creation.

Table 4: Outcomes of AI-HCDF Implementation

Framework Component	Immediate Outcome	Intermediate Outcome	Long-Term Outcome
AI-Based Education	Improved learning access	Higher digital literacy	Skilled workforce
Workforce Analytics	Skills identification	Targeted training	Employment readiness
Innovation Capacity	Research enhancement	Entrepreneurship growth	Economic diversification
Policy Support	Institutional coordination	Technology adoption	Sustainable development

As demonstrated in table 4 below, the recommended framework for AI-HCDF is predicted to deliver a number of developmental gains at various levels of application. Short-term gains relate to improved access to education, identification of skills required for workers, improvements in research and coordination using AI tools. These results then lead to a number of intermediate gains including digital literacy, workforce training, entrepreneurship, and greater use of technology. The long-term effects of all these gains result in building a high-quality workforce, better job readiness, economic diversification, and sustainable national development. Therefore, from table 4 above, it is clear that the recommended framework provides a progressive path from AI to broader social-economic transformations, underlining the importance of human capital development in achieving national growth in Papua New Guinea.

As shown in fig. 4 below, the different elements of the AI-HCDF framework contribute in diverse ways towards national development results. The relative contribution from workforce development and national development elements is high, indicating the significance of skills development, employability, and human capital readiness in achieving sustainable development. AI-based education and productivity development also make considerable impact through their efforts to improve efficiency and knowledge generation. Innovation potential and economic diversification are important for sustained competitiveness through entrepreneurship, technology, and the growth of emerging economic sectors. In general, fig. 4 indicates that national development is not influenced by one factor alone but by the collective contribution of educational transformation, workforce capability development, innovation generation, and economic development through the AI-HCDF framework.

Relative Contribution of AI-HCDF Components to National Development

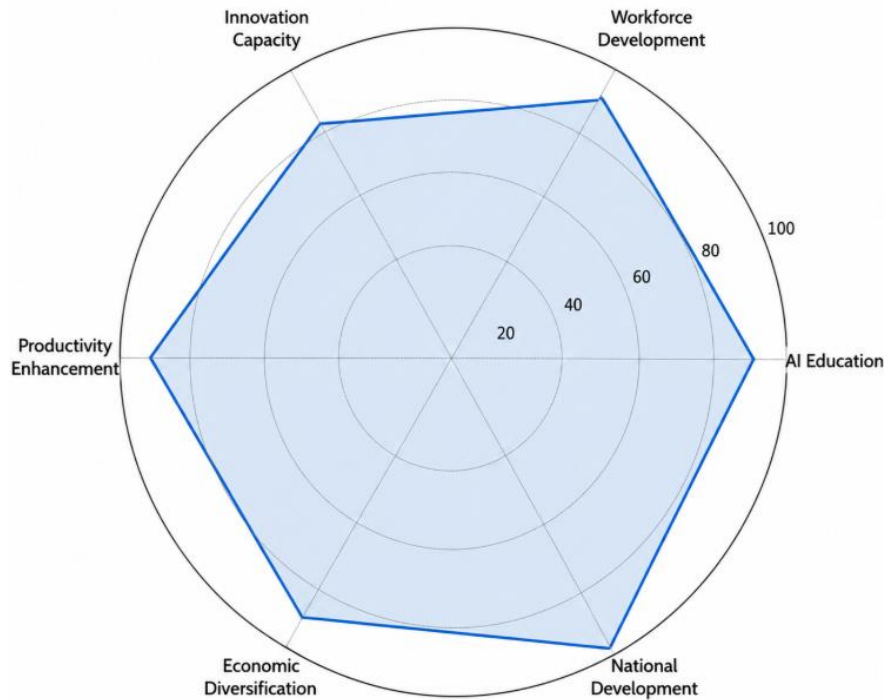


Fig. 4: Relative Contribution of AI-HCDF Components to National Development

National Development Implications

The framework clearly shows that AI-powered human capital development is not only economically beneficial but also contributes to other areas of national development. Enhanced access to education, labor market participation, and innovation can be used to address issues of poverty alleviation, social inclusion, and capacity building. With digital skill enhancement through the framework, there will be increased participation in economic activities due to the growing technological nature of the global economy.

The framework can offer a strategic pathway for Papua New Guinea in terms of aligning AI development with national development needs. This will provide a comprehensive strategy for dealing with developmental challenges by integrating educational development, labor force development, and economic modernization.

Discussion

The Artificial Intelligence-Driven Human Capital Development Framework (AI-HCDF), as presented, offers a pathway through which the Papua New Guinea may harness its potential AI technologies to improve its education system, workforce capabilities and economic competitiveness in the long run. This framework illustrates that AI is a key component that can act as an enabler in solving some of the problems linked to the mismatch of skills, accessibility to education and workforce readiness. In incorporating intelligent learning systems, workforce analytics and skill assessment, this framework links education to the labor market needs to create a future-ready workforce. From the

comparative analysis results, it is evident that the proposed AI-HCDF framework provides a much broader integration of human capital development, economic transformation and national development dimensions compared to the other models. The development pathway provided in fig. 1 also provides a clear illustration of the link between AI-driven education transformation and workforce development leading to increased productivity, innovation and economic diversification.

Despite the possible advantages that can arise from it, the success of AI-HCDC will depend on the ability to solve a number of structural problems that still exist in the country. Digital infrastructure, access to the internet for rural communities, technical readiness, and low digital literacy rates are still some of the challenges that Papua New Guinea experiences. Such challenges might limit the full use of AI technologies in order to enhance the quality of educational services provided in the country as well as the development of the workforce. Effective implementation will require close cooperation between government bodies, educational institutions, industry representatives, and even international partners in order to ensure the development of policies, digital infrastructure, and training programs. Thus, the presented framework can serve as an important source of implications for policymakers as they have to take into consideration such issues as national AI strategies, digitalization of the workforce, PPPs, and innovation-driven development policies.

Policy Recommendations

The implementation of the suggested AI-Driven Human Capital Development Framework (AI-HCDF) will require the development of an integrated national strategy for the incorporation of AI solutions into human capital development policies in order to achieve its goals in the areas of education, workforce development, and economic modernization in PNG. It is necessary to create an AI policy in education aimed at the use of intelligent learning systems, adaptive educational platforms, and assessment techniques based on big data. An AI policy in education will help to ensure that all AI technologies used in the educational process are in line with national policies on human capital development and ensure equal access to quality education irrespective of geography. Additionally, it is important for the government of PNG to create a national AI-enabled system of labor market intelligence, which will allow tracking labor market trends, identify emerging skill needs, and conduct workforce planning. Such a system will ensure the better alignment of educational programs and the requirements of the labor market. Moreover, there should be significant investments in digital infrastructure.

Another aspect that is equally important to develop in this regard is a capacity building ecosystem that can facilitate digital literacy, AI awareness, technological skills, and innovation capacities among learners, employees, policymakers, and organizational leaders. The role of public-private partnerships must be leveraged further to enhance the transfer of technology, foster research and innovations activities, and deploy AI solutions that match the socio-economic needs of Papua New Guinea. Moreover, the government must develop and adopt phased workforce development programs that could help in improving the digital skills, data literacy, AI applications, entrepreneurship, and lifelong learning of people to prepare them for future job market demands. In addition to that, an AI governance framework must be put in place to ensure responsible, transparent, safe, and accountable application of AI technologies. These AI governance tools must address various challenges regarding fairness, privacy protection, data security, explainability, and regulatory compliance while fostering public trust in AI technologies.

Limitations and Future Work

Research methodology and constraints of the research make the conceptual research that cannot include statistical analysis with the primary data of Papua New Guinea as well as any simulations with the actual workforce of Papua New Guinea due to the creation of the conceptual framework based on secondary data only. Consequently, the constraints in the implementation of statistical analysis of the conceptual framework of the research and implementation of AI for each country makes it possible to analyze only the quantitative aspects.

Future recommendations for research to overcome these limitations, future research should be conducted based on an empirical study with the help of primary and secondary data related to the education and labor system of Papua New Guinea. The simulation models based on artificial intelligence should be used to analyze AI-HCD models under various conditions of economic and market environment.

Conclusion

The current study proposes an innovative strategic framework known as the Artificial Intelligence-Driven Human Capital Development Framework (AI-HCDF) for effective human capital development, economic transformation, and national development in Papua New Guinea. This framework combines the foundational enablers, AI technological

competencies, human capital development processes, economic transformation effects, and national development goals into one framework that will be able to solve Papua New Guinea's workforce development problems. With the integration of intelligent learning, workforce analytics, skill assessment, and data-driven decision-making tools, this framework is capable of showing how AI can make education more efficient, workforce ready, innovated, and productive. The comparative study made in this research also indicates that the suggested AI-HCDF has more theoretical coverage and functional integration compared to other sectoral frameworks.

The findings on the relative contributions of the framework revealed strong potentials for sustainable development through development of the work force, productivity improvement, AI-based education, innovation capacity, and national development outcomes. This implies that AI has great potential to act as a catalyst in aligning the educational outputs to the demands of the labor markets, bridging the skills gaps, improving employability, and diversifying economies. Moreover, the framework reveals the potential of the AI-based human capital development systems to positively impact other aspects of national development such as competitiveness, technology advancement, social inclusion, and sustainable economic development.

The successful implementation of the AI framework requires considerable investments into digital infrastructure development, internet connectivity, digital literacy of the workforce, institutional capability building, and ethics of AI governance. Consequently, it is critical that national AI policies, PPPs, re-skilling of the workforce, and other related strategies are in place. Overall, the proposed AI-HCDF reveals that Artificial Intelligence needs to be considered not only as a technological innovation, but as a strategic approach to human capital development and national economic transformation in Papua New Guinea.

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