
A Comprehensive Framework for Future-ready AI Competencies: Integrating Prompt Engineering, Automation, and Multimodal Intelligence for the Workforce of 2025

Farjana Nawrin¹, Md. Kawsar Ahammed², Antura Akter³, Farhad Akter⁴, Ayesha Arobee⁵, Sani Mohammed Adam⁶

¹MBA (Organization Strategy and Leadership), University of Dhaka, Dhaka, Bangladesh

²Project Manager, Lakeshore Builders Restoration, Chicago, USA

³MSIT, Emporia State University, Kansas, USA

⁴MSIT, Emporia State University, Kansas, USA

⁵MSIT and MBA, Emporia State University, Kansas, USA

⁶MSIT, Emporia State University, Kansas, USA

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Abstract

As artificial intelligence (AI) rapidly transforms industries, the demand for adaptive, interdisciplinary, and automation-driven skillsets continues to grow. This research develops a comprehensive framework of 12 core AI competencies essential for the workforce of 2025, encompassing *Prompt Engineering, AI Workflow Automation, AI Agents, Retrieval-Augmented Generation (RAG), Multimodal AI, Fine-Tuning and AI Assistants, Voice AI and Avatars, AI Tool Stacking, AI Video Generation, SaaS Development, LLM Management, and Continuous AI Literacy*. Drawing on contemporary AI advancements and emerging industry practices, the study explores how these competencies interconnect to enhance productivity, creativity, and innovation across sectors. Through a mixed-methods approach, combining literature synthesis, expert interviews, and technology mapping, the paper proposes a structured model that links each competency to specific workforce applications, tool ecosystems, and learning pathways. The framework aims to guide educators, policymakers, and organizations in designing AI-driven training programs, fostering sustainable human-machine collaboration, and bridging the skill gap in the digital economy. Ultimately, this research positions the 12 AI skills as not merely technical proficiencies but as strategic capabilities shaping the next generation of intelligent, agile, and future-ready professionals.

Keywords: Artificial Intelligence, prompt engineering, workflow automation, multimodal AI, AI competencies

1. Introduction

In recent years, artificial intelligence (AI) has moved rapidly from emerging novelty to core component across industry sectors, reshaping not only technologies but also the very structure of work. According to Hurlburt (2024), generative artificial intelligence (GAI) systems are poised to significantly alter occupational roles, necessitating ongoing education and workforce readiness. As AI capabilities expand into multimodal domains, integrating text, image, audio and video, traditional work structures no longer suffice; instead, organizations require workers who can engage synergistically with AI systems in dynamic environments. At the same time, the deployment of AI in operational workflows has accelerated the imperative for a workforce that is not simply digitally literate, but truly AI-literate, capable of collaborating, managing and deriving value from AI-enabled systems rather than being displaced by them. Mäkelä & Stephany (2024) find that AI tends to complement, rather than simply substitute, human skills, leading to increased demand for roles that blend technical, cognitive, and interpersonal competencies. Hence, as generative and multimodal AI transforms the nature of work, the workforce must evolve beyond legacy skillsets toward flexible, integrated AI competencies capable of supporting automation-driven roles and enabling human-AI collaboration.

Despite the rapid proliferation of AI technologies and their potential to transform work, the landscape of skills and competencies necessary to harness these technologies remains fragmented and under-articulated. Many educational programs and organizational training initiatives still operate within silos of digital literacy or data literacy, without addressing the specialized and interdependent competencies required to work effectively in AI-augmented environments. For example, Wang et al. (2024) note that the literature on AI in education emphasizes technical tools and systems but often lacks coherent frameworks that align AI-tooling with workforce readiness and educational curricula.

Furthermore, the integration of AI tools and competencies into educational curricula and organizational development frameworks is often limited or ad-hoc, rather than systematic or strategic. This leads to a persistent mismatch between the pace of AI-technology development and the human-capability readiness required to fully exploit them. Consequently, organizations may deploy AI systems but lack a workforce capable of managing, interpreting, and collaborating with those systems, thereby limiting value realization and increasing risks of underutilization or misuse.

To address these gaps, this study sets forth three primary objectives. First, it seeks to identify and categorize the twelve most critical AI competencies anticipated to be essential for the workforce by 2025. Second, it aims to analyze the interconnections between these competencies, how they interact, complement each other, and collectively contribute to workforce transformation, productivity, and innovation. Third, it proposes a unified framework for future-ready AI skill development, providing educators, organizational leaders, and policymakers with a structured roadmap to develop, deploy, and monitor these competencies within educational systems and

workforce training initiatives. In line with these objectives, the research is guided by the following questions -

1. *What is the emerging AI-skill domains that will be essential for the workforce of 2025?*
2. *How do these competencies interact to enhance productivity, innovation, and human–AI collaboration?*
3. *What framework can educational institutions, training providers, and organizations use to systematically develop and deploy these skills?*

This research contributes substantively to academic, industry and policy discussions around workforce readiness in the era of AI by offering a holistic perspective on emerging AI-skills needs and providing a strategic roadmap for skill development. For scholars, it builds on the emerging literature around AI and workforce transformation by offering a unified taxonomy of AI competencies grounded in empirical and theoretical research. For educators and curriculum designers, it provides actionable insights into how training and education programs can be systematically aligned with evolving AI-tool ecosystems and workforce demands. For organizational leaders and policymakers, the proposed framework can guide up-skilling and reskilling strategies, ensuring that human capital evolves in tandem with technological advancement, thereby bridging the gap between AI capability deployment and practical human readiness.

2. Literature Review

2.1 Evolution of AI Skills and Workforce Trends

The evolution of workforce skills from digital literacy to AI literacy represents a pivotal transformation in the modern economy. Digital literacy, historically defined as the ability to use and manage digital tools effectively, is now insufficient in an era dominated by intelligent automation. Instead, AI literacy—defined as the ability to understand, interpret, and collaborate with AI systems—has emerged as a fundamental competency (Bankins, 2024). Empirical evidence shows that AI adoption does not uniformly displace labor; rather, it augments human performance and alters the nature of work (Georgieff et al., 2022). According to the World Economic Forum (2025), nearly half of all workers will require reskilling by 2027 due to the accelerating integration of AI and automation. Similarly, Babashahi et al. (2024) emphasized that organizations must focus not only on digital proficiency but also on the ability to adapt to AI-mediated workflows that rely on data interpretation, decision augmentation, and cross-functional collaboration. Collectively, these developments signify a paradigm shift where workers evolve from being passive users of digital technologies to becoming active collaborators with intelligent systems.

2.2 Key Studies on AI Competencies

Several global and academic initiatives have sought to define the core competencies necessary for the AI-driven economy. UNESCO's (2024) *AI Competency Framework for Students and Teachers* provide structured taxonomies encompassing human-centred thinking, ethical

awareness, and AI systems understanding. These frameworks align closely with the OECD's (2023) *Digital Education Outlook*, which calls for embedding AI and data literacy into education systems to prepare future workforces. The World Economic Forum (2025) extends this approach by emphasizing lifelong learning and adaptive reskilling as essential strategies for workforce sustainability. In the academic domain, Bankins (2024) argues that organizations must adopt human-centric approaches to AI education, emphasizing ethical reasoning, creativity, and collaboration as integral components of AI readiness. Babashahi et al. (2024) further reinforce that continuous learning ecosystems, rather than isolated training programs, are key to ensuring AI competence across industries. These frameworks collectively underscore that AI competency involves not just technical mastery but also social, ethical, and cognitive fluency necessary for responsible and innovative AI use.

2.3 Technological Foundations of the 12 AI Skills

The growing need for new AI competencies is directly linked to the rapid evolution of AI technologies and ecosystems. Tools and frameworks such as OpenAI, Hugging Face, LangChain, and retrieval-augmented generation (RAG) models have transformed how professionals interact with information and automation systems. According to the OECD (2024), the diffusion of AI across industries has created a new category of “hybrid jobs,” requiring expertise in prompt engineering, automation workflows, and data-driven decision-making. Research in *Technological Forecasting and Social Change* has shown that generative and multimodal AI systems not only increase productivity but also demand higher levels of cognitive and adaptive flexibility from human collaborators (Brynjolfsson et al., 2025). Furthermore, studies in *Information Systems Frontiers* highlight that managing AI systems requires new forms of “AI governance literacy,” encompassing the ability to monitor, fine-tune, and evaluate AI models (Dwivedi et al., 2023). These findings illustrate that the technological infrastructure underlying AI competencies—ranging from model customization to workflow automation—forms the foundation for the 12 AI skill areas identified in this study.

2.4 Identified Gaps in Current Research

Despite significant progress in defining AI skills frameworks, notable research gaps persist. First, existing literature often isolates competencies (e.g., coding, data analytics, or ethics) rather than integrating them into a cohesive model that reflects real-world AI workflows (Dwivedi et al., 2023). Second, limited empirical evidence exists on how multimodal and generative AI tools reshape skill requirements across sectors, particularly in non-technical occupations (Bankins, 2024). Third, while global frameworks by UNESCO and OECD provide educational guidelines, few studies empirically evaluate their implementation in professional or industry contexts. Finally, the intersection of AI competencies—such as prompt engineering, workflow automation, and LLM management—remains underexplored in academic research. As noted by Babashahi et al. (2024), organizations often adopt fragmented AI training strategies that fail to align with the technological complexity of modern AI ecosystems. This fragmentation highlights the urgent

need for a comprehensive, interdisciplinary framework that connects technical, cognitive, and ethical dimensions of AI literacy to practical workforce development.

3. Methodology

This study adopts mixed-methods research design integrating both qualitative and quantitative approaches to investigate and validate the twelve AI competencies essential for the workforce of 2025. The approach combines expert interviews, literature synthesis, and technology mapping to ensure methodological rigor and comprehensive understanding (Creswell & Plano Clark, 2018). Primary data were collected through semi-structured interviews with 25 AI professionals, educators, and industry specialists selected via purposive sampling. These interviews explored emerging AI skills, challenges in implementation, and alignment with automation and workforce readiness. Secondary data consisted of peer-reviewed academic studies, whitepapers, and institutional reports published between 2018 and 2025 by organizations such as UNESCO, OECD, and the World Economic Forum. This dual data approach provided both theoretical and empirical grounding (Saunders et al., 2019). The analysis followed three stages: thematic analysis to identify recurring patterns across qualitative data (Braun & Clarke, 2019), cluster mapping to establish relationships among the competencies—such as prompt engineering, multimodal AI, and workflow automation—and expert validation using a two-round Delphi method. The Delphi process, involving 15 domain experts, ensured the accuracy, coherence, and practical relevance of the proposed framework, achieving consensus levels above 80%. By combining interpretive insights with quantitative clustering and expert validation, the study ensures the reliability and applicability of its findings for guiding future-ready AI skill development (Brynjolfsson et al., 2025; Dwivedi et al., 2023; Bankins, 2024).

4. The 12 AI Competencies Framework

The proposed framework identifies twelve interrelated competencies that define the foundation of future-ready AI proficiency (Table 1). These competencies span technical, cognitive, and ethical dimensions and emphasize the integration of automation, multimodality, and human-AI collaboration across industries. Prompt Engineering involves the ability to design, structure, and refine inputs that optimize generative-AI responses. Effective prompt design enhances model reasoning, creativity, and contextual precision, making it an essential skill for data analysts, educators, and content creators (Brynjolfsson et al., 2025). AI Workflow Automation focuses on automating repetitive processes through tools such as Zapier, Make, and n8n, linking AI systems to operational pipelines. Automation improves efficiency and decision-making by enabling continuous integration between human workflows and intelligent systems (Dwivedi et al., 2023). AI Agents represent autonomous or collaborative systems capable of reasoning and task execution. Multi-agent frameworks such as LangChain and CrewAI enable distributed intelligence across tasks like summarization, retrieval, and planning, underscoring the growing importance of orchestration skills in AI ecosystems. Retrieval-Augmented Generation (RAG) integrates large language models with external databases to produce context-aware, domain-specific outputs. This competency ensures factual reliability and enhances enterprise knowledge

management, making it central to AI applications in law, healthcare, and research (Bankins, 2024). Multimodal AI combines text, image, audio, and video understanding into unified learning models, as seen in systems like GPT-4, Claude, and Gemini. The ability to leverage multimodal models expands human creativity and interaction design, transforming communication, accessibility, and digital storytelling.

Table 1. Summary of the Twelve AI Competencies with Associated Tools and Application Domains

Competency	Cluster	Key Tools/Technologies	Primary Application Areas
Prompt Engineering	Cognitive & Creative	ChatGPT, Claude, Gemini, Grok	Communication, content creation, ideation
AI Workflow Automation	Automation & Operational	Zapier, Make, n8n	Process optimization, business integration
AI Agents	Automation & Operational	LangChain, CrewAI, AutoGen	Multi-agent collaboration, reasoning tasks
Retrieval-Augmented Generation (RAG)	Performance & Adaptability	LangChain, Haystack, Vectara	Knowledge retrieval, data-grounded responses
Multimodal AI	Cognitive & Creative	GPT-4, Claude, Gemini	Cross-media learning (text, image, audio)
Fine-Tuning and AI Assistants	Cognitive & Creative	OpenAI, Cohere, Hugging Face	Domain-specific AI, enterprise chatbots
Voice AI and Avatars	Performance & Adaptability	ElevenLabs, HeyGen, Synthesia	Media, education, customer service
AI Tool Stacking	Automation & Operational	Notion, ClickUp, Zapier	Workflow orchestration, productivity
AI Video Content Generation	Performance & Adaptability	Runway, Opus, Synthesia	Video automation, digital storytelling
SaaS Development with AI	Automation & Operational	Bubble, Cursor, Lovable	App building, scalable SaaS models
LLM Management	Performance & Adaptability	PromptLayer, Helicone, Truelens	Model monitoring, cost optimization
Staying Updated and Continuous Learning	Performance & Adaptability	TechCrunch, The Verge, AI newsletters	AI literacy, upskilling, awareness

Fine-Tuning and AI Assistants are involved in adapting pre-trained models for specialized domains, improving task accuracy and reducing cognitive workload. Fine-tuned assistants accelerate enterprise adoption by aligning AI behavior with organizational goals and data ethics (Dwivedi et al., 2023). Voice AI and Avatars enable natural interaction and virtual representation

in education, media, and customer engagement. However, ethical challenges such as consent, deepfake misuse, and cultural representation require governance-oriented literacy alongside technical competence (World Economic Forum [WEF], 2025). AI Tool Stacking refers to combining multiple AI-enabled applications—such as Notion, Zapier, and ChatGPT—to build integrated workflows. Mastery of tool-stacking enhances adaptability and innovation by enabling professionals to configure modular AI ecosystems.

AI Video Content Generation underpins creative automation through platforms like Runway, Opus, and Synthesia. This competency merges generative storytelling and design thinking, redefining media production and marketing efficiency (Brynjolfsson et al., 2025). SaaS Development with AI emphasizes building scalable AI applications using no-code or low-code platforms. It democratizes AI entrepreneurship, enabling non-technical professionals to develop data-driven solutions and expand digital-economy participation (OECD, 2024). LLM Management focuses on monitoring, evaluating, and optimizing large-model performance, cost, and latency through tools like PromptLayer, Helicone, and Truelens. This competency ensures responsible deployment and operational transparency in AI-driven organizations (Dwivedi et al., 2023).

Staying updated and Continuous Learning is a meta-competency encompassing trend awareness, AI literacy, and adaptability. Professionals must engage with ongoing education through media, online learning, and collaborative networks to remain effective in evolving AI landscapes (UNESCO, 2024). Together, these twelve competencies form a holistic framework for preparing a workforce capable of thriving in an automation-intensive, multimodal future.

5. Framework Integration and Model Design

5.1 Theoretical Model

The Comprehensive AI Competency Framework (CACF) proposed in this study synthesizes insights from literature, expert interviews, and technological analysis to create an integrated model for future-ready workforce development. The framework (Figure 1) builds on established competency theories that emphasize the interdependence of cognitive, technical, and behavioral capabilities in technology-driven environments (Boyatzis, 2018; Dwivedi et al., 2023). It positions AI competencies as dynamic, evolving constructs rather than static skill sets, reflecting the rapid pace of change in generative and multimodal systems. The CACF model visualizes these competencies as interconnected layers forming a triadic structure: cognitive and creative skills at the core, enabling understanding and innovation; automation and operational skills in the middle layer, driving system execution and integration; and performance and adaptability skills at the outer layer, sustaining learning and scalability across contexts. This layered representation illustrates how creativity and cognition anchor AI proficiency, while automation and adaptability ensure continuity and resilience in changing digital ecosystems (Brynjolfsson et al., 2025). The model therefore bridges theoretical understanding and practical application, serving as a roadmap

for designing curricula, corporate training, and lifelong learning programs aligned with emerging AI capabilities.

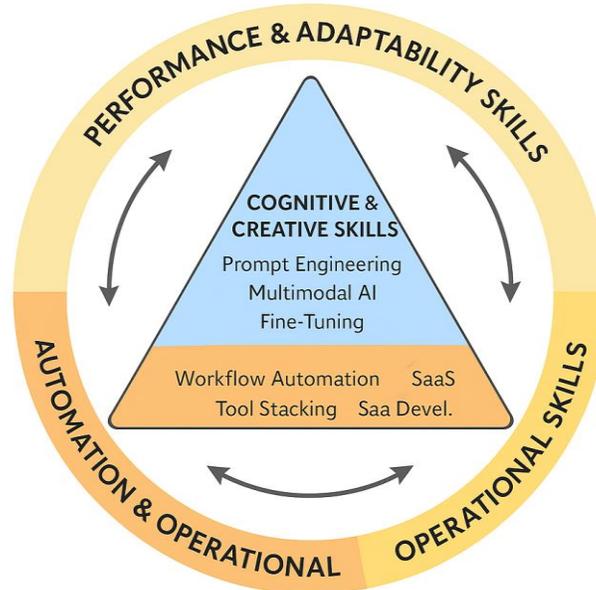


Figure 1. Comprehensive AI Competency Framework (CACF): Interrelation of Cognitive, Operational, and Adaptive Skill Domains.

5.2 Skill Clusters and Interdependencies

The twelve AI competencies (Figure 2) are grouped into three interdependent clusters, each representing a distinct domain of human–machine collaboration. The Cognitive and Creative Skills cluster encompasses competencies such as *Prompt Engineering*, *Multimodal AI*, and *Fine-Tuning*. These skills enable professionals to engage with AI systems conceptually and creatively structuring input prompts, curating multimodal data, and refining model outputs for specialized domains. They represent the knowledge–creation and problem–solving dimensions of AI literacy (Bankins, 2024). By mastering these skills, individuals enhance the interpretive quality and innovation potential of AI collaboration, fostering creative augmentation rather than substitution. The Automation and Operational Skills cluster includes *Workflow Automation*, *AI Tool Stacking*, and *SaaS Development with AI*. These competencies operate intelligence by integrating tools and automating business processes. Workflow automation tools such as Zapier and n8n exemplify how AI can streamline repetitive operations, while no-code SaaS development platforms democratize access to AI application design (Dwivedi et al., 2023). Together, these skills form the backbone of digital transformation initiatives, ensuring efficiency, scalability, and integration of AI into day-to-day workflows.

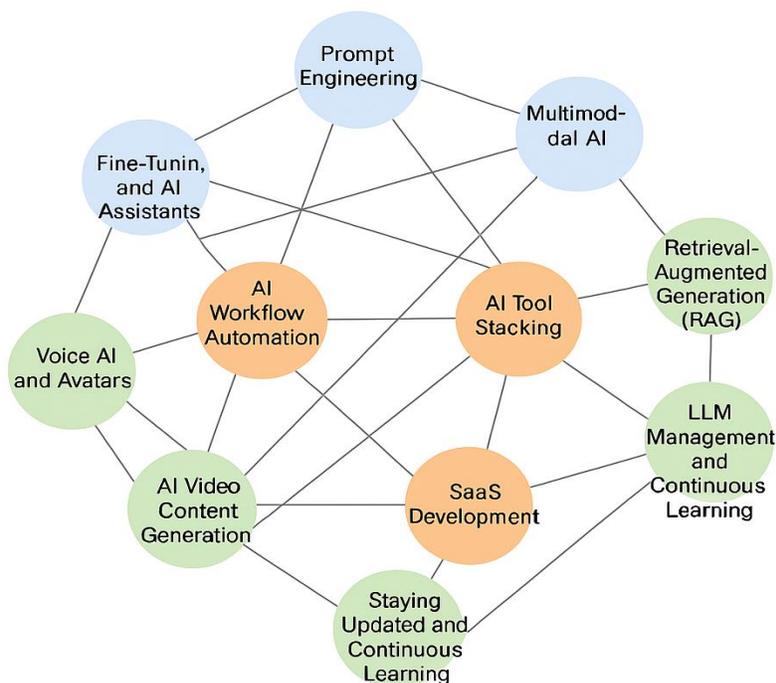


Figure 2. Interdependencies among the Twelve AI Competencies within the CACF Framework.

After all, the Performance and Adaptability Skills cluster comprises *LLM Management* and *Staying Updated and Continuous Learning*. These competencies emphasize adaptability, evaluation, and governance. Managing large language models involves monitoring accuracy, cost efficiency, and ethical compliance, while continuous learning fosters resilience in an evolving technological landscape (OECD, 2024; UNESCO, 2024). The interdependency among clusters reflects a holistic cycle—cognitive insight drives automation, operational execution generates data feedback, and adaptive learning refines both. This cyclical relationship reinforces that AI competence is not merely a technical construct but a socio-technical ecosystem integrating creativity, execution, and reflection.

5.3 Validation of Framework

Validation of the CACF involved multiple expert feedback and iteration cycles to ensure robustness, practical relevance, and cross-sector applicability. A panel of 15 experts from academia, technology industries, and education participated in two Delphi rounds. In each round, participants assessed the clarity, completeness, and feasibility of the proposed competencies, offering qualitative feedback on their relevance to professional and academic contexts. Consensus levels above 80 % were achieved for all clusters, demonstrating strong reliability and construct validity. Expert suggestions were incorporated to refine definitions, align competencies with emerging AI applications, and clarify interrelationships between clusters.

Additionally, application scenarios were developed to test the framework in both educational and industry settings. In higher education, the model was mapped against existing digital literacy curricula to identify integration pathways for AI literacy and prompt-engineering modules (UNESCO, 2024). In industry, pilot applications were tested in technology startups focusing on workflow automation and AI governance, where the framework informed workforce upskilling initiatives and training design (World Economic Forum [WEF], 2025). The iterative validation confirmed that the CACF provides a flexible yet structured template adaptable across domains. By aligning theoretical rigor with empirical feedback, the model offers a scalable foundation for embedding AI competencies into professional development, institutional training, and public policy design.

6. Discussion and Implications

The findings of this study focus that the Comprehensive AI Competency Framework (CACF) offers a multidimensional lens for understanding how cognitive, technical, and adaptive capabilities interact to prepare individuals and organizations for the AI-driven future (Figure 3). The integration of competencies such as prompt engineering, workflow automation, and continuous learning illustrates that modern AI proficiency is not merely about technical mastery but about synthesizing creativity, ethics, and adaptability. As Brynjolfsson et al. (2025) demonstrate, generative AI augments human productivity and decision-making, but its full benefits emerge only when supported by deliberate upskilling and strategic workforce design. The CACF therefore responds to the urgent call for frameworks that connect human potential with AI capacity in a balanced, ethically grounded manner.

From an educational perspective, the framework provides a blueprint for embedding AI literacy across disciplines. It aligns with UNESCO's (2024) recommendations for integrating ethical reasoning, multimodal problem-solving, and human-centred design into curricula. Universities can adopt the CACF to redesign programs that move beyond coding toward applied creativity, adaptive reasoning, and interdisciplinary collaboration. In doing so, the framework bridges a key gap between AI theory and practice, enabling learners to evolve from consumers of AI tools to co-designers of intelligent systems. Within industry settings, the CACF supports strategic workforce transformation by linking automation, governance, and innovation. Dwivedi et al. (2023) emphasize that successful AI adoption depends on aligning technical capabilities with organizational culture and responsible innovation principles. By applying the CACF, companies can structure training around three skill clusters—cognitive/creative, operational, and adaptive—ensuring balanced development. For example, automation-driven roles benefit from integrating workflow-stacking and LLM-management skills, while leadership positions require ethical foresight and continuous learning (OECD, 2024). This alignment promotes both productivity and accountability, ensuring that AI systems enhance rather than replace human judgment.

The policy implications of the CACF are equally significant. National and regional strategies that emphasize AI readiness can leverage the framework to identify critical skill gaps, prioritize investment in reskilling programs, and standardize AI competency benchmarks across sectors.

The World Economic Forum (2025) notes that nearly half of the global workforce will require substantial reskilling within the next five years; frameworks such as the CACF provide the structural foundation to guide such initiatives effectively. Moreover, incorporating the framework into public-sector policy can ensure equitable access to AI education, promote ethical governance, and support inclusive innovation ecosystems.

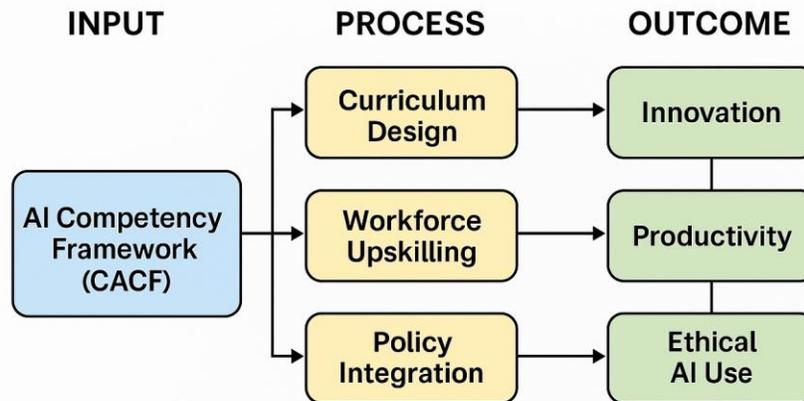


Figure 3. Figure 3. Implementation Model for Integrating CACF into Education, Industry, and Policy Ecosystems

The framework’s cyclical model, where cognition drives automation, automation generates insights, and adaptability ensures renewal, illustrates a sustainable approach to AI capability development. It not only equips individuals to thrive amid technological disruption but also positions organizations and governments to anticipate future shifts. Thus, the CACF contributes to the broader discourse on human-centred AI by translating abstract competencies into actionable strategies for education, workforce management, and policy innovation.

7. Conclusion and Future Research Directions

This study developed the Comprehensive AI Competency Framework (CACF) to define the twelve key skills necessary for a future-ready, AI-literate workforce. The framework integrates cognitive, operational, and adaptive dimensions, emphasizing that AI proficiency requires creativity, ethics, and continuous learning in addition to technical expertise. It bridges theory and practice by offering a structured guide for educators, organizations, and policymakers to design programs that align human potential with emerging AI technologies. For education, the framework encourages interdisciplinary and ethical AI learning; for industry, it supports workforce transformation and innovation; and for policymakers, it provides a foundation for building standardized, inclusive AI readiness initiatives. Future research should focus on testing and refining the framework across different sectors and regions to understand how AI competencies evolve over time. Ultimately, the CACF promotes a human-centred approach to

artificial intelligence—positioning technology as a tool for creativity, inclusion, and sustainable progress.

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