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Integrating AI in TVET

A practical guide for institutions

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Authors: Congkun Yang, Wenxi Wu and Hannes Tegelbeckers
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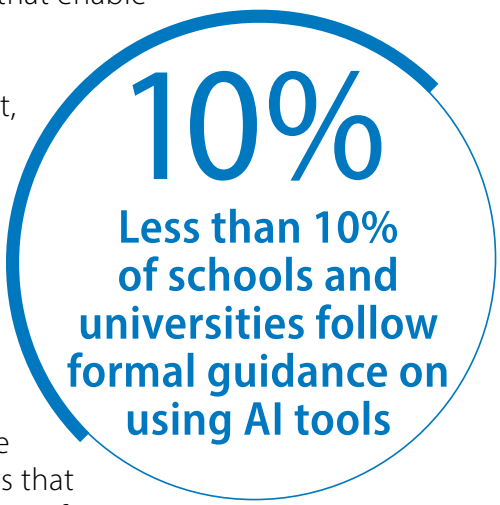
SHORT SUMMARY

Guiding responsible AI integration in TVET institutions

Artificial intelligence (AI) is becoming part of everyday life and the fast-evolving world of work. This is creating a gap between how people already use AI and the formal training required to do so ethically and effectively. Technical and vocational education and training (TVET) institutions need to prepare learners for changing occupational tasks and skill demands, as well as making informed decisions about AI use within institutional practice.

This practical guide supports TVET institutions in developing a coherent approach to AI integration that keeps educational purpose, human agency, equity and safety at the centre. It helps institutions harness the potential of AI with a clear understanding of its impacts, limitations and risks.

The guide presents principles for ethical and responsible AI use and examines the ecosystem conditions that enable AI-ready TVET. It proposes an institution-wide approach covering AI governance, programme and curriculum development, pedagogy and training delivery, assessment, competency development, AI use in safety-critical occupations, innovation and entrepreneurship, as well as monitoring and evaluation.



TVET policy-makers, institutional leaders, educators and other TVET professionals are invited to use the guide as a reference for planning and implementing AI in ways that strengthen the quality and relevance of TVET for successful and just transitions.

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"Since wars begin in the minds of men and women, it is in the minds of men and women that the defences of peace must be constructed"

Integrating AI in TVET

A practical guide for institutions

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Acronyms and abbreviations

AI	Artificial intelligence
AI CFS	AI competency framework for students
AI CFT	AI competency framework for teachers
ALECSO	Arab League Educational, Cultural and Scientific Organization
AR	Augmented reality
ASEAN	Association of Southeast Asian Nations
BILT	Bridging Innovation and Learning in TVET
BIM	Building information modelling
Cedefop	European Centre for the Development of Vocational Training
CPD	Continuing professional development
GenAI	Generative artificial intelligence
GSA	Global Skills Academy
ICT	Information and communication technology
IIEP	International Institute for Educational Planning
ILO	International Labour Organization
LAC	Latin America and the Caribbean
LLM	Large language model
OECD	Organisation for Economic Co-operation and Development
OSH	Occupational safety and health
RAM	Readiness Assessment Methodology
SEAMEO VOCTECH	Southeast Asian Ministers of Education Organization's (SEAMEO) Regional Centre for Vocational and Technical Education and Training
SME	Small and medium-sized enterprise
TVET	Technical and vocational education and training
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-UNEVOC	UNESCO International Centre for Technical and Vocational Education and Training
VR	Virtual reality

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Foreword

The opportunities presented by artificial intelligence (AI) come with a responsibility to ensure that technological advances do not diminish human agency. Striking the right balance between innovation and equity is one of the defining challenges facing education and training systems today.

Technical and vocational education and training (TVET) stands at the forefront of this transformation. As the bridge between learning and the world of work, TVET plays a critical role in preparing learners for changing labour markets. AI is already reshaping the competencies required across many occupations, as well as how teaching, learning, assessment and institutional management are designed and delivered. TVET systems and institutions therefore have an imperative to engage with AI in thoughtful, deliberate and purposeful ways.

UNESCO has long supported Member States in harnessing the potential of digital technologies while safeguarding fundamental human values and rights. The practical guide on the integration of AI in TVET builds on UNESCO's normative and policy work in this area, including the Recommendation on the Ethics of Artificial Intelligence, the AI competency frameworks for students and teachers, and UNESCO's guidance on generative AI in education and research. Together, these instruments provide a foundation for ensuring that AI serves people, expands learning and contributes to the public good.

This publication translates global principles into practical considerations for the TVET sector, recognizing that effective AI integration extends beyond the adoption of new tools. It requires clear governance, investment in institutional capacities and a focus on educational objectives. Above all, it calls for approaches that place learners, educators and communities at the centre of decision-making process. Developed through extensive collaboration with members of the global UNEVOC Network and international TVET experts, this guide offers practical recommendations for policy-makers, institutional leaders, teachers and trainers seeking to ensure the relevance, quality and resilience of TVET in an era of rapid technological change.

As AI continues to evolve, there can be no single roadmap that applies to every context. There is, however, a shared responsibility to ensure that its adoption advances inclusion, supports lifelong learning, promotes decent work and contributes to sustainable development. UNESCO remains committed to working alongside Member States and partners in this endeavour.

Qun Chen
Assistant Director-General for Education
UNESCO

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Graham Attwell, *Pontydysgu SL, Spain*

George Bekiaridis, *Active Citizens Partnership, Greece*

Egle Celiesiene, *Vilnius Business College, Lithuania*

Sriya Chakravarti, *Higher Colleges of Technology, United Arab Emirates*

Twaambo Chiinza, *Technical and Vocational Teachers' College, Zambia*

Rachael Chikoore, *Harare Institute of Technology, Zimbabwe*

Carlos Corrales Tapia, *Tungurahua Higher Technological Institute, Ecuador*

Irina Dimitrova, *Institute for Training of Personnel in International Organizations, Bulgaria*

Reza Fajarsyah, *Ministry of Manpower of the Republic of Indonesia*

Samer Fayez Alsawalgeh, *Vocational Training Corporation, Jordan*

Mao Garzón Quiroz, *Humane Technological Institute, Ecuador*

Craig Andrew Gibbs, *JET Education Services, South Africa*

Samson Mburu Gitau, *National Industrial Training Authority, Kenya*

Meline Grigoryan, *Standford University, USA*

Pablo Hernández Valerio, *National Institute of Apprenticeship (INA), Costa Rica*

Affero Ismail, *Universiti Tun Hussein Onn Malaysia*

Christian K. Karl, *University of Duisburg-Essen, Germany*

Rusudan Makhachashvili, *Borys Grinchenko Kyiv Metropolitan University, Ukraine*

Cher Ping Lim, *Hong Kong S.A.R., China*

Alejandro Piñón Méndez, *Ministry of Education, Mexico*

Simona Michelon, *University of Reggio Emilia, Italy*

Robert Mitton, *BRITEthink, United Kingdom*

Oliver Nahm, *Federal Institute for Vocational Education and Training (BIBB), Germany*

Hugo Nakatani, *National Service for Industrial Training (SENAI), Brazil*

Arnaldo Ramírez Fernández, *National Service for Industrial Work Training (SENATI), Peru*

Leena Ramtohul-Keerodhur, *Human Resource Development Council, Mauritius*

Swaran Ravindra, *Fiji National University*

Abosede Adenike Rufus, *Yaba College of Technology, Nigeria*

Cassandra Sturgeon Delia, *Malta College of Arts, Science and Technology*

Daniel Taylor, *Delegation of German Industry and Commerce in Ghana*

Robert Nicky Tjano, *University of South Africa*

Thomas Viik, *University of Eastern Finland*

Huanhuan Wang, *Beijing Normal University, China*

Isakova Zebo, *Kimyo International University in Tashkent, Uzbekistan*

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1. Introduction

1.1 Why integrating AI matters for TVET

Technical and vocational education and training (TVET) plays a central role in periods of economic, social and technological transition. It connects education with the world of work and helps young people and adults develop the skills needed for employment, decent work, entrepreneurship and lifelong learning. The UNESCO Strategy for TVET 2022–2029 presents TVET as a catalyst for digital and green transitions and sets out three priorities: developing skills for individuals to learn, work and live; developing skills for inclusive and sustainable economies; and developing skills for inclusive and peaceful societies (UNESCO, 2022b).

Artificial intelligence (AI) now forms part of the context in which TVET pursues this mandate. Across sectors, AI is changing work organization, job profiles and skills requirements. Some tasks are being automated. Many more are being reshaped through closer interaction between people and AI systems. AI also affects how people access information, build social relationships, form digital identities and exercise agency in learning, work and civic life. In TVET institutions, AI is increasingly used in teaching, learning, assessment, administration and learner support. TVET institutions therefore need to prepare learners for this changing context and make judicious use of AI to enhance the quality and relevance of education and training.

UNESCO's work on AI in education places ethical governance, human rights and human capacity development at the centre of AI use (UNESCO, 2022a, 2023b, 2024b). In TVET, AI should strengthen occupational competence and human expertise, rather than displace professional judgement or create technological dependence. AI integration therefore goes beyond adopting AI tools for selected tasks. It involves embedding AI-related decisions across strategy, governance, programme design, staff development and everyday teaching and training practice. Because TVET operates at the interface between education and work, occupational standards, qualification systems, employer engagement, work-based learning, labour-market intelligence and school-to-work transitions all inform institutional approaches to AI integration.

AI integration in TVET builds on the wider process and conditions of digital transformation. UNESCO defines digital transformation in TVET as the 'planned and structured introduction of technology into institutions and national TVET systems, with the goal of enhancing scope, scale, efficiency and effectiveness, ultimately driving more sustainable development' (UNESCO, 2023a, p. 19). AI integration depends on many of the same foundations, including infrastructure, connectivity, data systems, staff capacity, organizational culture, governance arrangements and sustainable financing. These foundations shape what institutions can realistically implement. At the same time, AI raises specific questions that digital transformation does not fully address, such as how algorithmic tools affect professional judgement, assessment validity, data protection, transparency and accountability.

AI integration also needs to reflect the diversity of TVET contexts. Institutions serve different learner groups and labour markets, and they operate across urban, rural, work-based, community-based and low-connectivity settings. Language, culture, disability inclusion and local occupational practice shape how AI tools are accessed and used. These factors matter because AI systems may perform unevenly across languages, data contexts and workplace settings. For TVET institutions, context-sensitive AI integration is therefore essential to protect equity and inclusion and respond to local learning, work and development needs.

1.2 Purpose of this guide

This guide supports TVET institutions in responding to AI in deliberate, responsible and context-appropriate ways. It brings together ethical, contextual and practical considerations to inform institutional decisions on AI use, with particular attention to human oversight, occupational relevance, equity and safety.

The guide uses the term AI broadly to refer to AI systems and applications that process data and information, generate content, identify patterns, support prediction or decision-making, or operate with varying degrees of autonomy. In TVET contexts, this includes generative

AI (GenAI), data-driven systems, AI-assisted analytics, simulation-related applications and AI embedded in workplace and training technologies. Many institutions first encounter AI through general-purpose AI tools, and their capacity to use AI differs widely across systems and regions.

The primary audiences are TVET institutional leaders, teachers and trainers, curriculum and assessment staff, and other staff involved in institutional planning and delivery. The guide is also relevant to policy-makers, qualification authorities, workplace learning providers and partners supporting TVET development, as they help shape the system-level conditions for institutional action.

This is a practical guide for institutional planning and implementation, rather than a manual for operating specific AI applications. Its focus is on the considerations, conditions and priority actions that can help TVET institutions engage with AI ethically and effectively.

1.3 How to use this guide

This guide moves from context and principles to ecosystem conditions, institutional practice and recommendations. Chapter 2 explains how AI is influencing work, skills and qualifications, and situates AI integration in current TVET policy and practice. Chapter 3 sets out principles for ethical and responsible use. Chapter 4 considers the wider TVET ecosystem, including stakeholder engagement and enabling conditions. Chapter 5 provides practical guidance across core domains of institutional work, supported by tools for AI readiness self-assessment, risk review, and monitoring and evaluation. Chapter 6 presents recommendations for policy-makers, TVET institutions, and TVET teachers and trainers.

Readers may use the guide selectively according to their role and needs. Policy-makers may focus on the context, ecosystem and recommendations chapters. Institutional leaders may use the principles, ecosystem and implementation chapters to inform planning and governance. Teachers, trainers and other staff members may find the institutional practice chapter most directly relevant. These entry points should be considered in relation to the guide as a whole, because decisions in one domain affect what is possible in others.

No institution starts from the same position. National policy direction, infrastructure, funding, human resources, language and culture, and industry readiness all shape what can be done in practice. The guide should therefore be used as a resource for phased and purpose-led decision-making adapted to local conditions.

2. Context

AI is changing work, skills demands and occupational competence requirements across sectors and regions. For TVET systems, understanding these changes is important to keep programmes, qualifications and institutional practice relevant. This chapter examines the influence of AI on work, skills and qualifications, the current state of AI integration in TVET, emerging policy responses, and the main opportunities and challenges arising from these developments.

2.1 The influence of AI on work, skills and qualifications

Human–AI automation and augmentation

AI is changing work through automation and augmentation. Automation delegates specific tasks to AI systems, especially where processes are repetitive, standardized or rule-based. Augmentation supports human performance while people retain responsibility for interpretation, supervision and action. Both modes can coexist in the same occupation or workplace (Nguyen and Elbanna, 2025).

Current evidence points mainly to task-level change

Automation is concentrated in routine administrative, claims processing and machine-adjustment tasks. Clerical support occupations remain the most exposed category globally but exposure is also extending into digitized professional and technical fields (ILO, 2025b). Job displacement can still be significant. In five Association of Southeast Asian Nations (ASEAN) countries, robot adoption displaced an estimated 1.4 million low-skilled formal jobs even as it created new skilled opportunities (Arias et al., 2025).

Augmentation is becoming more visible across service and industrial settings. Few jobs consist only of tasks that current AI can fully automate, and workplace reorganization appears more common than wholesale redundancy (ILO, 2025b). In customer service and insurance processing, AI systems handle standard queries and simple claims, whereas human workers manage contested decisions and irregular cases. In manufacturing, AI supports quality assurance and machine control, shifting human roles towards monitoring, troubleshooting and edge-case intervention (Milanez, 2023).

The balance between automation and augmentation varies across sectors and workplace contexts. TVET learners therefore need preparation for tasks delegated to AI systems, as well as for work requiring judgement, verification and accountable human intervention.

Broadening demand for hybrid skills

AI-related skills demand is widening across occupations. Emerging profiles combine technical and transversal capabilities. Demand is rising for AI and big data, cybersecurity and technological literacy, alongside analytical thinking, resilience and lifelong learning (World Economic Forum, 2025). In highly AI-exposed occupations, complementary skills often include management and business capabilities such as project management and communication (Green, 2024).

Labour-market data show a similar pattern. In four African labour markets, nearly half of online job postings require at least one digital skill. Advanced digital skills reached 20 per cent of postings by 2024, while AI-related skills remained below 0.6 per cent. Transversal skills such as problem-solving and teamwork are prominent across occupational clusters (Chinen and Montorsi, 2025). AI-related change is expanding demand for hybrid profiles more quickly than for specialist AI roles.

The supply of AI-related education and training remains concentrated in information and communication technology (ICT) fields. As AI spreads into sectors such as health, agriculture and social services, limited training provision in these areas may create gaps in sector-specific AI competencies (Bertoletti et al., 2025).

Upskilling, reskilling and qualification adaptation

Technological change is accelerating the obsolescence of existing skill sets. Global employers expect up to 39 per cent of workers' core skills to undergo transformation by 2030 (World Economic Forum, 2025).

Among European workers, 61 per cent believe AI will result primarily in new skill requirements, and 42 per cent consider that they need knowledge in using AI tools (Cedefop, 2025). UNESCO-UNEVOC's (2025b) survey found that 62 per cent of youth use AI in practical learning and work contexts, whereas only 30 per cent have received formal instruction.

Qualification and assessment systems are beginning to adapt. Occupational standards are expanding to include responsible AI use, data protection, accountability and related legal requirements, as shown by the United Kingdom's (UK) new AI and automation practitioner standard (Skills England, 2026). In New Zealand, the qualifications authority has issued integrity guidance and is piloting AI-assisted marking under the principles of transparency and accountability (NZQA, 2025). Micro-credentials and other short credentials are emerging for timely upskilling in occupational AI competencies.

For TVET, this points to more frequent review of occupational standards, particularly in clerical support, business services, manufacturing inspection, finance and customer-facing roles. Assessment systems also need fresh approaches to establish authentic individual performance in AI-mediated tasks.

Uneven exposure and readiness

AI exposure and readiness vary sharply across economies. In high-income economies, job exposure to GenAI is around 32 per cent of total employment. Low-income economies have around 15 per cent exposure but face infrastructure bottlenecks that limit their ability to benefit from GenAI and manage risks (UN and ILO, 2026). Workers with similar occupational titles can therefore have different levels of AI readiness depending on country context (Gmyrek et al., 2026).

Regional patterns also differ. In Latin America and the Caribbean, weak workplace digitalization constrains much of the potential for AI augmentation. At the same time, automation in exposed formal jobs could push more workers into informality if transition support is inadequate (Gmyrek et al., 2024). In East Asia and the Pacific, robot and AI adoption has increased overall manufacturing employment by creating skilled formal jobs while displacing lower-skilled ones (Arias et al., 2025).

The impact of AI is uneven across gender. Women face higher exposure to GenAI because they are concentrated in occupations such as business administration, clerical support and call centre work (UN and ILO, 2026). In TVET systems, young women remain under-represented in highly digitized vocational fields, limiting their access to high-demand technical AI-related competencies (UNESCO-UNEVOC, 2025b). Similar inequalities affect other groups, such as older workers and people in precarious employment, who often have limited access to AI-related learning and transition support.

2.2 Current state of AI integration in TVET

AI integration in TVET is developing rapidly, but remains early, transitional and fragmented. AI-related teaching and training activities are visible across regions. However, they are still concentrated in pilots, short courses, innovation hubs and selected programme offerings rather than whole-institution embedding. Recent TVET research similarly suggests that AI integration is neither linear nor uniform, and is constrained by infrastructure, inclusion and institutional readiness (Lai et al., 2026).

The degree of AI integration is also shaped by occupation. It is strongest in fields close to software, data and automation, including ICT, advanced manufacturing, robotics and engineering design. It remains weaker in traditional trades and service fields, where learning depends more heavily on tacit skill, direct observation, psychomotor performance and supervised practice.

Main areas of current AI use in TVET

Current AI applications in TVET cluster around five areas, although evidence remains uneven and often comes from institutional cases rather than systematic surveys.

- **Pedagogical support and teacher capacity building**
  Large language model (LLM)-based tools are increasingly used to support teaching practices. UNESCO Global Skills Academy (GSA) and partners have supported TVET teachers' AI capacity building through a bootcamp in Malaysia and a train-the-trainer approach in Kenya (UNESCO, 2025, 2026a). The AI-supported Self-learning System for Educator Training (ASSET), a UNEVOC Network Coaction Initiative involving institutions from Germany, Mauritius and Sri Lanka, provides teachers with multilingual self-paced training materials (Illig, 2025).

- **Curriculum and labour-market alignment**
  AI-powered platforms can support more responsive curriculum planning. Jamaica's Labour Market Information Portal (LMIP) uses real-time data from job postings and employer surveys to inform curriculum reform. China's industry–education mapping tool aligns vocational programmes with demand across 18 sectors. Brazil's National Industrial Apprenticeship Service (SENAI) uses AI tools to monitor learning outcomes and adjust programme offerings based on labour-market shifts (IIEP–UNESCO, 2025).

- **Training delivery, simulation and practical learning**
  AI-supported simulation tools allow learners to practise complex or high-risk tasks in controlled settings and receive more immediate feedback. Current applications are mainly found in manufacturing and technical trades such as welding, robotics and automotive training, where equipment may be limited, expensive or unsafe for repeated use (Zary and Zary, 2025).

- **Career guidance and learner support**
  AI-based career guidance tools extend counselling reach to underserved learners. Examples include South Africa's Tshepo 1Million platform, India's KnackApp, and platforms in Canada, Singapore and Belgium that offer personalized job matching and skill-gap diagnostics (IIEP–UNESCO, 2025).

- **Institutional administration and workflow**
  AI is used for routine institutional processes such as information management, drafting, communications, scheduling and reporting, which reduces some of the administrative workload for TVET staff.

Institutional initiatives in AI integration

Institution-level initiatives provide a concrete view of how AI integration is beginning to take shape in TVET across regions.

In **South Africa**, the Department of Higher Education and Training (DHET) launched a Digital Innovation Lab at Esayidi TVET College in 2025, exposing students to AI, robotics, virtual reality and coding. The initiative puts AI in a wider digital inclusion agenda in a system where roll-out remains uneven (DHET, 2025).

In **Morocco**, the public training provider Office of Vocational Training and Employment Promotion (OFPPT) has established Digital and Artificial Intelligence Professions as a distinct training domain. The offer includes diploma and short qualifying pathways across digital development, digital design and digital infrastructure, and an explicit AI career strand (OFPPT, no date).

In **Singapore**, Temasek Polytechnic's FutureX centre illustrates a whole-institution entry point. It combines student and staff training, industry-in-residence partnerships, continuing education, joint projects and workshops on generative AI, including prompt design, assessment and ethics (Temasek Polytechnic, 2024).

In **Croatia**, the elective subject Artificial Intelligence: From Concept to Application was piloted across 53 TVET schools in 2024/25. The curriculum combines practical work with AI tools and digital content creation with reflection on ethical and digital safety issues (ReferNet Croatia and Cedefop, 2025).

In **Colombia**, the National Training Service (SENA) has incorporated AI into its mainstream training offer. In its first 2025 intake, it offered 294 in-person and distance programmes and 37,000 places, including provision in technology and AI across regional offices and training centres (SENA, 2024).

These cases reflect different institutional entry points, from innovation labs and AI career pathways to whole-institution hubs, curriculum pilots and mainstream programme renewal. They show that AI integration in TVET is becoming more structured, but remains uneven across contexts.

2.3 Policy responses

Policy responses to AI in TVET have emerged across international, regional and national levels, though with varying degrees of specificity. For TVET institutions, their practical value lies in clarifying what AI integration should align with, such as ethical standards, digital transformation strategies, qualification systems, data protection rules and sector skills priorities. In recent years, policy activity has expanded quickly, while operational guidance for implementation remains uneven.

International and regional frameworks

At the international level, UNESCO has led the normative response. The *Recommendation on the Ethics of Artificial Intelligence* urges Member States to support responsible AI use in teaching and teacher training and to apply strict data protection conditions to AI systems used in learning (UNESCO, 2022a). The AI competency frameworks for teachers (AI CFT) and for students (AI

CFS) provide global reference points for developing AI competencies among teachers and learners (UNESCO, 2024b, 2024a). UNESCO's *Guidance for Generative AI in Education and Research* complements the frameworks by addressing the regulation and validation of GenAI tools and their implications for teaching, learning and assessment (UNESCO, 2023b).

The International Labour Organization (ILO) contributes evidence on AI, labour markets and skills systems, including practical guidance on the digitalization and blending of training programmes (ILO, 2025a). The World Bank's Digital Progress and Trends Report 2025 frames AI readiness around four foundations: 'connectivity, compute, context and competency', and documents disparities in AI-related skills demand between high-income and developing economies (World Bank, 2025). These contributions provide evidence and readiness frameworks for TVET policy on AI, skills and system development.

At the regional level, policy responses increasingly place TVET within broader digital and AI agendas.

- The African Union's Continental AI Strategy adopts a development-oriented and inclusive approach to AI capability-building and investment in Africa. For TVET, this highlights the relevance of AI-related skills development and alignment with national AI and digital transformation agendas (African Union, 2024).

- The ASEAN TVET Council Work Plan 2021–2030 promotes more market-responsive and digitally ready TVET systems through labour-market information, skills needs anticipation, industry cooperation, trainer capacity development, flexible delivery and assessment, and skills development aligned with Industry 4.0 (ASEAN TVET Council, 2022).

- The European Union (EU) links digital education, vocational education and training, and AI governance through the Digital Education Action Plan 2021–2027, the Osnabrück Declaration, the Herning Declaration and the EU AI Act. The EU AI Act classifies AI systems used in education and vocational training as high-risk, requiring safeguards such as transparency, human oversight and data protection (European Commission, 2020, 2024).

- The Arab League Educational, Cultural and Scientific Organization (ALECSO) Charter on Artificial Intelligence Ethics addresses responsible AI use in education, culture and science. For education and training, it emphasizes AI ethics, digital skills, human oversight and preparation for changing labour-market demands (ALECSO, 2025).

- The Inter-American Development Bank's fAIr LAC initiative promotes responsible AI use in Latin America and the Caribbean through AI pilot projects, ethical evaluation tools and policy engagement in areas such as education, health, social protection and labour markets (Inter-American Development Bank, 2020).

National policies

Countries are translating these international and regional frameworks into national-level instruments, though with significant variation in scope and TVET specificity (**Table 1**).

TABLE 1 National policies relevant to AI and TVET

Policy function	Focus	Examples
National AI or digital strategy with skills and education provisions	AI governance or digital economy strategies covering education, skills and workforce preparation	• India (2018): National Strategy for Artificial Intelligence • Malaysia (2021): Malaysia Digital Economy Blueprint • Chile (2021): National Artificial Intelligence Policy • Jordan (2022): Artificial Intelligence Strategy and Implementation Plan 2023–2027 • Kenya (2025): Kenya Artificial Intelligence Strategy 2025–2030
TVET-specific digital or AI policy	TVET policies addressing AI or digital transformation in delivery, curricula or institutional practice	• China (2025): Guidelines on Artificial Intelligence Applications in Vocational Institutions • Tanzania (2025): National Digital Education Guidelines for Technical and Vocational Education and Training
Qualification and curriculum reform embedding digital or AI skills	Reforms integrating digital or AI-related competencies into occupational standards, training standards or qualification frameworks	• Germany (2021): modernized standard occupational profile items, including *Digitalisierte Arbeitswelt* (digitalized world of work), embedded across all dual-system training regulations
AI ethics and governance instruments relevant to education and training	Ethics or governance frameworks with provisions relevant to public-sector AI use, including education and training	• Jordan (2022): National Artificial Intelligence Code of Ethics

The policy gap

Rapid policy production continues to sit alongside persistent implementation challenges. A gap remains between high-level policy formulation and practical delivery. A discussion paper on policies for the digital transformation and integration of AI in TVET, developed as part of the UNESCO-UNEVOC Bridging Innovation and Learning in TVET (BILT) project, highlights the limited involvement of frontline actors in policy development and calls for more continuous co-design with practitioners (UNESCO-UNEVOC, 2026a). Similar concerns are reported in Europe, where national AI strategies are now widespread but systematic provision for vocational teacher training remains weak (Tegelbeckers et al., 2025).

This gap also lies between institutional policy and everyday professional judgement. TVET teachers, trainers and institutional leaders need supported spaces to test AI tools, reflect on their effects on occupational competence and assessment integrity, and build shared judgement. Responsible implementation therefore requires structured institutional learning alongside formal policy adoption.

2.4 Opportunities and challenges

AI in TVET presents opportunities and challenges. The following are particularly prominent.

Opportunities

Improved practical training where equipment is costly, scarce or hazardous. AI-supported simulation and extended reality tools can broaden access to practice and provide feedback where physical equipment is expensive, limited or unsafe for repeated use.

More responsive curricula and programme offerings. AI-supported labour-market intelligence can help institutions to identify emerging skills demands and inform curriculum review, modular design and programme mapping.

Expanded learner support and career guidance. AI-based guidance and matching platforms can extend counselling services to learners who have limited access to conventional provision, especially in large TVET systems.

Stronger support for TVET teachers and trainers. AI tools can reduce time spent on routine tasks such as preparing materials, summarizing information and supporting feedback. This creates more space for mentoring, practical supervision and formative support.

Innovation and applied problem-solving. AI tools can help TVET learners who have limited resources to develop prototypes and address applied problems linked to workplaces and communities.

Challenges

Infrastructure, cost and sustainability gaps. AI tools depend on reliable connectivity, adequate devices and stable electricity. Even where initial access is secured, recurring costs, procurement constraints and short-term pilot funding can make sustained use difficult.

Capability gaps among TVET staff and leaders. Effective AI integration requires capacity across the institution. Progress is weaker where AI is treated as a stand-alone technology initiative rather than part of broader institutional development.

Governance and policy-to-practice gaps. Many TVET institutions lack clear guidance on AI use, assessment integrity, data handling and vendor relationships. Where governance is weak, external providers can end up shaping educational practice by default.

Equity risks. AI systems can reproduce or intensify existing inequalities through biased outputs, uneven language performance or unequal access to infrastructure and support. These risks are acute for learners already affected by digital exclusion.

Pedagogical and assessment misalignment. AI can make it easier for learners to produce competent-looking work without demonstrating underlying knowledge. Product-oriented assessments are becoming less reliable in AI-supported workflows. Assessment therefore needs to give greater attention to process, judgement and authentic vocational competencies.

3. Principles for the ethical and responsible use of AI in TVET

Technology has altered almost every aspect of life, including education and training (UNESCO-UNEVOC, 2020b; UNESCO, 2022b, 2023b; Deckker and Sumanasekara, 2025). This chapter establishes the core ethical principles that underpin any institutional AI strategy in TVET. These principles are practical decision-making tools that shape procurement, curriculum design, assessment, data management and professional development.

Core principles for institutional AI governance

Five interconnected principles form the foundation of ethical AI governance in TVET institutions. Each principle has direct implications for policy and practice.

Human agency and teacher authority. Teachers have to remain the primary pedagogical decision-makers. AI can assist with data processing, preliminary feedback and content recommendations, but it cannot replace professional judgement. Institutional policy needs to structure AI use so that teachers retain authority over curriculum choices, assessment decisions and the interpretation of AI-generated outputs (Nguyen et al., 2022; Luckin et al., 2022).

Equity and non-discrimination. AI systems should be designed and governed to serve all learners fairly, regardless of their gender, socio-economic background, geographic location or disability status. This requires proactive effort – it is not enough to simply avoid obvious harm. Institutions have to actively test AI tools for bias and ensure that infrastructure investments reach learners in rural and low-resource settings (Amdan et al., 2024; Joseph et al., 2025).

Pedagogical purposefulness. Every AI tool adopted by a TVET institution needs to be justified in terms of its contribution to a specific learning outcome. AI should serve vocational pedagogy, rather than drive it. Institutions have to resist the adoption of technology for its novelty or administrative convenience alone (Suparyati et al., 2024; Deckker and Sumanasekara, 2025).

Transparency and explainability. Learners and teachers need to be able to understand why an AI system produced a particular output, whether it is a grade, a learning recommendation or a flag for further support. Opaque systems undermine trust and prevent meaningful learning from the process. Institutions should mandate that all AI tools deployed in assessment or guidance provide an explainable rationale for their outputs (Foltýnek et al., 2023; Fu and Weng, 2024).

Accountability and data protection. When AI contributes to decisions about learner progression, certification or career guidance, the ultimate responsibility has to rest with a qualified human educator or administrator. Clear lines of accountability should be established in institutional policy. At the same time, learner data need to be treated as sensitive and protected under a robust data governance framework that applies principles of data minimization, consent and security (Nguyen et al., 2022; Peñalvo et al., 2024).

From principles to practice

The translation of ethical principles into institutional practice requires embedding them in concrete policy decisions. **Table 2** illustrates how each principle translates into a policy action and its pedagogical rationale.

FIGURE 1 Core principles for institutional AI governance

TABLE 2 Translating ethical principles into policy and pedagogy

Ethical principle	Policy action	Pedagogical rationale
Human agency	Mandate that all AI-assisted assessments include a human review step	Acknowledges the professional role of the TVET teacher and learner
Equity	Conduct an equity impact assessment before deploying any AI in assessment or guidance	Prevents algorithmic bias from disadvantaging marginalized learner groups
Pedagogical purposefulness	Require a written competency rationale for every AI tool procurement	Ensures technology serves skills development, not institutional prestige
Transparency	Require that all AI tools provide a plain-language explanation of their outputs	Supports learner understanding and enables meaningful feedback
Accountability and data protection	Establish an institutional AI ethics committee that has oversight over all deployments and a data minimization policy: collect only what is necessary for the stated pedagogical goal	Creates a structured governance mechanism that has clear lines of responsibility while the policy builds learner trust and protects sensitive performance data from misuse

3.1 Human-centred approach to AI

AI as augmentation, not replacement

The most important distinction for any TVET institution considering AI adoption is between augmentation and replacement. Augmentation uses AI to extend human capability: to give a trainer better information, to give a learner more targeted practice or to give an administrator clearer data for decision-making. Replacement removes the human from the process, substituting automated judgement for professional expertise. TVET institutions should adopt augmentation as the guiding principle for all AI deployment. This means structuring every AI application so that the teacher remains in a supervisory and interpretive role. An intelligent tutoring system, for example, can track a learner's progress through a simulation and generate detailed feedback. However, the teacher needs to review this feedback, put it in the context of the learner's broader development and decide how to act on it. Automated assessment tools can speed up marking and identify patterns across a cohort. Nevertheless, teachers have to verify the results and retain the authority to adjust grades based on contextual knowledge (Nguyen et al., 2022; Onatere-Ubrurhe and Ubrurhe, 2025). Furthermore, research consistently shows that the effectiveness of AI in education depends not on the sophistication of the tool itself, but on the quality of the human judgement surrounding it (Luckin et al., 2022). For TVET institutions, this finding has a clear policy implication: investment in teacher capacity is as important as investment in technology.

Placing the learner at the centre

Human-centred AI in TVET means designing not only for institutional efficiency, but also for the learner's experience. Learners need to understand what AI is doing in their learning environment, how it affects their assessment and what recourse they have if they disagree with an AI-generated outcome. Institutions should provide clear, accessible information to learners about every AI tool in use, written in plain language and free of technical jargon (Chan, 2023; Foltýnek et al., 2023).

Learners also need to retain agency in AI-enhanced learning environments. They should be able to see their data, understand how these data are being used and have the ability to raise concerns. AI-driven adaptive learning systems should be presented as tools the learner can use, not systems that act on the learner without their awareness or participation. This distinction matters especially in TVET, where many learners have had limited prior experience with formal educational technology and may be more vulnerable to feeling surveyed or judged by opaque systems (Peñalvo et al., 2024; UNESCO, 2023b).

Participatory design: involving all stakeholders

The human-centred approach extends to how AI tools are selected and configured. Institutions should not adopt AI tools developed entirely outside the TVET context without adapting them to local needs. Wherever possible, tool selection and customization should involve the full range of stakeholders who will use or be affected by the technology: teachers, learners, industry partners and community representatives (Esposito et al., 2025). Participatory design does not require technical expertise from all participants. What it requires is structured dialogue about needs, concerns and values. Institutions can organize co-design workshops that bring together these perspectives before they finalize procurement decisions. This process improves the relevance and acceptability of the resulting tools and builds the trust that is essential for sustained adoption.

3.2 Equity, inclusion and non-discrimination

TVET systems exist to open pathways to decent work and social participation for all members of society, including those who face the greatest barriers. This foundational mission makes equity the primary lens through which AI adoption has to be evaluated. When AI tools are introduced without deliberate attention to equity, they risk reinforcing existing inequalities. Historical biases may be embedded in automated decisions, deepening the digital divide between well-resourced and under-resourced institutions, and excluding learners who do not conform to the characteristics of the majority dataset (UNESCO, 2022a; Abulibdeh et al., 2024).

Defining the terms

Equity in AI for TVET means that every learner has access to the quality of educational experience that their needs require. Equal treatment – giving everyone the same tool or the same score – is not sufficient when learners start from different positions. An equitable AI system adapts to support those who need it most, without penalizing them for the disadvantages they already face.

Inclusion is an active commitment to removing the structural, economic, physical, linguistic and cultural barriers that prevent specific groups of learners from fully participating in AI-enhanced learning environments. Inclusion is a process, not a fixed state: institutions need to continuously monitor and respond to emerging barriers as their use of AI evolves.

Non-discrimination means that AI tools should not disadvantage any learner on the basis of protected characteristics, including gender, race, disability, socio-economic background, geographic location (urban or rural) or language background. This applies not only to the design of the tool, but also to the data on which it is trained and the way its outputs are interpreted and acted on.

Risks of AI-driven inequity in TVET

The most significant equity risk in AI for TVET is algorithmic bias. This is the tendency of AI systems to produce systematically different outcomes for different demographic groups, usually as a result of biased training data or biased design assumptions. In TVET contexts, it can take several forms.

- **Assessment bias:** AI assessment tools trained predominantly on data from one demographic group may evaluate the work of learners from other groups less accurately.
- **Guidance bias:** career and skills pathway recommendation systems may steer learners from certain backgrounds towards lower-status occupations, replicating existing labour market inequalities rather than challenging them.
- **Access inequality:** if AI-enhanced learning requires high-bandwidth connectivity or expensive devices, it will systematically disadvantage learners in rural and low-income communities.

Research indicates that these risks are not hypothetical. They have been documented in AI systems deployed in educational settings internationally (Beriğel et al., 2025). Consequently, TVET institutions have to treat bias detection and mitigation as an ongoing operational responsibility, not a one-time evaluation task.

Building an equitable AI infrastructure

Embedding equity into AI adoption requires structural changes at the institutional level, beyond the choice of individual tools.

Closing the digital divide. Before institutions deploy AI tools that require reliable internet connectivity or modern devices, they should map the actual connectivity and device access available to all the learners they serve. Where significant gaps exist, institutions could either invest in infrastructure, adopt low-bandwidth alternatives or develop off-line compatible versions of the learning experience. Policies should mandate equitable access across all campuses, training centres and community outreach sites (Niwamanya et al., 2025; Tonui et al., 2025).

Representative training data. AI tools used in TVET, particularly for assessment and guidance, need to be trained on data that are representative of the full diversity of the learner population. Institutions procuring external tools should ask suppliers to provide evidence of the demographic composition of training datasets and the results of bias testing across groups. Institutions that develop their own tools should build diversity requirements into their data collection protocols from the outset (Dhiman et al., 2025).

Equity impact assessments. Before any AI system is deployed for a consequential function, such as admissions, assessment, early intervention or career guidance, the institution should conduct a formal equity impact assessment. This assessment should evaluate the potential for differential outcomes across demographic groups and establish monitoring mechanisms to track outcomes over time.

Inclusive design. AI tools should be designed to work for learners who have diverse needs, including learners with disabilities. This means ensuring compatibility with assistive technologies, supporting multiple languages including local languages, and designing interfaces that are accessible to users with varying levels of digital literacy (UNESCO, 2024c).

3.3 Pedagogical purposefulness

The effectiveness of AI in TVET depends fundamentally on how it is integrated into pedagogy, that is, the art and science of teaching. Technology that is well-designed but poorly integrated into the learning process will not improve outcomes. Conversely, even modest AI tools can produce significant learning gains when they are thoughtfully aligned with specific vocational competencies and supported by skilled, AI-literate teachers (UNESCO-UNEVOC, 2020c; Deckker and Sumanasekara, 2025).

Competency-based learning and AI alignment

TVET is built around the development of specific, verifiable competencies that meet industry standards. This competency focus provides a clear framework for evaluating AI tools: every AI application should be justified in terms of its contribution to a defined competency. Its effectiveness needs to be measured against that competency, not against secondary metrics such as time savings or engagement rates (Deckker and Sumanasekara, 2025).

AI tools are well-suited to supporting competency-based approaches because they can track learner performance across multiple dimensions simultaneously, adapt the difficulty and sequence of tasks to individual learner needs, and provide immediate, detailed feedback on performance. For example, intelligent tutoring systems can give a welding student precise feedback on technique after each simulation attempt. This form of personalized coaching would be difficult for a single instructor to provide consistently across a large cohort (Strielkowski et al., 2025; Kovalchuk et al., 2025).

However, AI-driven personalization cannot become a substitute for the complex, judgement-intensive pedagogy that characterizes skilled TVET teaching. AI can adapt the pace and sequence of content delivery, but it cannot replicate the experienced trainer who recognizes that a learner's technical difficulty is rooted in a conceptual misunderstanding, or the trainer who knows that a learner is struggling because of circumstances in their personal life. These forms of holistic professional judgement remain irreducibly human (Hassan et al., 2021; UNESCO-UNEVOC, 2021; Lampropoulos, 2025).

AI in assessment

Assessment is one of the most consequential applications of AI in TVET and one of the most ethically complex. AI tools can accelerate feedback loops, identify learning gaps before they become serious, and generate detailed records of competency development over time. Automated marking of structured responses can free teacher time for the qualitative mentoring and observation that is at the heart of TVET assessment (Onyango and Kelonye, 2022; Onatere-Ubrurhe and Ubrurhe, 2025). At the same time, assessment decisions in TVET carry significant consequences for learners, affecting their certification, their employment prospects and their professional identity. These stakes require that AI-assisted assessment be governed with care. The following principles should guide any institution using AI in assessment:

- AI tools may support assessment, but a qualified teacher has to make or review all final grading decisions.
- AI assessment needs to be explainable: the teacher has to be able to understand and explain why the AI reached a particular conclusion.
- Learners should have access to a clear process for appealing any assessment outcome where AI played a role.
- AI assessment tools need to be tested for bias before deployment and monitored for differential outcomes across learner groups after deployment.

The redefined role of the TVET teacher

AI adoption changes, but does not diminish, the role of the TVET teacher. In an AI-enhanced environment, teachers shift from being the primary transmitter of information to being the principal guide through a richer, more complex learning environment. They interpret AI-generated data about learner progress, challenge AI outputs that do not align with their professional observation, scaffold learners' engagement with AI tools and model the critical thinking that responsible AI use requires (Schmitt and Brutzer, 2025).

This shift demands new competencies. TVET teachers need not become AI experts, but they do need to understand how the AI tools in their environment work, what assumptions they are based on, where they are likely to fail and how to explain their outputs to learners in plain language. UNESCO's AI CFT (2024b) provides a structured model for developing these competencies across different levels of institutional readiness.

3.4 Transparency, accountability and data protection

The fourth and fifth principles – transparency and accountability – are closely interdependent and are therefore addressed together in this section, alongside the data protection obligations that follow from both. Transparency and accountability are foundational requirements for any institution that uses AI in ways that affect learners' educational trajectories. Without transparency, learners and teachers cannot understand what AI systems are doing or why. Without accountability, there is no clear pathway for redress when AI produces harmful or inaccurate outcomes. Together, these principles protect the integrity of the TVET learning experience and maintain the trust of learners, employers and the broader community (Foltýnek et al., 2023; Yu and Yu, 2023).

Transparency in AI use: disclosure and explainability

Transparency begins with disclosure. Every learner in a TVET institution has the right to know when AI is being used in their learning environment, what it is doing and how it may affect their educational experience. This right to disclosure extends to AI used in learning management systems, adaptive content delivery, assessment, career guidance and attendance monitoring (Chan, 2023; Huang, 2023).

Transparency also requires explainability. When an AI system makes a recommendation or generates an output that affects a learner – for example, a grade, an indicator of a skills gap or a career pathway suggestion – that output needs to be explainable in terms that a teacher and learner can understand and evaluate. Systems that produce outputs without explanations, which are often called 'black box' AI, are not appropriate for use in high-stakes educational contexts (Nguyen et al., 2022; Fu and Weng, 2024).

Human accountability loops

Accountability in AI use means that there is always a clearly identified human who bears ultimate responsibility for the decisions that AI informs. This principle has several practical implications for TVET institutions.

First, no AI system should be positioned as the sole decision-maker for any consequential educational decision. Final authority over assessment, progression, referral for additional support and certification must always rest with a qualified human educator or administrator. AI can inform and support these decisions, but it cannot make them autonomously (Foltýnek et al., 2023; Radanliev and Santos, 2024).

Second, institutions should establish clear audit mechanisms. This means maintaining records of how AI tools have been used, what outputs they have generated and what human decisions have been made in response to these outputs. The records should be reviewed regularly to identify patterns of concern. These include cases where teachers have frequently overridden AI outputs in the same direction, which may indicate a systematic problem with the AI's calibration.

Third, institutions could provide clear, accessible channels through which learners can raise concerns about AI-generated outcomes and seek human review. The existence of these channels should be communicated proactively to all learners, not just in response to complaints.

Data protection and privacy

AI tools in TVET collect and process significant volumes of sensitive learner data. Performance records, behavioural patterns, biometric data from simulations and personal background information are all potentially captured by AI systems. These data need to be treated with the highest level of care (Sgantzos et al., 2025).

Institutions should adopt a privacy-by-design approach, which means that data protection is built into the design of every AI system from the outset, rather than added as an afterthought. Key elements of this approach include:

- **Data minimization**: collecting only the data that are strictly necessary for the stated pedagogical purpose
- **Purpose limitation**: using data only for the purpose for which they were collected, and not repurposing them without explicit consent
- **Consent**: ensuring that learners (and guardians, where applicable) provide informed, specific and revocable consent for data collection
- **Security**: applying robust technical safeguards, including encryption and access controls, to all learner data
- **Retention limits**: establishing and enforcing clear policies on how long learner data are retained and when they are deleted

A minimum standard is compliance with applicable data protection legislation, including the European Union's General Data Protection Regulation (GDPR) for institutions operating in or with the European Union. Institutions operating in regions with less comprehensive data protection legislation should apply internationally recognized standards as a matter of institutional policy (Peñalvo et al., 2024).

Governance: the AI ethics committee

Effective governance of AI in TVET requires a formal, multidisciplinary oversight structure. Institutions should establish an AI ethics committee with responsibility for overseeing the entire AI life cycle, from procurement through to retirement. This committee should include teachers, technical staff, learner representatives and, where possible, an external ethics expert (Yu and Yu, 2023; Esposito et al., 2025).

The committee's responsibilities should include reviewing all proposed AI procurements against ethical criteria, monitoring the ongoing performance of deployed AI tools, responding to concerns raised by learners or teachers, and providing annual reporting to institutional leadership on the state of AI governance. The committee should operate transparently, with its terms of reference and meeting outcomes made available to the institutional community.

3.5 Safety, sustainability and resilience

Beyond the five principles above, responsible AI governance in TVET requires institutions to build the operational capacity to maintain quality and safety when AI systems fail, produce unexpected outputs or are misused. Resilience, in this context, refers to the ability of an institution to maintain the quality, safety and equity of its educational provision under precisely these conditions. As AI tools become more deeply embedded in TVET operations – from admissions and learning management to assessment and career guidance – the risks associated with AI failure or misuse grow correspondingly. Institutions that have not built resilience into their AI strategy will find themselves exposed when problems emerge (Nguyen et al., 2022; Dhiman et al., 2025).

Understanding the risks

AI systems can fail or cause harm in several ways that TVET institutions need to anticipate and plan for.

Technical failure. AI systems can malfunction, produce inaccurate outputs or become unavailable. For TVET institutions, this means that any critical institutional function, including assessment, scheduling and learner support, should retain a viable non-AI pathway so that operations can continue when AI tools are unavailable.

Emergent bias. AI systems that perform equitably at deployment can develop bias over time as the characteristics of the learner population change, the tool is used in contexts its training data did not anticipate, or societal patterns shift in ways that alter the meaning of the data the tool is processing. This phenomenon is sometimes called model drift. It requires ongoing monitoring and regular re-evaluation of AI tools (Klimova et al., 2023; Yu and Yu, 2023).

Misuse and manipulation. Learners and teachers may use AI tools in ways that were not intended. Learners may use generative AI to complete assessed work, or may exploit adaptive learning systems by supplying responses that trigger favourable system outputs rather than demonstrate authentic understanding. Teachers may over-rely on AI outputs and reduce the quality of their professional judgement (Foltýnek et al., 2023; UNESCO, 2023b).

Security and data breaches. AI systems that process sensitive learner data are potential targets for unauthorized access. A security breach involving learner performance data or personal information can have serious consequences for learners and for institutional reputation. Institutions have to apply robust security protocols and ensure that third-party AI providers meet appropriate security standards (Sgantzos et al., 2025).

Building adaptive capacity

Resilient institutions do not merely plan for failure, they also build the capacity to detect problems early and respond effectively. Several organizational practices support this adaptive capacity.

Continuous monitoring and algorithmovigilance. Institutions should establish ongoing protocols for monitoring AI system outputs. This includes tracking performance metrics across learner groups, reviewing the frequency of teacher overrides, and maintaining records of concerns raised by learners and staff. The concept of algorithmovigilance provides a useful operational framework through regular, systematic evaluation and monitoring of AI behaviour to detect emerging problems.

Stakeholder feedback mechanisms. Resilient institutions create structured channels through which teachers, learners and industry partners can report concerns about AI tools. These channels should be genuinely accessible – not buried in institutional policy documents – and lead to real responses. The feedback received through these channels should be treated as a form of institutional intelligence and integrated into ongoing AI governance.

Maintaining human capability. One of the most significant risks of deep AI integration is atrophy of the human capabilities that AI supports. If teachers become so accustomed to AI-generated assessment that they lose the skill to assess independently, the institution becomes dangerously dependent on a single technological pathway. TVET institutions should deliberately maintain and develop the human capabilities that underpin their core functions, to ensure that AI enhances rather than supplants professional skill.

Documentation and audit trails. Every decision in which AI plays a role should be documented, with a clear record of what the AI recommended and what the human decision-maker decided. These audit trails serve multiple purposes. They support accountability, enable learning from errors, provide evidence for appeals and create the institutional memory needed to evaluate AI performance over time.

Sustainability and long-term governance

Resilience also has a long-term dimension. AI governance frameworks need to be designed to endure beyond initial enthusiasm, leadership transitions and technological upgrades. This requires embedding AI ethics into institutional culture rather than depending on the commitment of individual champions.

In institutional cultures of critical engagement, teachers routinely question AI outputs, learners are encouraged to evaluate the tools they use and governance committees genuinely scrutinize AI performance. They are more resilient than cultures where AI is accepted uncritically. Building a critical culture is a leadership responsibility, and it requires sustained investment in professional development, transparent communication and demonstrated institutional accountability (Tubella et al., 2023; Khan et al., 2025).

Institutions should also consider the environmental sustainability of their AI investments. Large-scale AI systems can have significant energy footprints. Consequently, institutions that are committed to broader sustainability goals should factor environmental impact into procurement decisions and operational planning.

3.6 Critical engagement with AI

Translating the five principles into lasting institutional practice ultimately depends on a culture of critical engagement. Critical engagement with AI means more than using AI tools responsibly: it means developing the capacity to interrogate AI systems across the institution, among teachers and learners alike. Relevant questions include who designed the systems, for what purpose, on what data and with what assumptions. This level of engagement transforms AI from a black box that delivers outputs into a system that can be understood, evaluated and held to account (Tubella et al., 2023; Okada et al., 2025). In TVET, critical engagement with AI has particular importance because the sector's graduates will encounter AI in their working lives, often in conditions where the quality and fairness of AI systems will affect their employment, their safety and their professional development. Preparing learners to work critically and confidently alongside AI is therefore not only a pedagogical goal, but also a workforce readiness imperative (UNESCO-UNEVOC, 2021; Sun and Pratt, 2024).

What critical engagement looks like in TVET

Critical engagement requires sustained investment in AI literacy, which is the knowledge and skills needed to understand how AI works, where it succeeds and where it fails. UNESCO's AI competency framework for teachers (2024) provides a useful architecture for this investment at the teacher level. It identifies five competency areas, from basic AI literacy and ethical reasoning to the use of AI for curriculum design, professional development and professional engagement (UNESCO, 2024a). TVET institutions can use this framework as a planning tool for professional development programmes, mapping current staff capabilities against each competency area and designing targeted learning pathways.

For learners, AI literacy should be embedded across vocational programmes, not treated as a stand-alone digital skills module. In a construction programme, this might mean analysing how AI is being used in site management and safety monitoring and discussing its limitations. In a health care programme, it might mean examining the evidence base for AI-assisted diagnosis tools and understanding the regulatory frameworks that govern their use. In each case, the goal is to develop learners who are informed, critical and capable participants in AI-enhanced workplaces.

Embedding critical engagement in curriculum and governance

Curriculum integration of critical AI thinking requires that TVET teachers receive adequate preparation. Professional development programmes should move beyond training teachers to use specific tools. Instead, they should develop teachers' capacity to critically evaluate AI claims, identify potential sources of bias or error, and guide learners through similar evaluations (Esposito et al., 2025).

At the governance level, critical engagement means establishing a culture of questioning technology adoption. When an AI vendor presents a tool as a solution to an institutional problem, the institution's response should be structured inquiry: What evidence supports the claims? What data were used to train the tool? What bias testing has been conducted? What is the appeals process when the tool produces an inaccurate output? What happens to learner data? These questions should be standard features of every AI procurement process, built into the terms of reference of the AI ethics committee (Foltýnek et al., 2023).

Multistakeholder dialogue is also essential. Decisions about AI adoption are not purely technical decisions – they are also about values, priorities and power. Involving learners, teachers, industry partners and community representatives in AI governance processes ensures that these decisions reflect a diverse range of perspectives (Esposito et al., 2025).

Developing a labour market perspective

For TVET institutions, critical engagement with AI should also encompass a clear-eyed analysis of AI's impact on the labour market that their graduates will enter. AI is automating certain tasks, creating new roles and transforming the nature of work across many occupational areas. Institutions have a responsibility to understand these shifts and to design curricula that prepare learners for the labour market as it is evolving, not as it was (UNESCO-UNEVOC, 2021).

This analysis should be conducted in ongoing dialogue with industry partners, who are best placed to describe how AI is reshaping specific occupational areas. Institutions should integrate this intelligence into curriculum review cycles, to ensure that learning outcomes, assessment criteria and practical components reflect the AI-transformed reality of the workplace (Mohamad et al., 2024).

4. Building an AI-ready TVET ecosystem

The ethical principles and pedagogical frameworks set out in Chapter 3 can only be realized within a supportive ecosystem. In TVET, however, learning is not confined to the institution: it is distributed across workplaces, industries, qualification systems and labour-market interfaces. Learners move between institutional training and employer-based practice, occupational standards are defined by industry bodies and validated through qualification frameworks, and employment outcomes depend on labour-market conditions that no institution can shape alone. An AI-ready TVET ecosystem is therefore not simply one that has acquired AI tools. It is one in which partnership networks, enabling infrastructure and shared capacities are aligned across these multiple sites of learning and governance to support responsible, effective and sustainable integration of AI over time.

Building this ecosystem is a multi-year process that reaches beyond any single institution. It requires coordination across leadership, academic, administrative and technical functions. It also needs sustained engagement with external partners, including industry, qualification authorities, government, community organizations and international networks such as UNESCO-UNEVOC. This chapter outlines the four key dimensions of the AI-ready TVET ecosystem and provides practical guidance for institutions at different stages of readiness.

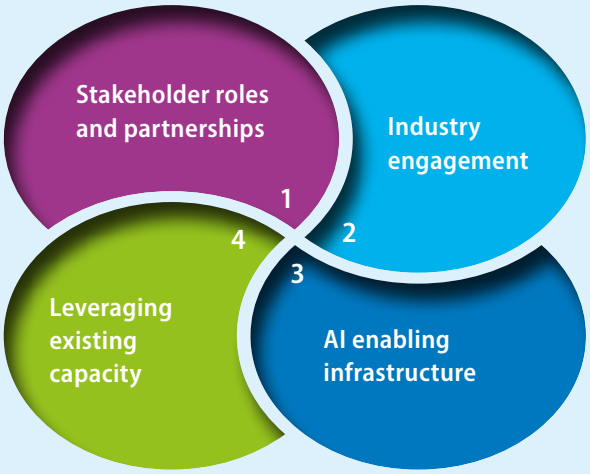
The four dimensions of an AI-ready TVET ecosystem

Stakeholder roles and partnerships. Because AI-ready TVET ecosystems extend well beyond institutional boundaries, their development depends on structured engagement across a wide range of actors. Learners, teachers, employers, qualification authorities, government bodies and international partners all play distinct roles in shaping how AI is integrated into training and qualifications. Building these partnerships is not optional: without multistakeholder governance, AI adoption tends to be fragmented and inequitable. It may be advanced in well-resourced settings, absent in others and ungoverned by any shared standard (Joseph et al., 2025; Rabiu et al., 2025).

Industry engagement. Industry is simultaneously a consumer of AI-literate graduates, a provider of expertise about AI in the workplace, a co-designer of AI-enhanced learning environments, and a potential partner in funding and resource development. Without ongoing input from employers about how AI is reshaping specific occupational areas, institutions risk preparing learners for a workplace that no longer exists. Structured industry collaboration provides the real-time intelligence that institutions need to keep curricula relevant and to bridge the gap between training provision and workplace reality (Rajamanickam et al., 2024; Niwamanya et al., 2025).

AI enabling infrastructure. AI integration depends on enabling conditions that span connectivity, devices, cloud access and technical support capacity. For many TVET institutions, particularly those serving rural or low-income communities, infrastructure deficits represent the most immediate barrier to equitable AI adoption. Infrastructure investment needs to be planned with equity at its centre to be able to anticipate the long-term trajectory of AI adoption in both institutional settings and the workplaces learners will enter (Olafare et al., 2025).

FIGURE 2 The four dimensions of an AI-ready TVET ecosystem



Leveraging existing capacity. AI integration in TVET is best understood as a multi-year, systemic process rather than a single technology procurement. Most TVET institutions have invested over many years in learning management systems, digital laboratories, simulation environments and curriculum frameworks that represent both pedagogical experience and substantial financial investment. AI integration strategies should identify how new tools can accommodate these existing capacities, building incrementally and sustainably rather than displacing what already works. Capacity building needs to be continuous, structured and differentiated. It must meet staff and institutions where they are and build towards the level of AI literacy that their role and context requires.

4.1 Stakeholder roles and partnerships

No TVET institution can build an AI-ready ecosystem alone. The knowledge, resources and legitimacy needed for successful AI integration span multiple sectors, and the outcomes of AI adoption affect communities and labour markets that extend far beyond the institutional campus. Effective AI governance in TVET is therefore inherently a partnership effort, requiring structured engagement with a range of internal and external stakeholders.

Mapping the stakeholder landscape

Learners are the primary stakeholders in any educational technology initiative. Their experiences, concerns and needs should be at the centre of AI design and governance decisions. Learner representatives should participate in AI ethics committees, co-design workshops and curriculum review processes. Their feedback should be actively solicited and genuinely acted on.

Teachers and trainers are the institutional actors most directly responsible for the quality of learning that AI tools enable or undermine. Their professional expertise is essential for evaluating whether AI tools are pedagogically appropriate, for interpreting AI outputs in context and for safeguarding learner interests. Professional associations representing TVET teachers should be engaged in national and institutional AI policy development.

Institutional leadership sets the vision, allocates resources and establishes the governance structures within which AI integration occurs. Leaders who lack AI literacy may inadvertently make decisions that expose the institution to ethical, legal or reputational risk. Leadership development programmes should include AI governance as a core component.

Industry partners, including employers, industry associations and professional bodies, define the competency standards that TVET has to deliver and, increasingly, the AI tools that graduates will encounter in the workplace. Their engagement in curriculum design ensures that AI integration serves real labour market needs rather than abstract technological aspiration.

Government and regulatory bodies set the policy and legal framework in which institutions operate. They determine data protection requirements, fund infrastructure development and establish national qualification frameworks. Institutions should actively engage in national AI in education policy processes to ensure that TVET perspectives are represented.

International organizations, including UNESCO and UNESCO-UNEVOC, provide the global frameworks, research evidence and peer learning networks that support institutional practice. TVET institutions benefit significantly from participation in these networks, particularly in lower-resource contexts where internal expertise is limited.

Structures for effective partnership

Effective partnerships require more than goodwill. They need clear structures that define roles, responsibilities, decision-making authority and mechanisms for accountability. The following structures have proven effective in supporting AI integration in TVET contexts.

Institutional AI ethics committees, as described in Section 3.4, provide the internal governance hub for AI strategy. These committees should include external members – typically an industry representative and an independent expert – to ensure that institutional decisions are subject to external scrutiny.

Joint curriculum development groups bring together teachers and industry partners to review and update curriculum content in response to AI-driven changes in occupational standards. These groups should meet regularly (at least annually) and should have a formal mandate to make recommendations to institutional leadership on curriculum changes.

Regional TVET networks enable institutions to share experience, pool resources for professional development and develop common standards for AI governance. UNESCO-UNEVOC supports such networks globally. Institutions should actively take part in networks relevant to their region and occupational area.

Research partnerships with higher education institutions can provide TVET institutions with access to expertise in AI ethics, learning analytics and educational technology that may not be available internally. These partnerships can also generate evidence about the effectiveness of specific AI applications that strengthens institutional decision-making.

Multidirectional accountability

A critical principle of TVET partnership is that accountability needs to flow in multiple directions. Industry partners who co-design curricula also have to be accountable for the accuracy of the labour market intelligence they provide. Government bodies that set national AI strategies in education policy should be accountable for ensuring that policies are equitable and do not systematically disadvantage certain types of institution or communities. International organizations need to be accountable for ensuring that global frameworks are relevant and accessible to institutions in diverse national and regional contexts (Cai and Kosaka, 2024; UNESCO-UNEVOC, 2024b).

Institutions should build accountability expectations into all partnership agreements, including clear provisions on data governance, intellectual property and the resolution of disputes. Partnerships that do not include these provisions create institutional exposure and undermine the trust that is essential for long-term collaboration.

4.2 Industry engagement

The relationship between TVET institutions and industry is the defining characteristic of vocational education. TVET supports the preparation of learners for work. The standards for this preparation are set by the employers, professional bodies and industry associations that constitute the world of work. In the context of AI integration, this relationship takes on new dimensions: industry is simultaneously a consumer of AI-literate graduates, a provider of expertise about AI in the workplace, a co-designer of AI-enhanced learning environments and a potential partner in funding and resource development.

The case for structured industry collaboration

Industry engagement is foundational in TVET AI integration. Without ongoing input from employers about how AI is reshaping specific occupational areas, institutions risk preparing learners for a workplace that no longer exists. The skills that were central to a trade five years ago may now be partially automated and the competencies that are most valued by employers today may not yet appear in curriculum frameworks developed several years earlier.

Structured industry collaboration provides institutions with the real-time intelligence they need to keep curricula relevant. It also gives learners access to the AI tools and workplace environments where they will eventually apply their skills. Many institutions cannot provide such access independently. Joint investment in digital laboratories, simulation platforms and AI-enabled assessment environments allows institutions to offer learning experiences that closely mirror industrial reality.

Research consistently shows that learners who have experienced industry-embedded learning, including exposure to AI tools in real or simulated workplace settings, have stronger employment outcomes. This evidence provides a compelling basis for institutions to prioritize industry partnership in their AI integration strategies.

Forms of industry engagement

Industry engagement in TVET AI integration can take multiple forms, each with distinct contributions to institutional capacity.

Curriculum co-design. Industry experts contribute practical expertise that helps institutions ensure their curricula reflect current and emerging AI applications in specific occupational areas. This might involve reviewing learning outcomes, contributing to the design of assessment criteria or developing case studies and industry-specific scenarios for use in simulation-based learning. Co-design relationships work best when they are structured and ongoing, rather than episodic consultations.

Apprenticeship and workplace learning partnerships. AI-enhanced apprenticeship models allow learners to develop competencies in real workplace settings, with AI tools supporting the documentation and assessment of their progress. Industry partners who host apprentices can provide data about learner performance in situ. This enriches the institution's understanding of how well its training is translating to workplace competence.

Equipment and technology provision. Industry partners may be able to provide institutions with access to current AI tools, equipment and platforms that would be prohibitively expensive to procure independently. This might include access to industrial simulation platforms, AI-driven diagnostic tools or cloud computing resources. Agreements of this kind should include provisions for data governance and training support.

Guest expertise and industry-led instruction. Practitioners who work daily with AI tools can bring practical, current knowledge to TVET classrooms that institutional teachers may not be able to replicate independently. Structured programmes for industry practitioners to contribute to instruction (as guest speakers, workshop leaders or co-instructors) enrich the learning environment and strengthen the institution–industry relationship.

Research and development collaboration. Some institutions have developed co-research arrangements with industry partners to investigate how AI tools perform in specific vocational training contexts, and to develop new AI applications tailored to TVET needs. These arrangements can generate institutional expertise and contribute to the broader evidence base for AI in TVET.

Governing industry partnerships

Industry partnerships for AI integration require careful governance. Institutions need to ensure that partnership agreements do not compromise institutional independence, learner rights or data security. Key governance provisions should include:

- Clear statements of the institution's ultimate authority over curriculum content and assessment standards
- Data governance provisions that specify what learner data may be shared with industry partners, under what conditions and for what purposes
- Intellectual property provisions that clarify the ownership of any tools or content developed through the partnership
- Conflict of interest provisions that address situations where an industry partner's commercial interests may diverge from learners' educational interests
- Review and exit clauses that allow the institution to renegotiate or end the partnership if its terms no longer serve the institution's mission

4.3 AI enabling conditions

Infrastructure is the foundation on which AI integration in TVET is built. Without reliable connectivity, capable devices and technical support, the most pedagogically sound AI strategy will fail in implementation. For TVET institutions, particularly those serving rural or low-income communities, infrastructure deficits may represent the single greatest barrier to equitable AI adoption (Amdan et al., 2024; Rajamanickam et al., 2024).

What AI-ready infrastructure looks like

AI-ready infrastructure has several interconnected layers.

Connectivity. AI tools typically require reliable, reasonably fast internet connectivity to function effectively. This applies to cloud-based learning management systems, AI-enhanced simulation platforms, adaptive content delivery systems and AI assessment tools. For institutions with learners in areas of poor connectivity, this dependency creates a significant equity risk. Infrastructure planning should address connectivity for all sites.

Devices. Learners and teachers need access to devices capable of running AI tools effectively. Older or lower-specification devices may not be able to run current AI applications, or may run them too slowly to be pedagogically useful. Device access should be assessed across all learner groups, and device procurement planning needs to include provision for learners who cannot supply their own devices.

Cloud computing and digital infrastructure. Many AI tools are cloud-based, requiring institutions to have agreements with cloud service providers and to manage the data governance implications of storing learner data in cloud environments. Institutions should ensure that cloud service agreements include adequate data protection provisions and that they retain the right to export their data if they change providers.

Technical support capacity. AI tools require ongoing technical support for configuration, troubleshooting, updates and integration with other institutional systems. Institutions that lack this capacity internally will be dependent on vendors for support, which creates vulnerability. Building internal technical support capacity, or forming shared service arrangements with other institutions, is an important element of infrastructure resilience.

Low-bandwidth and off-line alternatives. Institutions serving learners in low-connectivity environments should prioritize AI tools that offer low-bandwidth or off-line modes. This may require working with vendors to develop customized versions of tools, or developing internally a portfolio of off-line compatible learning resources that can be used when connectivity is unavailable.

Planning for equitable access

Infrastructure planning should be driven by an equity-first approach. This means beginning with a comprehensive audit of current connectivity, device access and technical support capacity across all sites and learner groups, not only the main campus and the most technologically advanced programmes.

The results of this audit should drive investment priorities. The sites with the greatest infrastructure deficits serve the learners who most need equitable access to quality learning environments. Directing infrastructure investment towards these sites is not only ethically appropriate but strategically important: institutions that successfully serve learners from disadvantaged backgrounds build institutional legitimacy and fulfil their social mission.

Infrastructure planning should also anticipate the long-term trajectory of AI adoption. The infrastructure requirements of current AI tools may be significantly exceeded by the tools that institutions will want to deploy in three to five years. Planning horizons should be realistic about this trajectory, and infrastructure investments should be designed for scalability.

Digital literacy as infrastructure

Infrastructure is both physical and human. Learners and teachers who lack the digital literacy skills to use AI tools effectively cannot benefit from even the most sophisticated physical infrastructure. Digital literacy development should be treated as an integral component of infrastructure investment, not a separate educational objective (UNESCO-UNEVOC, 2020c; Obasa et al., 2025).

For learners, this means assessing digital literacy at entry and providing support programmes for those whose skills are below the level needed to engage effectively with AI-enhanced learning. For teachers, it means ensuring that professional development programmes address not only how to use specific AI tools, but also the foundational digital competencies on which effective tool use depends.

4.4 Leveraging existing capacities for phased AI integration

The integration of AI in TVET is best understood as a multi-year, systemic process rather than a single technology procurement. Institutions that attempt to deploy AI tools across all functions simultaneously risk poor implementation, staff fatigue and the erosion of institutional coherence. A phased approach begins with an honest assessment of existing capacities and calibrates its ambition to institutional readiness. It offers a more sustainable pathway and is more likely to deliver genuine benefit to learners (Rabiu et al., 2025). Crucially, the four phases described in this section are not a single obligatory sequence: institutions should enter the pathway at the phase that best reflects their current readiness and progress at a pace commensurate with their human, financial and infrastructural capacity.

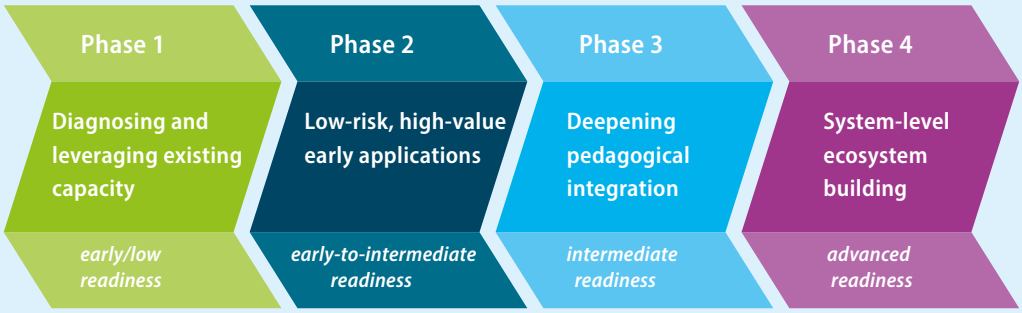
The case for a phased approach

Effective AI adoption in TVET depends on leveraging the human, digital and institutional capacities that an institution already possesses, rather than designing a strategy from a zero baseline. Most TVET institutions have invested over many years in learning management systems, digital laboratories, simulation environments and foundational curriculum frameworks. These assets represent both pedagogical experience and substantial financial investment. AI integration strategies should identify how new tools can augment these existing capacities, rather than displacing them with parallel systems that create duplication and confusion (Hassan et al., 2021; Rajamanickam et al., 2024; Beriğel et al., 2025). Readiness is not uniform across an institution: a single provider may have mature industry partnerships and weak staff digital literacy simultaneously. The diagnostic in Phase 1 is designed to identify these asymmetries, so that integration decisions build on genuine strengths rather than assumed ones.

Phase 1: Diagnosing and leveraging existing capacity (early/low readiness)

The first phase of any AI integration strategy should be a systematic audit of the institution's current capacities. This audit should cover four dimensions: digital infrastructure (connectivity, devices, platforms, cloud access), human capacity (staff and learner digital literacy, pedagogical expertise), institutional processes (assessment systems, administrative procedures, curriculum frameworks) and partnerships (existing industry, government and international relationships).

FIGURE 3 Phased AI integration



The results of this diagnostic should shape the institution's subsequent choices. Institutions with strong adoption of a learning management system but weak staff digital literacy will need to prioritize different activities from those with the opposite profile. Institutions with strong industry partnerships in some occupational areas can pilot AI integration in these areas first, leveraging the partnership to access tools and expertise. Institutions with significant connectivity limitations at some sites will need to sequence deployments to account for infrastructure readiness (Amdan et al., 2024; Obasa et al., 2025). In resource-constrained settings, Phase 1 may extend across twelve to eighteen months and involve no new technology investment at all: its value lies in the clarity it produces, not in the tools it deploys. Well-resourced institutions completing this phase rapidly should resist the temptation to skip ahead as the diagnostic intelligence gathered here prevents costly missteps in later phases.

Phase 2: Low-risk, high-value early applications (early-to-intermediate readiness)

Early AI deployments should target areas where the pedagogical stakes are relatively low but the operational benefits are tangible. Administrative functions and formative assessment are suitable for this first wave of integration. Automated marking of structured formative tasks, learning analytics dashboards that help teachers identify learners who may be falling behind, and AI-supported scheduling of teaching spaces and equipment can deliver immediate efficiency gains without requiring a fundamental redesign of core vocational curricula. In resource-constrained settings, a single pilot in one programme, using freely available or mobile-first tools, is a credible and sufficient ambition for this phase. Institutions with established infrastructure and staff capacity can extend pilots across several departments simultaneously. In either case, the principle is the same: show value before scaling up.

These early applications serve a dual purpose. First, they build institutional familiarity with AI tools, giving staff the opportunity to develop confidence, identify limitations and establish governance habits. Second, they have visible benefits that sustain support for deeper integration. Institutions should treat these early applications as learning opportunities, documenting what works, what does not, and why. The intelligence gathered in this phase is a critical input to subsequent decisions (Onyango and Kelonye, 2022; Deckker and Sumanasekara, 2025). Before advancing to Phase 3, institutions should ensure that a basic AI use policy is in place and that at least one staff member or committee holds responsibility for data governance. These are not bureaucratic prerequisites; they are the governance conditions that are essential for deeper pedagogical integration to proceed with accountability.

Phase 3: Deepening pedagogical integration (intermediate readiness)

Once early applications have been evaluated and stabilized, institutions can move towards deeper pedagogical integration. This phase leverages existing simulation and laboratory environments by adding AI-driven adaptive features, richer feedback loops and more detailed learner performance tracking. For example, a welding simulator that is already in use can be enhanced with AI feedback that analyses technique and suggests targeted practice. An existing electrical training platform can be upgraded with scenario-based adaptive tasks that respond to learner performance. The transition into this phase presupposes that staff have developed working familiarity with at least one AI tool, that the institution has an established process for reviewing learner data responsibly, and that the lessons from Phase 2 have been documented and reviewed. Institutions that have not yet met these conditions should consolidate their earlier work before proceeding. Curriculum content should also be adapted

incrementally during this phase. Rather than designing entirely new programmes, institutions can embed AI literacy, data ethics and occupation-specific AI applications into existing modules. A business administration programme can include case studies on AI in workplace processes; a health care programme can address AI-assisted diagnostic tools in existing clinical modules; a construction programme can examine AI in site management and safety monitoring. This incremental approach preserves curriculum coherence while ensuring that graduates leave with an informed understanding of AI in their field (Amdan et al., 2024; Olafare et al., 2025). For institutions in resource-constrained settings, this curricular adaptation can rest on analytical and critical content that requires no additional digital infrastructure, including structured case studies, ethics discussions and guided inquiry into AI in the relevant occupation. Institutions with stronger infrastructure can complement such content with adaptive simulation platforms and AI-enhanced learner performance tracking.

Phase 4: System-level ecosystem building (advanced readiness)

The most advanced phase of AI integration shifts the focus from individual tools to the institutional ecosystem as a whole. At this stage, AI is embedded in governance structures, curriculum review cycles, assessment frameworks and industry partnership arrangements. Ethical oversight matures into a routine institutional function rather than a reactive response to concerns. Data governance is standardized across departments and the institution's strategic planning explicitly accounts for the continuing evolution of AI in the occupations its graduates will enter.

This phase also requires deeper industry engagement. Co-development of AI-aligned curricula, joint investment in simulation platforms and shared research on sector-specific AI applications all become feasible once the institution has shown its capacity to absorb and govern AI responsibly. The partnerships formed at this stage are substantively different from conventional advisory relationships: they are collaborative arrangements in which both institution and industry partner contribute expertise, data and infrastructure (Rajamanickam et al., 2024; Joseph et al., 2025; Obasa et al., 2025). Phase 4 is realistic only for institutions that have already achieved stable governance, whole-staff AI literacy provision and a sustainable multi-year financing model for AI. Institutions that have not yet reached these conditions should not prematurely move towards ecosystem-level ambitions. The value of the earlier phases lies precisely in building the foundations that make this level of integration coherent rather than cosmetic.

Table 3 summarizes the focus and characteristic applications of each phase, organized as a readiness-based pathway from early to advanced institutional capacity.

TABLE 3 Focuses and applications of different phases of AI integration

Phase	Primary focus	Typical applications
1. Diagnosis (low readiness)	Mapping existing capacities	nfrastructure audit, staff digital literacy assessment, stakeholder mapping
2. Early adoption (early-to-intermediate readiness)	Administrative and formative functions	Automated marking, learning analytics dashboards, scheduling and administrative support
3. Pedagogical deepening (intermediate readiness)	Teaching, learning, simulation	Adaptive simulations, curriculum modules on AI, intelligent tutoring systems
4. Ecosystem integration (advanced readiness)	Governance, curriculum, partnerships	AI-aligned curricula, joint industry platforms, mature ethics, governance frameworks

5. Integrating AI in TVET institutions

This chapter examines AI integration across seven core domains of institutional practice: governance, readiness and risk management; programme and curriculum development; pedagogy and training delivery; vocational assessment; AI competency development for TVET staff and learners; safety-critical and regulated occupations; and innovation and entrepreneurship. It then considers monitoring and evaluation as a cross-cutting function that helps institutions review progress and adjust implementation over time.

Two considerations underpin the following guidance. First, AI integration depends on an adequate level of digital readiness, yet digital infrastructure across TVET systems remains highly uneven. The digital divide continues to shape what institutions can realistically do, and the guidance therefore needs to be adapted to actual technological conditions. Second, although the chapter focuses mainly on strengthening internal institutional capacity, engagement with the wider ecosystem remains essential. Sustained partnerships with industry, employers and community stakeholders are needed to align institutional action with sectoral priorities and local workplace contexts.

5.1 Institutional AI governance, readiness and risk management

Before a TVET institution allocates resources to AI integration, it needs to define the purpose AI is expected to serve and establish clear governance, readiness and risk management arrangements. This includes agreed processes for evaluating and monitoring AI systems, as well as clear lines of responsibility. Establishing these foundations early can help institutions avoid costly missteps as AI use expands.

The scope of institutional authority varies across systems. In some contexts, TVET institutions have substantial autonomy over policy, procurement and curriculum decisions. In others, their room for action is shaped by national policy, data protection legislation, qualification requirements or public investment in infrastructure. The discussion that follows focuses on approaches that institutions can take within their existing mandate, while recognizing that system-level conditions shape what is feasible.

Establishing AI governance and policy

AI integration should respond to genuine institutional needs. The starting question is: what challenges does the institution face in teaching and learning, institutional management or engagement with industry, and could AI help address any of them? In some cases, AI may not be the right response or may offer limited value.

UNESCO's conceptual framework for digital transformation in TVET identifies three broad domains where digital technologies can create value: teaching and learning processes, organizational management of learning, and the institution's role within its education and labour market ecosystem (UNESCO, 2023a). These domains provide a practical diagnostic for identifying where AI could make a meaningful contribution and what should take priority. Sectoral skills forecasts, national AI strategies and TVET reform agendas can also help institutions calibrate their plans to realistic conditions and available support.

After institutional priorities are identified, they should be translated into an agreed vision and purpose for AI integration. Governance structures and policy can then be developed to guide action. The AI governance body coordinates the following process, adapted to the institution's mandate and context.

Stage 1: Define the vision and purpose of AI integration. Define the purpose of AI integration and link it to the institution's mission, including its contribution to skills development, employability, inclusion and innovation.

Stage 2: Institute a cross-functional AI governance body. Use an existing governance, quality assurance or curriculum structure with an expanded mandate, or create a specific body where needed. Ensure broad representation by including leadership, heads from across programme areas and the ICT department,

teacher and student representatives, and industry advisors. Members need enough understanding of AI to make informed governance decisions.

Stage 3: Assess the current situation. Gather evidence on current AI use, challenges, expectations and perceived risks through surveys, interviews or focus groups with teachers, trainers, management staff and learners. Combine this evidence with self-reflection on readiness so that the policy responds to actual institutional conditions.

Stage 4: Draft the policy. Based on the evidence gathered, draft a policy covering the areas the institution considers most relevant to its context. Table 4 defines the minimum elements this guide recommends addressing. The policy should align with national digital strategies and data protection legislation. Where such frameworks do not yet exist, the UNESCO *Recommendation on the Ethics of Artificial Intelligence* (UNESCO, 2022a) provides a starting point.

Stage: Consult and revise. Circulate the draft policy institution-wide for feedback and, where needed, organize discussions. Seek input from relevant stakeholder groups and revise the policy based on the feedback.

Stage 6: Formally adopt and disseminate. Upon approval by the institution's governing body, communicate the policy through multiple channels to all members of the institutional community.

Stage 7: Provide training and support. Invest in sustained capacity development for staff and learners, covering AI literacy, AI tool use, ethical responsibilities and trade-specific applications. Training should be ongoing, not a one-off session.

Stage 8: Monitor, evaluate and revise. Track compliance, collect feedback and review the policy at least annually or following significant technological or regulatory changes. Treat the policy as a living document.

FIGURE 4 Establishing AI governance and policy

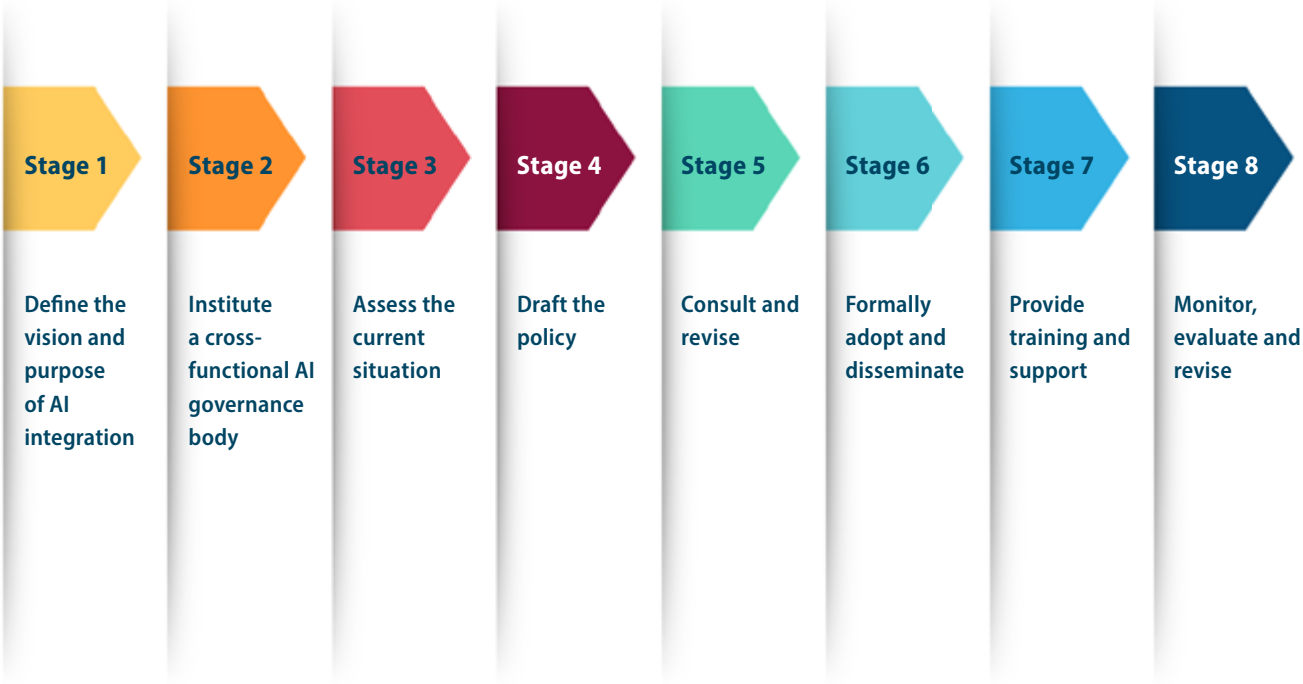


TABLE 4 Minimum elements of an institutional AI policy

Policy element	What it should address
Scope and purpose	Which AI systems, users and activities the policy covers; the institution's overarching objectives for AI use
Ethical principles	The institution's commitments on fairness, transparency, accountability, privacy and human agency, aligned with relevant national or international frameworks
Data governance	Data classification, collection standards, storage security, access permissions, retention and deletion procedures; compliance with applicable data protection regulations
Procurement and evaluation	Criteria for assessing external AI tools and services, including requirements for transparency about how the tool processes data and how algorithmic bias is detected and addressed; due diligence on vendor data handling practices
Acceptable use	Clear guidelines for staff and learners on permitted and prohibited uses of AI in teaching, learning, assessment and administration; academic integrity expectations for AI-assisted work
Safety-critical applications	Additional safeguards for AI use in trades and occupations involving physical safety, including human oversight requirements, task boundaries and liability provisions
Capacity development	Commitments to AI literacy and ethics training for all staff and learners, including provisions for ongoing professional development
Risk management and incident response	Procedures for identifying, assessing and responding to AI-related risks, including data breaches, biased outcomes and automated decision errors; a clear reporting and remediation process
Roles and responsibilities	Designated responsibilities for AI oversight, policy enforcement and coordination across departments
Review cycle	A defined schedule for policy review and the process for revising the policy in response to technological, regulatory or institutional change

Source: adapted from Ally and Mishra (2024).

Institutional AI readiness self-assessment

An AI readiness self-assessment helps an institution identify its current capacity and priority areas for action. AI readiness is a contextual capacity that depends on the institution's functions, staff and learner profiles, and intended uses of AI (Luckin et al., 2022). This assessment is treated as a reflection and planning process conducted alongside or as part of the governance and policy development process described above. While few tools currently address AI readiness for TVET, several instruments offer useful foundations.

At the national level, the **Readiness Assessment Methodology (RAM)** developed by UNESCO (2023c) to support implementation of the *Recommendation on the Ethics of AI* provides analysis of data protection frameworks, AI-related education policies and ICT infrastructure conditions across participating countries. RAM country reports published at the UNESCO Global AI Ethics and Governance Observatory can help institutions understand their operating environment for AI integration.

At the institutional level, the **Smart Education Readiness Index (SERI)** developed by the Southeast Asian Ministers of Education Organization's Regional Centre for Vocational and Technical Education and Training (SEAMEO VOCTECH, 2024) offers a self-assessment tool designed for TVET institutions to gauge their readiness for Industry 4.0. SERI assesses readiness across three blocks (process, technology and organization) and through eight pillars covering areas such as technology curriculum integration, industry engagement, digital infrastructure and workforce capability. Although framed around Industry 4.0 broadly, its diagnostic structure provides a relevant reference for institutions assessing capacity for technology integration, including AI.

A further institutional-level reference is provided by the *Report on the Development of Artificial Intelligence Applications in Vocational Education* (Liu, 2025). The report includes a tested AI application readiness index applied across a large national sample of 998 TVET institutions in China. It assesses institutional readiness across six dimensions: strategic planning, organizational structure, process support, ethics and safety, data readiness, and technological environment. Its findings suggest that governance-related dimensions, especially strategic planning and organizational support, often lag behind infrastructure and technology deployment.

Building on these instruments, **Annex A** provides an indicative AI readiness self-reflection and planning tool for TVET institutions. It adapts relevant ethical, institutional, technical and TVET-specific dimensions for internal use by a cross-functional group. The tool is designed to help institutions identify priorities and connect AI integration with institutional planning cycles. It is intended as a guidance instrument for internal planning, not as an external measurement or ranking tool.

AI risk management

AI risk management in TVET institutions requires a proactive approach. Unlike conventional digital tools that execute tasks predictably, AI systems operate with a degree of autonomy and produce probabilistic outputs. The reasoning behind an output is opaque to users, and error may be difficult to detect. Risks therefore need to be identified before deployment rather than addressed only after problems emerge. If poorly managed, the risks can harm learners and expose institutions to financial and legal consequences.

Risk management should distinguish between types of AI-related risk. Generative AI tools raise risks such as hallucinated content, unclear authorship, prompt-based misuse and plagiarism in assessment. Broader AI systems, including analytics, recommendation and decision-support tools, pose risks related to algorithmic bias, opacity, automation bias, data protection, and dependency on vendors or platforms. Embedded, automated or AI-assisted technical systems used in workshops, laboratories, simulations or workplaces raise additional safety risks related to task boundaries, supervision, equipment malfunction and accountability.

TVET institutions face risks common to AI use in education and risks specific to vocational training environments, including physical safety in workshops, laboratories and workplaces. These risks may extend beyond the institution itself, especially where AI use intersects with employer partnerships, work-based learning, apprenticeships, external assessment or qualification requirements. **Table 5** summarizes key risks and the corresponding mitigation measures.

TABLE 5 AI-related risks for TVET institutions and mitigation measures

Risk category	Key risks	Mitigation measures
Pedagogical risks	• Overreliance on AI may weaken learning depth and critical thinking. • AI-generated outputs may allow learners to complete tasks without developing the underlying understanding. • AI-supported learning may overemphasize digital outputs and reduce opportunities for hands-on practice, tacit skill development and situated judgement.	• Sequence learning so that foundational skills are developed before AI-assisted work. • Design tasks that require verification, reflection and explanation. • Ensure that AI-supported learning complements supervised practical training, workshop-based learning and workplace exposure.
Assessment risks	• AI use may distort evaluation processes. • Product-based tasks may no longer show what learners understand or can do independently. • Certification validity may be weakened.	• Redesign assessment to include process evidence, practical demonstration and oral validation. • State clearly when AI use is permitted, excluded or expected. • Combine outcome-based and process-based assessment methods.
Governance risks	• AI adoption may become fragmented, with unclear accountability across departments. • Weak procurement and oversight can expose institutions to unsuitable tools or vendor dependency. • AI tools and equipment may be selected based on upfront costs and convenience, without enough attention to total cost of ownership and maintenance. • AI governance may remain limited to institutional processes and fail to cover employer partnerships, workplace learning, external assessment and qualification requirements.	• Establish an institutional AI vision, purpose and policy with clear roles and procedures. • Apply review processes for procurement, monitoring and policy revision, including checks on vendor transparency and data practices. • Apply sustainable procurement criteria that consider total cost of ownership, maintenance and long-term affordability. • Extend AI governance arrangements to cover partnerships with employers, workplace learning providers, and qualification or accreditation bodies.

Risk category	Key risks	Mitigation measures
Legal and ethical risks	• AI use may breach data protection requirements. • Intellectual property may be mishandled. • Bias, opacity and weak human oversight may lead to unfair or unethical decisions. • Data generated during workplace learning or apprenticeships may create uncertainty about ownership, consent and appropriate use.	• Set rules for data use, consent and uploading of materials. • Clarify ownership and acceptable use of AI-generated content. • Require human oversight and review against legal and ethical standards. • Ensure workplace learning and apprenticeship data are covered by clear agreements among institutions, employers, learners and training providers.
Equity risks	• Unequal access to devices, connectivity and paid tools can deepen exclusion. • Accessibility and language barriers may limit participation. • Biased AI systems, including guidance or matching tools, may disadvantage some learner groups or reproduce gender, social and occupational stereotypes.	• Prioritize affordable tools and provide institutional support in under-resourced settings. • Use accessible and multilingual tools where possible. • Maintain human review for decisions with significant consequences for learners, and monitor AI guidance or matching outcomes by gender, disability, socio-economic background and other relevant learner characteristics.
Competency risks	• Staff and learners may lack the competencies needed to use AI critically and responsibly. • Weak AI competency can lead to misuse and poor judgement. • Capacity-building may focus only on teachers, while excluding workplace mentors, assessors, institutional leaders and support staff.	• Provide sustained, role-specific capacity development. • Strengthen verification skills and critical use across teaching, learning and professional development. • Define role-specific AI competency profiles for leaders, teachers, trainers, assessors, workplace mentors and learners.
Safety risks	• Incorrect AI outputs may be acted on in workshops, laboratories or simulations. • Overreliance on AI can weaken safety-critical judgement. • Responsibility for unsafe decisions may become unclear.	• Define clear task boundaries for AI use in safety-critical contexts. • Retain qualified human oversight for safety-critical decisions. • Specify liability, escalation and incident response in institutional policy.
Environmental risks	• AI use may increase energy demand. • It may accelerate hardware turnover and electronic waste.	Prioritize uses with clear educational value. • Review life cycle costs and infrastructure implications before adoption.

Sources: summarized from UNESCO (2022a, 2023b) and Isakova (2026).

BOX 1 Examples of institutional AI policy-making

Some TVET institutions have begun to formalize their approaches to AI through institution-level strategies, policies and guidelines. The examples below illustrate different entry points.

Duoc UC, Chile: Duoc UC has issued formal institutional AI guidelines through its *Lineamientos Generales de Inteligencia Artificial para Duoc UC* (General Guidelines on Artificial Intelligence). Applicable to the whole institutional community, the document establishes principles covering safe use, academic integrity, transparency, privacy, security, implementation control, audit and compliance.

The Joint Authority of Education in the Espoo Region (Omnia), Finland: Omnia has published an institutional guideline on the use of AI to enable learners and staff to use AI in study and work in an open-minded and responsible manner. The guideline covers data security, protection of personal data, compliance with applicable laws and institutional rules, and teachers' role in guiding when and how AI may be used in learning situations.

Malta College of Arts, Science and Technology (MCAST), Malta: MCAST has adopted a comprehensive institution-wide approach through its AI Strategy and its Policy on the Safe and Ethical Use of AI Systems. These documents frame AI adoption across education, research, administration and industry engagement. The policy adopts a risk-based approach aligned with the EU AI Act.

Temasek Polytechnic, Singapore: Temasek Polytechnic has embedded AI governance within its existing academic integrity framework through a revised plagiarism policy that addresses student use of AI in academic work. The policy clarifies the definition of plagiarism, disciplinary actions, guidance on how to avoid plagiarism, and samples of acceptable and unacceptable practices for AI-generated content in different assignment types.

Sources: Duoc UC (2025); Omnia (2024); MCAST (2019); Temasek Polytechnic (no date).

Managing the risks requires a systematic approach over a continuous cycle. Institutions are encouraged to maintain an AI risk register, which is used to document identified risks, the controls in place, and the measures and responsibilities for addressing them. **Annex B** provides a sample risk register that institutions can adapt to their context and scale of AI use.

5.2 Programme and curriculum development for AI-driven skills demand

Responsiveness to occupational demand is a defining feature of TVET curriculum and programme design. However, AI changes both the pace and nature of this demand. Within occupations, tasks are being redistributed between humans and intelligent systems. Across occupations, boundaries are blurring as AI creates hybrid roles that need new combinations of technical and digital competencies. These changes affect virtually every sector in which TVET operates, though the speed and depth of impact vary across industries and economies. This section addresses how TVET institutions can organize their programme portfolios and curriculum content to respond to the emerging and future skills demand brought by AI.

Mapping occupational change and skills demand

The occupations a TVET institution serves are evolving at multiple levels simultaneously. In many trades, tasks are shifting from manual execution and routine processes towards oversight, analysis and coordination of automated systems. Where institutions fail to observe these changes, the training risks preparing learners for task profiles that no longer reflect workplace realities. An essential step in improving curriculum relevance is to identify what is changing, and at what level, in the industry and labour market. **Table 6** presents an analytical framework for this purpose. The focus moves from broad industry and sector trends to the competencies that occupational profiles require, providing a basis for aligning learning objectives with current workplace demands.

TABLE 6 Levels of analysis for mapping occupational change and skills demand

Level of analysis	What to examine	Sources of information
Industry and sector	Where AI is being adopted; which processes are being automated or augmented; emerging roles; restructuring of the value chain	Industry reports, sector skills forecasts, national labour market information systems
Occupation	Emerging, declining or redefined occupations; shifting role boundaries; occupations growing in demand	Occupational standards, job posting analysis, recruitment trend data, national qualifications frameworks
Work tasks and scenarios	Tasks being automated; tasks requiring human–AI collaboration; new tasks emerging in workplace scenarios	Workplace observation, occupational task analyses, employer interviews
Occupational competency profile	Knowledge, skills and attitudes now required; competencies growing in importance; competencies declining in relevance	Occupational competency frameworks, industry certification standards, workplace skills audits, professional association guidelines

Where this analysis reveals a shift in demand, the institution should assess the implications for its programme structure and curriculum content. Several systems and tools can support this analysis. At the international level:

- **UNESCO Global Skills Tracker:** a labour market intelligence tool that uses online job advertisement data to track changing skills demand across countries, industries and occupations.
- **European Centre for the Development of Vocational Training's (Cedefop) Skills Forecast:** a regional skills anticipation system that projects future employment trends by sector, occupation and qualification across European countries.

At the national level, countries use various forms of labour market intelligence to inform education and training decisions. Examples include:

- **Germany's QuBe data portal:** a projection system linking labour demand and labour supply by occupation and qualification.
- **Jamaica's Labour Market Information Portal (LMIP):** an intelligence platform developed with UNESCO, which collects real-time data from job postings, employer surveys and economic indicators to support the country's planning of curriculum and qualifications.
- **Kenya's Labour Market Information System (KLMIS):** a national platform bringing together labour market indicators and demand signals.
- **Singapore's Jobs–Skills Portal:** an integrated system combining jobs and skills data, dashboards and related resources.

Insights from using these systems cannot replace direct engagement with employers and industry bodies. Industry AI integration varies considerably across and within sectors. In many economies, most enterprises are small and medium-sized firms that have not yet adopted AI systems at scale. TVET institutions should identify which specific sectors and employers in their context are deploying AI and focus their analysis accordingly rather than responding to generic global projections.

Programme architectures for AI integration

Once an institution has a clear picture of how AI is reshaping the relevant occupations, the next step is to assess and, if necessary, adjust its existing programmes. The development of AI creates demand across a wide range of occupational roles on the industry value chain. These span research and science, algorithm and model development, application and integration, and technical support and operations. A further category covers domain-specific roles, in which practitioners apply AI in sectors such as manufacturing, health care, agriculture, logistics and education.

For TVET, the roles that are most relevant to graduates are typically concentrated in the more applied parts of this landscape. One major area is technical support and operations, where roles focus on preparing data, maintaining systems and checking performance. Another is application and integration, where AI tools and systems are adapted to workplace and sectoral use. A third is the growing space of hybrid 'AI + X' roles, in which vocational expertise is combined with the ability to use, manage or work alongside AI applications in specific occupational settings. An institution's programme design should reflect the structure of its local and regional economy and the level of AI capability that employers require.

Table 7 illustrates four possible tiers of programme provision related to AI, each addressing a distinct learner profile and occupational pathway. Few institutions will operate across all four tiers. The framework is intended to help identify where institutional investment will have the greatest relevance.

Many TVET institutions operate within regulated systems where curricula must align with nationally defined occupational standards and qualification frameworks. Even when institutions recognize the need to embed AI competencies, they may lack the authority to update curricula if national standards have not yet been revised. As AI-related competencies change faster than full qualification revision cycles can accommodate, modular and stackable credentials offer a mechanism for incremental updating. This can allow learners to acquire focused competency units that can be accumulated into broader qualifications over time, without requiring institutions to redesign entire programmes.

TABLE 7 A tiered programme architecture for AI integration

Tier	Description	Target learners	Illustrative occupational roles
AI specialist programmes	Programmes training AI technicians and specialists	Learners entering AI-specific occupational pathways	Data annotation technicians, AI system maintenance technicians, AI quality assurance testers, AI model development specialists
Interdisciplinary programmes combining AI with a vocational domain	Programmes addressing emerging hybrid roles at the intersection of AI and a sector	Learners targeting occupations that blend AI with domain expertise	Smart manufacturing technologists, precision agriculture technicians, intelligent logistics coordinators, AI-assisted health care technicians
Existing programmes enhanced with AI modules	Established occupational programmes updated with AI content specific to that trade	Learners in trades where AI is transforming existing practice	Automotive technicians using AI diagnostics, construction workers operating AI-enabled site systems, hospitality staff managing AI service platforms
General AI education programmes	Foundational AI literacy and skills for broad-based provision	All learners in society seeking upskilling and reskilling	Workers across occupations where AI tools are becoming part of everyday tasks

BOX 2 Ethical AI integration and curricular digitalization in South Africa

The Project Integri-Tech TVET, led by the University of South Africa in partnership with Capricorn TVET College, addresses what its developers term the 'vendor–curriculum gap', meaning the disconnect between externally provided digital courses from companies such as Cisco and Microsoft and the nationally prescribed TVET modules (the National Certificate [Vocational] and the National Accredited Technical Education Diploma/ Report 191) that remain largely non-digitalized.

The initiative is developing a framework to integrate AI-driven pedagogical tools directly into native TVET modules while ensuring adherence to national AI standards developed through the South African Bureau of Standards. The project's ethical AI framework, grounded in principles of virtue ethics and cognitive justice, aims to ensure that TVET students become ethically informed digital citizens rather than passive consumers of technology. A parallel strand transitions manual library systems into AI-managed hubs capable of tracking high-demand materials and generating usage analytics to support institutional decision-making.

Source: contributed by Robert Nicky Tjano, University of South Africa.

Embedding AI knowledge and skills across trade specialisms

AI applications cut across sectors, and every trade specialism needs curriculum content that reflects how intelligent systems affect its specific occupational practice. The challenge varies across different types of learning. In the theoretical and cognitive domains of TVET curricula, AI-related concepts may be more readily embedded into existing learning content and objectives. However, in practical and psychomotor domains, integrating AI requires more careful sequencing because learners need direct engagement with tools, materials, equipment and workplace routines. Setting learning objectives for hands-on trades therefore requires attention to where AI changes workplace tasks and the knowledge and skills practitioners need.

Curriculum developers may focus first on trades and task areas where AI tools are currently used in workplaces, and design learning activities that reflect real AI-supported work processes. Table 8 illustrates this process, drawing on evidence of how AI is changing task profiles and competence requirements in selected occupations.

TABLE 8 AI knowledge and skills requirements across selected occupations

Occupation	Tasks affected by AI	AI knowledge and skills required
Health care worker	AI-assisted diagnostics, intelligent patient monitoring, algorithmic treatment recommendations	Evaluating AI diagnostic outputs against clinical judgement, operating AI-enabled monitoring devices, understanding when to override algorithmic recommendations (Manca and Eslava, 2025)
Hotel front office and guest services staff	Automated check-in and check-out, AI-powered customer management, demand forecasting	Data analytics for guest service personalization, digital fluency across booking and service platforms, managing human–AI service interactions (Singapore Tourism Board et al., 2023)
Construction worker	AI-supported building information modelling (BIM), safety monitoring systems, digital site coordination	Reading and acting on data from AI-enabled site systems, using BIM software with AI features, interpreting AI-generated safety alerts, exercising judgement over AI-supported outputs (Obi et al., 2025)
Agricultural technician	AI-generated soil and crop analysis, drone-based monitoring, precision farming systems	Interpreting crop, soil, weather and pest data from AI systems; acting on AI-generated recommendations for planting, fertilizing and pest management; managing data collection and system troubleshooting (Gupta and Kumar Pal, 2025)
Automotive maintenance technician	AI-assisted fault diagnosis, sensor-based predictive maintenance, connected vehicle data systems	Using AI-based diagnostic tools; interpreting sensor data across mechanical, electrical and software domains; validating AI-generated repair recommendations (Hossain et al., 2024)

Besides adding AI-related content, curriculum auditing is needed to identify content whose occupational value is declining as AI systems assume a greater share of routine technical tasks. This does not mean that such operational skills should be removed from the curriculum. Instead, it changes the purpose for which they are taught. Learners still need to master underlying processes and concepts so that they can analyse and assess AI-generated outputs. Curriculum renewal should therefore retain core technical knowledge while reorienting teaching and learning towards competencies in human–AI collaboration, critical evaluation, professional judgement and adaptive capability.

BOX 3 Content-integrated AI learning in Canada

The content-integrated AI learning (CIAIL) model, developed by the College of the North Atlantic in Canada, embeds AI across TVET curricula through a structured process of course review and redesign. The model has two objectives: AI is used to augment content delivery and assessment, and AI is learned through its application in teaching and learning.

Through reviews of existing courses and industry research, the institution identifies how AI-related competencies should be integrated into each discipline, and learning outcomes are revised accordingly. Staff readiness is placed at the centre of implementation, with instructors trained to teach about and with AI.

The model is being piloted in communications courses and in an Adult Learning, Teaching and Innovation certification course. Early findings indicate that initial instructor scepticism was overcome as training progressed. Students were able to use AI for tasks ranging from real-time writing support to generating initial drafts for critical refinement. The institution recommends starting with small pilots aligned to existing learning outcomes to minimize disruption to curriculum approval processes.

Source: UNESCO-UNEVOC (2025a).

Industry collaboration for ensuring curriculum relevance

The approaches described above depend on sustained engagement with industry. Employers and sector bodies are often the most direct source of information on how AI is changing occupational practice. Their involvement helps keep curriculum content and qualification standards aligned with evolving workplace realities.

Joint review of occupational standards is one of the most consequential forms of collaboration. TVET institutions, qualification authorities, employers' organizations and worker representatives can work together through recurring review processes to examine how AI is affecting task profiles, competence requirements and performance expectations in existing occupations. This is especially important where AI is reshaping work processes without creating entirely new job roles, since standards may still appear current even when the tasks they describe have already shifted.

Industry attachment and workplace exposure are also important. Short placements, attachments or shadowing opportunities allow TVET teachers and trainers to observe how AI tools are used in day-to-day practice and bring that understanding back into teaching. Kenya's 2023 TVET standard on industrial attachment is useful in this respect because it sets out clear roles for institutions and enterprises in placement, mentoring, coaching and assessment. It offers a practical model for more structured collaboration with industry (TVETA, 2023).

A further area is **partnership for applied learning environments**. Where institutions cannot easily reproduce AI working environments on their own, industry partners can provide access to tools, platforms, data environments and workplace scenarios. In Brazil, SENAI São Paulo's (SENAI-SP) partnerships with technology firms have expanded access to AI- and IT-related training through practical labs, localized content and real-world case studies (SENAI-SP, 2024). This kind of arrangement helps learners engage with current technologies and applied tasks that reflect contemporary workplace practice.

5.3 AI-assisted pedagogy and training delivery

TVET pedagogy links conceptual learning with embodied performance, and institutional instruction with workplace application. AI reshapes how teaching is prepared and how learners practise. It also changes how training is organized across classrooms, workshops and workplaces. The pedagogical task is to decide where AI strengthens vocational learning and where unaided performance remains essential. This section considers how AI can support TVET pedagogy across learning activities, simulation and workplace training, while preserving authentic skill formation.

The degree of AI integration in learning activities

A critical pedagogical decision is how far AI should enter the learning process in different learning activities. In TVET, many vocational competencies require learners to demonstrate manual precision, material sensitivity, safety judgement and professional reasoning under authentic conditions. The appropriate level of AI involvement therefore depends on two things: the competencies being developed, and whether the activity requires independent performance.

Drawing on Riis's (2025) five learning strategies for TVET, AI can be positioned across a range of learning spaces, from AI-independent to AI-centric, according to the purpose of the activity. These levels are not a linear progression. They form a repertoire of design choices that teachers combine in a single programme according to what each learning activity requires.

- **AI-independent learning**. Learners work without AI so that they build foundational competencies through direct engagement with tools, materials and processes. The focus is on practice, judgement and familiarity with the work.
  - *Example:* welding learners complete a basic weld joint manually, relying on visual inspection, hand control and material response without AI or digital assistance.
- **AI-aware learning**. Learners do not use AI in the task but examine how it is reshaping occupational practice and where human judgement retains its importance.
  - *Example:* hospitality learners discuss how AI-based booking and customer service systems are changing frontline roles, and identify tasks where human interaction remains essential.
- **AI-supported learning**. AI helps with task planning or preparation, while the learner remains responsible for the main task. Learners are expected to test and adapt AI outputs rather than follow them uncritically.
  - *Example:* electrical installation learners use an AI tool to generate a troubleshooting checklist before diagnosing a fault in a real training circuit.
- **AI-enhanced learning**. Learners use AI during the task as an active source of support, such as feedback, guidance or adaptation. The aim is to develop effective human–AI collaboration in occupational practice.
  - *Example:* logistics learners use an AI planning tool in a warehouse simulation to adjust routing, stock movement and scheduling decisions as conditions change.
- **AI-centric learning**. AI itself becomes the object of learning. Learners examine how AI systems work, the data and assumptions they rely on, and the practical or ethical issues that might arise from their use.
  - *Example:* agricultural technology learners examine how an AI crop monitoring system is trained, the data it uses, and the sources of potential error or bias in its recommendations.

In trades that require embodied skills, learners should first develop foundational manual competence before moving on to AI-assisted methods. TVET teachers and trainers can use the levels above as a design repertoire to select the form of AI involvement that best fits the learning objective rather than defaulting to the most technology-rich option.

BOX 4 AI-enabled transformation of a teaching and learning platform in China

Shenzhen Polytechnic University (SZPU) in China has embedded AI capabilities throughout its existing online/off-line integrated teaching and learning platform, SZPU i-Study, which hosts over 10,000 courses and 7 million online resources. The AI integration was implemented in phases. The first phase established foundational services, including data infrastructure and large-scale AI model training. Subsequent phases introduced AI-assisted teaching tools for teachers (AI-generated courseware, lesson plans and test questions), AI-assisted learning tools for students (question-and-answer support, study reminders and answer tracing), course knowledge graphs and smart classroom broadcasting with speech recognition and bilingual subtitles.

The initiative integrates both education-specific and general-purpose large-scale AI models, generating course-specific knowledge bases to provide AI teaching assistant and learning companion agents. Hybrid cloud deployment keeps teaching data on the campus private cloud while drawing on public cloud services for computing power and model hosting. The initiative also highlights open architecture design, allowing additional AI tools to connect with the platform and serve specific course instruction.

Source: contributed by Xiaoqing He, Shenzhen Polytechnic University.

Pedagogical approaches for AI-integrated vocational learning

Where AI-supported, AI-enhanced or AI-centric learning is appropriate, the question shifts to how teaching practice should change. GenAI enables learners to produce written outputs, analytical summaries and design work with limited original effort, which impacts teaching approaches that rely on final products as the primary evidence of learning. The pedagogical response is to shift emphasis towards the learning process, professional reasoning and applied problem-solving.

AI integration into vocational teaching works best as an iterative design process involving teachers and learners. Participatory approaches in which teachers trial AI applications in their own disciplines and refine them accordingly have shown stronger uptake than centrally imposed implementations (Chan, 2025). **Table 9** presents emerging approaches from recent research. Each approach positions AI as a support in a learning process. Professional judgement retains a clear role throughout. Teachers and trainers adapt their practice to facilitating critique rather than transmitting content. Assessment gives greater weight to process besides the product.

TABLE 9 Pedagogical approaches for AI-integrated vocational learning

Approach	What it involves	Vocational field and context
AI-scaffolded professional judgement	Learners use GenAI to support structured analysis of complex occupational scenarios. AI provides information inputs; learners interpret, evaluate and decide.	Construction management: learners used ChatGPT for situational analysis of project scenarios based on strengths, weaknesses, opportunities and threats (SWOT) (Daggubati, 2025).
AI-enhanced project-based learning	GenAI tools are embedded across a multiphase project cycle. Assessment is tied to authentic occupational outputs.	Fashion design: learners used language models, image generators and AI audio tools across a five-phase industry-simulated project, with usage logs to limit overreliance (Wang and Erdenebold, 2025).
GenAI-supported reflective practice	Learners use GenAI during clinical or workplace placements to support structured reflection, such as concept mapping or analytical journalling.	Nursing education: learners valued GenAI as a prompt for reflection during clinical placements (Bowen-Withington, 2025).
AI in alternating school–workplace training	AI tools are integrated into programmes alternating between formal education and enterprise-based practice. A design priority is to preserve the educational value of authentic work situations.	Professional training in manufacturing, forestry and automotive mechanics: three cases across alternating school–workplace programmes (Ciavaldini-Cartaut et al., 2024).
AI qualification through action-oriented didactics	AI competencies are taught through blended formats using practice-oriented examples from learners' own occupational fields.	Dual vocational training: apprentices and teachers identified blended, action-oriented formats as appropriate for AI qualification (Rott et al., 2022).

BOX 5 Developing intelligent tutoring systems with AI for TVET in Switzerland

EB Zürich, a public vocational and continuing education institution in Switzerland, is piloting a prototype of an AI-based intelligent tutoring system that supports personalized learning in vocational baccalaureate education. Vocational classrooms are highly heterogeneous, with learners from different educational backgrounds and ability levels, and traditional approaches struggle to address both under- and over-challenging learners simultaneously.

The system uses large language models to assess learners' prior knowledge, generate adaptive learning paths, provide continuous feedback and dynamically adjust content difficulty. The objectives are to enable individualized learning without excessive planning overhead, strengthen self-regulated learning, and shift the teacher role towards coaching and facilitation. The system architecture follows a privacy-by-design approach and a tool-agnostic design to allow future updates as AI technologies evolve rapidly.

The project team works closely with teachers and developers through iterative prototyping with real classroom feedback. After evaluation, the initiative may be expanded to additional subjects, school types and potentially bilingual learning contexts.

Source: contributed by Roy Franke, EB Zürich.

BOX 6 Implementation of adaptive learning technology in TVET in Brazil

Brazil's SENAI network implemented a data-driven adaptive learning platform to personalize technical education at scale in industrial vocational courses. The practice employed cognitive modelling and AI to instantaneously adjust the sequence, pace and content of learning based on each student's behaviour and performance. This enabled mass customization of education. The initiative was motivated by ineffective traditional instructional approaches that fail to engage students, and the difficulty for teachers to provide individualized personalization and support in large classrooms of 20 to 30 students without real-time data assistance.

The practice yielded three key results:

- Proven improvement in learning outcomes, with students who used the adaptive platform showing better overall performance in final course grades than those in traditional settings.
- High student motivation and acceptance, with 57.78 per cent strongly agreeing that the technology will be indispensable in the future.
- Enhanced ability to identify and correct learning gaps strategically through real-time data analysis.

Source: contributed by Luiz Eduardo Leao and Hugo Nakatani, SENAI.

AI-enhanced simulation and practical skill development

AI-enhanced simulation is among the most concrete applications of AI in TVET pedagogy. Combining AI with virtual reality (VR), augmented reality (AR) and digital twin technologies allows institutions to create training environments for scenarios that would be dangerous, expensive or impractical to replicate physically. Emerging evidence supports specific applications. In nursing, immersive VR has shown immediate gains in knowledge and perceived clinical competency, though gains may diminish after clinical placement (Kiegaldie and Shaw, 2023). In construction safety, VR-based fall hazard training has outperformed conventional instruction (Alzarrad et al., 2024). AI adds adaptive capability by adjusting scenario difficulty and providing individualized feedback, although evidence for AI-adaptive simulation in TVET remains in the early stage (Jongbloed et al., 2024).

The pedagogical question is where such simulation should be used and where physical practice remains essential (see Table 10). The most effective approach combines both modes in sequence. A 'virtual first, physical follow-up' progression allows learners to build procedural knowledge and confidence in a simulated environment before transitioning to supervised practice on the equipment. This reduces time spent on expensive machinery and improves safety.

Institutions with limited infrastructure can still benefit from simulation through lower-cost options, such as desktop-based simulations, AI-assisted scenario generators for case-based learning or shared access to simulation facilities through interinstitutional partnerships.

TABLE 10 When to use AI-enhanced simulation and when to prioritize physical practice

Decision criterion	AI-enhanced simulation is appropriate when...	Physical practice is essential when...
Learning objective	The goal is procedural knowledge, diagnostic reasoning, standardized workflow mastery or familiarization with equipment layout	The goal is fine motor skill acquisition, material sensitivity, real-time physical adaptation or professional judgement under authentic conditions
Skill type	Tasks involve high risk, high cost, rare or extreme conditions that cannot be safely or affordably reproduced	Tasks depend on haptic feedback, hand–eye coordination or the feel of tools and materials that virtual environments cannot replicate
Cost and resources	Equipment is expensive, consumable materials are costly, or access to real equipment is limited	Equipment is readily available, affordable and safe to operate; direct practice is more efficient than simulating it
Safety	Errors could cause injury, equipment damage or environmental harm; learners need to master safety protocols before handling real materials	Learners must develop situational awareness, respect for physical risk and emergency response capacity in authentic environments

BOX 7 Using AI-supported simulation to widen access to practical training in Fiji

In Fiji, some traditional TVET programmes are costly, time-consuming and risky to deploy, particularly for women and youth in rural and maritime areas who face geographic isolation, limited infrastructure and time constraints. The National Training and Productivity Centre at Fiji National University, in collaboration with the Asian Development Bank, is integrating AI-supported immersive learning tools, particularly VR and simulation-based training, into selected TVET programmes to improve access, quality and relevance of delivery for these underserved communities.

VR-based training compresses long practical sessions into short immersive experiences of around 15 minutes. This enables women with caregiving responsibilities to engage in skills development despite significant time constraints. Training content and VR simulations are designed to be highly visual, intuitive and language-light, allowing participants with basic literacy and language skills to learn through observation and practice rather than text-heavy instruction. The project emphasizes responsible, inclusive and human-centred use of AI, positioning AI as an assistive tool that supports instructors.

Source: contributed by Swaran Ravindra, Fiji National University.

Harnessing AI in work-based learning

TVET institutions can use AI to make apprenticeships and work-based learning more responsive and more relevant to current workplace practice. In these settings, AI is most useful when it supports specific learning functions, including helping learners to document workplace tasks, receive timely feedback, strengthen technical understanding and connect what they do at work with what they learn in the institution. International evidence shows that digital technologies can strengthen both the school-based and workplace components of apprenticeship, rather than serving as a separate layer added on top of them (Cedefop and OECD, 2024).

Existing practice highlights several approaches for institutions. In Germany, for example, the Koblenz Chamber of Skilled Crafts works with more than 8,000 training companies to identify emerging skills needs and adapt training accordingly. It has introduced a digital platform and customized chatbots to support trainees and trainers across dual training arrangements. This use of AI is intended to make inter-company training more efficient and to help equip learners with the digital skills needed for employment (Koblenz Chamber of Skilled Crafts, 2024).

For institutions working with employers that have limited capacity, shared provision is a practical solution. Inter-company centres, public training centres and sector-based intermediaries can give learners and trainers access to AI tools and applications that may be beyond the reach of individual firms. In Nigeria, the National Board for Technical Education (NBTE), in collaboration with the Commonwealth of Learning (COL), has introduced a trainer-in-the-loop AI approach through its Centre of Excellence for TVET in Kaduna. The initiative uses an AI-supported portal to streamline the creation of curriculum-aligned open educational resources (OERs). Subject matter experts and quality assurance reviewers validate the AI-generated content to ensure pedagogical integrity. Similar initiatives are being implemented across Nigeria, Ghana, Kenya and Jamaica (NBTE, 2025).

5.4 Vocational assessment in the AI context

The development of GenAI has created new challenges for traditional, product-oriented assessment formats. GenAI tools can now produce competent outputs for written assignments, reports and routine coding tasks, making it difficult to verify the learner's own contribution. Compared to general education, TVET is better positioned to adapt to these challenges. Practical demonstration, process documentation and the assessment of applied competencies alongside final outcomes are already established features of vocational assessment practice.

However, many TVET institutions still rely heavily on text-based assessment formats that are exposed to GenAI risks to assessment integrity. At the same time, the integration of AI into vocational assessment remains underdeveloped, since most current AI tools focus on assisting cognitive and theoretical tasks. AI integration is limited for the hands-on, practical elements that constitute the bulk of TVET delivery. Implementing AI-supported formative assessment also requires well-organized institutional data, which is difficult to achieve where institutions operate with fragmented data systems. This section addresses how teachers can

use AI responsibly in vocational assessment and ensure that it does not undermine the credibility of assessment outcomes.

Designing assessment that verifies genuine competence

In AI-influenced contexts, assessment design should begin by determining what role AI should and should not play in generating evidence of competence. This depends on the purpose of the assessment and the nature of evidence required. In some cases, assessments should exclude AI altogether because they are intended to verify foundational knowledge, manual skills, independent judgement or safe performance under controlled conditions. In others, AI should be integrated because authentic occupational practice now demands the ability to use such tools effectively. A separate issue concerns AI used by assessors to support marking, feedback or learning analytics. Building on existing research and qualification guidance on assessment integrity in the context of GenAI, Table 11 describes four categories of AI involvement in vocational assessment and the conditions under which each is appropriate.

TABLE 11 Categories of AI involvement in vocational assessment

Category	Definition	Appropriate when	Examples
AI-excluded assessment	AI tools are not permitted during the assessment task	The assessment must evidence independent knowledge, manual skills, direct performance or safety-critical judgement	Supervised examinations, live practical demonstrations, oral checks of individual understanding
AI-permitted assessment	AI tools may be used for specified purposes with disclosure and conditions	The task involves cognitive or preparatory work where AI can assist, but the assessed competency requires the learner to demonstrate independent understanding	Research support, planning, drafting assistance, language support, idea generation
AI-integrated assessment	AI use is expected because it is part of authentic occupational practice and part of the competencies being assessed	Workplace performance requires effective and critical use of AI tools	AI-assisted diagnostics, design, forecasting, simulation, data interpretation
AI-enabled assessment	AI is used by the institution or assessor to support assessment design, marking, feedback or monitoring	AI supports assessment operations, with human oversight retained for all evaluative decisions	Assisted feedback drafting, moderation support, learning analytics, item development

Source: adapted from Perkins et al. (2024), with modifications for application in TVET.

In practice, assessment tasks in the same course may fall into different categories. Assessors should classify AI involvement at task level rather than applying a single rule across an entire course or qualification. Where AI is permitted, each assessment should include at least one non-delegable anchor: a step that must be completed by the specific learner in their own context. The following approaches can help verify authentic competencies when AI tools are available.

- **Process documentation**. Learners keep reflective diaries or logs detailing the AI tools and prompts they used, along with how they critically evaluated and modified the outputs. This creates a transparent record of how the learner engaged with AI and encourages critical reflection rather than passive reliance.
- **Oral defence and professional discussion**. Short viva discussions, oral defences or question-and-answer sessions require learners to justify their decisions and demonstrate genuine understanding of work produced with AI assistance.
- **Layered assessment**. A layered model combines a real-world task or simulation with a documented portfolio of the learner's process and a professional discussion to verify applied skills and reasoning. By combining evidence from these elements, assessors can confirm competency even when AI tools were widely available.
- **Project-based and performance-based assessment**. Assessing real prototypes or authentic workplace actions reduces vulnerability to AI-assisted substitution, because these tasks demand active, situated participation that AI cannot perform on the learner's behalf.
- **In-class reflections**. Immediate written reflections at the end of a practical workshop capture the learner's genuine understanding without AI access. These can take the form of short written accounts or plenary discussions. They provide direct evidence of whether the learner has internalized the learning.
- **Assessing AI use as a professional competency**. The ability to craft effective prompts, verify AI outputs against professional standards and identify errors in AI-generated solutions should be treated as an assessable competency. These cross-cutting skills should be embedded within subject-specific evaluations.
- **Retaining traditional written exams**. Written examinations remain necessary for assessing foundational knowledge in fields such as accounting and other theory-intensive vocational subjects. Controlled examinations are necessary to verify whether learners can recall and apply essential concepts without assistance.

BOX 8 AI-enabled applied training with project-based assessment in Pakistan

The National Skills University Islamabad in Pakistan has integrated AI across its TVET-aligned undergraduate programmes, adopting project-based assessment as a central pedagogical strategy. Traditional assessments were replaced with tasks using real datasets and workplace-style problem statements, requiring students to apply AI-enabled workflows to practical problems. To strengthen academic integrity, documentation templates, checkpoints and viva-based verification were introduced, requiring students to demonstrate and explain their work rather than simply submit outputs.

To support this assessment redesign, the initiative developed reusable lab kits covering data cleaning, machine learning basics, evaluation and simple deployment. They were designed to work on modest infrastructure using open-source tools. Course learning outcomes were revised to include AI literacy, workflows and responsible use. Instructor capacity building was delivered through micro-training sessions, peer mentoring and shared teaching kits, including standard rubrics to ensure consistent marking across courses. The lab-first, scalable approach is being expanded across additional programmes and short courses for in-service trainers.

Source: contributed by Saud Altaf, National Skills University Islamabad.

Assessment methods across occupations

Assessment methods differ significantly across occupational domains, and AI affects assessment differently depending on the kind of work involved. In general, AI can support assessment more readily where performance can be simulated, recorded or analysed automatically. Its contribution is more limited where competency depends on tacit know-how and interpersonal interaction. Institutions should review assessment across occupations and match assessment conditions to the specific competencies being evaluated.

Occupations with high materiality and safety risk

In construction, welding, electrical installation and similar hands-on fields, direct practical demonstration remains the most defensible evidence of competency. Assessors observe process execution, safety compliance, tool handling and product quality against occupational standards. AI-assisted simulation can track procedural steps and provide formative feedback on positioning or sequencing errors. It is less effective for assessing a learner's feel for heat, material response or adaptive judgement under imperfect site conditions. High-stakes assessment in these fields should continue to rest on observed performance in authentic or near-authentic settings (Alzarrad et al., 2024).

Occupations where competency is strongly relational

In nursing, elder care, hospitality and other person-facing occupations, competency is both technical and interpersonal. AI can extend the range of simulated scenarios and support structured feedback on clinical reasoning or communication patterns. Its limits become clear where competency depends on empathy, trust-building, interpreting ambiguous social cues and responding appropriately to other people in context. The assessment of relational competency still requires human observation in live or closely supervised settings (Sengul and Sarıköse, 2025).

Occupations where work is digitally produced

Most evident in coding, network administration and related IT fields, GenAI can now complete many standard tasks. This means unsupervised output-based assessment no longer provides reliable evidence of individual competency. Assessment design therefore needs to shift towards supervised practical tasks, live troubleshooting, code review, process logs and oral explanation of the decisions and trade-offs behind the work (Franklin et al., 2025).

Occupations with mixed procedural and interpretive demands

Roles in laboratory and technical sciences sit between these categories. Competency depends partly on procedural accuracy and safe practice, and partly on interpretation, judgement and quality control. AI can support scoring where performance can be broken down into observable steps or recorded traces. It is less reliable for judging whether learners independently generated an interpretation or responded competently. Assessment in these fields may combine direct observation of in-lab work with documented reasoning (Nikolic et al., 2025).

No single AI assessment policy can serve all programmes. Assessment design should distinguish between what AI can support, such as simulation and process capture, and what requires direct observation, supervised performance or triangulated evidence.

Safeguards for assessment integrity

The following safeguards provide a checklist for institutions reviewing or redesigning assessment in response to AI. They address the specific requirements of assessment and should be read alongside the broader ethical principles set out in Chapter 3.

- **Human judgement as the final authority for summative decisions**. AI may support formative feedback, moderation, pattern detection or evidence aggregation. Final summative judgements on competency, grading, progression and certification should remain the responsibility of qualified human trainers.

- **Learner responsibility for assessed work**. AI use in assessment is acceptable only where the learner remains accountable for the work submitted and for the professional judgements it reflects. Assessment should verify that the learner can meet occupational standards, either independently or through appropriate use of AI where this forms part of competent practice.

- **Explicit conditions for AI use in each assessment task**. Assessment instructions should state clearly whether AI use is permitted. Where permitted, instructions should specify the purposes, conditions and disclosure requirements that apply. Learners should thus document their use in enough detail for the assessor to review the process.

- **Fairness and accessibility**. AI tools used for assessment should be reviewed for validity, bias, accessibility and data protection before deployment and at regular intervals thereafter. Institutions should provide accessible procedures through which learners can question or appeal AI-informed judgements, supported by human review and relevant process evidence.

- **Transparency and auditability**. Institutions should maintain a clear record of how AI was used in assessment design, delivery or decision support, including the points at which human review took place. Assessment decisions should remain explainable and open to scrutiny.

- **Critical verification as an assessable competency**. Where AI is permitted or integrated into assessment, learners are expected to validate AI-supported outputs against professional and occupational standards. In programmes where AI use is relevant to occupational practice, the ability to verify AI outputs should be reflected in assessment criteria.

5.5 AI competency development for TVET staff and learners

AI integration in TVET institutions depends on the capabilities of the people who work and learn in them. TVET staff across leadership, management, teaching, training and other institutional roles all need an appropriate understanding of AI to use it responsibly and support institutional AI integration. Learners need AI-related competencies that support ethical and informed engagement with AI in learning, work and life. UNESCO's AI CFT and AI CFS provide an important foundation for this work (UNESCO, 2024b, 2024a). Building on these, this section examines how TVET institutions can develop AI competencies among staff and learners.

An institution-wide approach to AI competency development for TVET staff

AI competency development should be treated as a cross-institutional priority. It combines shared foundations in human-centred and responsible AI use with role-specific requirements for different staff groups and learners.

The UNESCO AI CFT organizes AI competencies for teachers across five aspects: human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy, and AI for professional development. It also sets out three progression levels: acquire, deepen and create (**Table 12)**. Although designed for teachers, the framework offers a useful reference for wider TVET staff. Institutions can extend it to staff beyond teaching roles by anchoring competency expectations in institutional responsibilities and occupational practice, while recognizing that AI relevance varies across trades and sectors.

TABLE 12 UNESCO AI competency framework for teachers

Aspects	Progression		
	Acquire	Deepen	Create
1. Human-centred mindset	Human agency	Human accountability	Social responsibility
2. Ethics of AI	Ethical principles	Safe and responsible use	Co-creating ethical rules
3. AI foundations and applications	Basic AI techniques and applications	Application skills	Creating with AI
4. AI pedagogy	AI-assisted teaching	AI pedagogy integration	AI-enhanced pedagogical transformation
5. AI for professional development	AI enabling lifelong professional learning	AI to enhance organizational learning	AI to support professional transformation

Source: UNESCO (2024b).

Institutional leaders shape the conditions for responsible and effective AI adoption through decisions on strategy, investment, procurement, staffing, oversight and professional learning. Their AI competencies include evaluating the educational and organizational implications of AI, overseeing ethical and legal issues, engaging stakeholders, and creating space for staff learning and collaboration (DeMatthews et al., 2026). Strengthening leadership AI competency is therefore an important condition for wider institutional development.

For TVET teachers and trainers, AI competency is an applied professional capability. It involves using AI to support vocational teaching and learning, strengthen professional judgement and remain aligned with occupational standards. This requires a combination of pedagogical, occupational and technological knowledge, as well as the ability to evaluate AI outputs critically, manage risks and judge when human intervention is necessary (Setiyawan et al., 2025).

TVET institutions also rely on staff in technical, operational and learner support roles. These include workshop technicians, IT administrators, lab managers, pedagogical advisers, apprenticeship coordinators, industry liaison staff, career guidance staff, quality assurance staff and front-office personnel. Each role requires AI competencies suited to its function.

Table 13 outlines indicative AI competencies across the TVET institutional workforce, organized by role cluster and three competency dimensions. It draws on AI CFT, especially its foundations in a human-centred mindset, ethics and AI knowledge, and extends them to roles beyond teaching. It is not a prescriptive competency framework. Institutions should adapt it to their context, scale and regulatory environment. Staff at different stages of familiarity with AI will need different forms of support, and institutions should plan for progression over time.

TABLE 13 Indicative AI competency expectations for TVET staff

Role cluster	Foundational AI competency	Role-specific AI competency	Strategic or specialist capacity
Institutional leaders and senior management	Understand how AI systems work, their probabilistic nature and their limitations; commit to human-centred and ethical AI use in education; understand data protection requirements	Assess institutional readiness for AI adoption; make informed procurement and resource allocation decisions; evaluate risks including bias, privacy, safety and vendor dependency; communicate realistic expectations to staff and stakeholders	Set institutional AI strategy aligned with national and sectoral priorities; establish governance, oversight and accountability structures; create conditions for sustained professional development across all staff
Teachers and trainers	As above	Integrate AI tools purposefully into teaching, training and assessment; redesign learning activities to develop learners' AI competencies; critically evaluate AI-generated content for accuracy, bias and pedagogical suitability; document and disclose AI use in professional practice	Contribute to curriculum development that responds to AI-affected occupational standards; mentor peers in AI integration; lead pedagogical innovation in their programme area
Learning support and coordination staff	As above	Understand how AI is affecting the occupations and labour markets they advise on; use AI tools appropriately within their professional functions; identify where AI outputs require human verification in guidance, placement or quality decisions	Contribute to institutional AI strategy from the perspective of learner support and labour market alignment; advise on equity implications of AI-related programme decisions
Technical and operational staff	As above	Assess AI tools that are relevant to their operational functions; maintain safe and compliant operation of AI systems within institutional infrastructure; support data management practices that enable responsible AI use	Lead on technical evaluation of AI tools and infrastructure requirements; advise institutional leadership on data governance, system security and interoperability

BOX 9 GenAI training for TVET teachers and trainers in Singapore

Temasek Polytechnic in Singapore developed a three-module blended learning programme to upskill its academic staff in the effective and ethical use of generative AI. Module 1, a self-paced online course, builds baseline AI literacy and is assessed through a quiz with a digital badge awarded on completion. Module 2 is a hands-on workshop where teachers from the same discipline explore AI tools for content creation, lesson planning, formative feedback and learner engagement. Module 3 focuses on redesigning assessments for the generative AI era, with participants collaboratively identifying vulnerabilities in existing tasks and brainstorming AI-resilient alternatives.

In 2024/25, over 800 teachers completed the programme. Participants reported a shift in mindset from viewing AI primarily as a plagiarism risk to recognizing it as an opportunity to design authentic learning experiences that foster higher-order thinking. Discipline-based communities of practice and a monthly newsletter sustain application after the training.

Source: UNESCO-UNEVOC (2026b).

Supporting TVET learners in developing AI competencies

AI CFS provides a foundation for all learners, including those in TVET. It covers four competency areas: human-centred mindset, ethics of AI, AI techniques and applications, and AI system design, across three progression levels: understand, apply and create (**Table 14**). These competencies apply to TVET learners as they do to all students, but in TVET they also need to be grounded in occupational contexts.

AI competency development in TVET is shaped by learners' occupational destinations. At a **foundational level**, every TVET learner needs a working understanding of what AI systems can and cannot do. This includes using AI tools critically and safely, recognizing bias and errors in AI-generated outputs, and applying ethical judgement in workplace contexts.

At the **occupation-specific level**, learners need competencies linked to AI systems used in their field, such as AI-assisted diagnostics in automotive mechanics and health care, design and planning tools in construction, and service-management platforms in hospitality. These competencies build on AI techniques, application skills and system design, applied in specific occupational contexts.

TABLE 14 UNESCO AI competency framework for students

Competency aspects	Progression levels		
	Understand	Apply	Create
Human-centred mindset	Human agency	Human accountability	Citizenship in the era of AI
Ethics of AI	Embodied ethics	Safe and responsible use	Ethics by design
AI techniques and applications	AI foundations	Application skills	Creating AI tools
AI system design	Problem scoping	Architecture design	Iteration and feedback loops

Source: UNESCO (2024a).

At the **specialist level**, learners pursuing specific AI and data pathways need deeper technical preparation. These programmes focus on building and deploying AI systems, managing data pipelines, and conducting validation and bias assessment. Aspects of the human-centred mindset and AI ethics remain essential, as many of these learners are preparing to design AI systems.

Table 15 presents this three-pathway structure for AI competency development among TVET learners, building on the AI CFS foundation.

TVET learner populations are diverse in age, prior education, language background and digital access. This diversity shapes the design and delivery of AI competency development programmes.

Learners from rural, low-income or other marginalized backgrounds may face barriers in accessing AI tools and connectivity. Institutions serving these populations need low-bandwidth or off-line alternatives and should ensure that AI integration does not widen existing gaps. At the same time, AI can help broaden access to learning when used with appropriate safeguards.

TABLE 15 AI competency pathways for TVET learners

Competency pathway	Relationship to AI CFS	Who it applies to	Indicative competency expectations
Foundational AI competency	Engages all four AI CFS competency areas (human-centred mindset, ethics of AI, AI techniques, AI system design). All three progression levels are accessible, with emphasis on 'understanding' and 'applying' in vocational contexts	All TVET learners	Use AI tools for learning and workplace tasks critically; verify AI outputs against professional standards and observable evidence; protect personal and institutional data; identify when AI-generated content is unreliable or biased
Occupational AI competency	Deepens the AI CFS areas of AI techniques and system design in trade-specific workflows; applies ethical and human-centred principles to occupational practice; the 'create' level may be reached by developing AI-supported solutions in the learner's trade	Learners in occupations where AI is actively reshaping practice	Apply AI tools in trade-specific workflows (e.g. diagnostics, quality control, design, customer interaction); evaluate AI-assisted outputs against occupational standards; exercise professional judgement about when to follow, modify or override AI recommendations
Specialist AI competency	Engages all AI CFS areas with sustained emphasis on the 'create' level in AI techniques and system design; focuses on building, validating and governing AI systems	Learners in dedicated AI, data or machine learning programmes	Design and implement AI solutions; manage data pipelines and model life cycles; conduct testing, validation and bias assessment; apply responsible AI principles in system development

Learners studying in a second or third language may benefit from GenAI support for communication and comprehension, including assistance with drafting professional documents and understanding complex technical texts. They also need to understand that AI models can carry linguistic and cultural biases that could distort outputs in non-dominant languages.

Women remain under-represented in many technical and ICT-related TVET pathways. AI competency development offers an opportunity to strengthen their participation through gender-responsive programme design, visible role models and early exposure to AI applications across occupational fields, including fields where women are already well represented.

For **learners with disabilities**, AI-supported personalization, including adaptive tutoring, speech-to-text and text simplification, can improve access to learning when embedded in structured pedagogical and social support.

TVET serves **learners across life stages**, from young school leavers to adults returning for reskilling. Young learners may have strong digital agility but need support in digital well-being and the socio-economic and ethical implications of AI. Adult learners may face barriers in digital fluency or concerns about job displacement. In this case, flexible, modular pathways and confidence-building support are important for inclusion.

BOX 10 Building AI competencies among TVET students in Poland

The AI for Youth programme, developed by Intel and implemented in Poland by the Poznan Supercomputing and Networking Centre (PSNC), equips secondary school students, including those in technical and vocational tracks, with foundational AI knowledge and project-based skills. Teachers receive training in AI fundamentals, Python programming language and design thinking methodology, supported by PSNC engineers and certified through Intel. Students apply what they learn by developing team projects that use AI to address social or environmental problems, with winning entries presented at a national competition.

Across five editions, the programme has reached over 120 schools, nearly 200 teachers and more than 2,000 students, producing around 100 student-led AI projects. A key lesson has been the importance of discipline-specific training materials and sustained support for teachers of varying technical backgrounds.

Source: UNESCO-UNEVOC (2024a).

Institutional support for sustained competency development

Sustained AI competency development depends on institutional conditions that support continuous learning across the whole community. Useful support measures include:

- **Protected time for experimentation**. Staff need time during working hours to test AI tools in relation to their own roles. This signals that AI competency development is an institutional responsibility, rather than an additional burden on individuals.
- **Graduated, trade-specific professional development**. Professional learning should move from foundational orientation to applied use and be tailored to vocational fields. Practical examples, ready-to-use resources and adaptable templates can help staff apply what they learn.
- **Peer learning and communities of practice**. Regular exchange among staff can strengthen collaborative learning more effectively than isolated training. Cross-departmental mentoring, support from IT or AI specialists, and structured reverse mentoring with digitally fluent learners can help build confidence across the institution.
- **Recognition and incentives**. AI-related professional development should be recognized in continuing professional development structures. Credited and flexible learning opportunities can support participation without disrupting staff members' core responsibilities or reducing their income.
- **Industry engagement in competency development**. Collaboration with employers and industry bodies helps keep competency development aligned with workplace practice. Job shadowing, workplace exchange and engagement with placement hosts can strengthen staff understanding of real-world AI use and improve learners' occupation-specific preparation.

5.6 AI use in safety-critical and regulated occupations

Safety-critical occupations are those in which errors in professional practice can result in physical injury, environmental damage or loss of life. In TVET, these include occupations in construction, electrical installation, welding and manufacturing, automotive diagnostics and repair, health care support, and transport, among others. Practice in these fields is typically governed by occupational safety and health (OSH) regulations and has formal accountability requirements. AI and digital technologies are entering these workplaces with the potential to improve safety outcomes. However, they also introduce new risks or shift existing ones. Because errors in these occupations have physical consequences that are often irreversible, TVET institutions need to address how AI is integrated into relevant programmes. This section discusses the key measures and training approaches that apply.

Human oversight, task boundaries and accountability

AI and digital technologies can improve occupational safety, for example by taking over tasks that expose workers to physical danger or by detecting hazards earlier than human observation alone. At the same time, they can introduce new risks or shift existing ones in unexpected ways. Overreliance on AI and automation can reduce human oversight and increase OSH risks. Consequently, digital tools should complement rather than replace human judgement in safety-critical practice (ILO, 2025c). Outcome evidence for AI-based occupational safety tools remains limited. Research found that industrial adoption of these tools is substantially outpacing evaluation of their actual impact on worker injury or illness (Jetha et al., 2025). In teaching and training for safety-critical occupations, institutions should apply precautionary standards. Table 16 summarizes the main categories of AI application in safety-critical work, their OSH benefits and risks, and implications for risk mitigation.

Existing applications show that AI can contribute to safer working conditions. However, it can also generate new vulnerabilities, shift responsibility or weaken professional judgement. Institutions therefore need a clear framework for its use.

- **Human oversight**. In safety-critical training and practice, AI should be used under qualified human oversight. Institutions should ensure that teachers, trainers and supervisors retain the authority and responsibility to review AI outputs, intervene when necessary, and make or confirm safety-relevant decisions. From the outset, learners should understand that human oversight of AI is an occupational requirement.

- **Defining task boundaries**. Institutions should specify, for each programme, which tasks and decisions may involve AI support and which require unassisted human performance. These boundaries should reflect the applicable OSH standards and certification requirements for the occupation. They should be documented in programme regulations and communicated to learners, teachers and workplace partners.

- **Accountability**. AI may support professional judgement, but it does not replace human responsibility. Institutions should therefore make clear that the ultimate accountability for safety-relevant decisions and for certifying occupational competencies remains with qualified human trainers and responsible institutions, within the applicable regulatory framework.

- **Compliance with OSH standards**. AI governance in these programmes should be embedded in institutions' existing quality assurance and OSH compliance structures. Before AI-generated instructions, scenarios or operational recommendations are used in physical workshops or clinical settings, institutions should assess whether those outputs are consistent with established safety protocols.

Training for safe AI use in safety-critical occupations

Beyond institutional safeguards, safety-critical programmes need to translate these principles into training and assessment. Learners should develop the ability to work safely with AI, to recognize when its outputs are unreliable and to perform core tasks without depending on it.

TABLE 16 AI use in safety-critical occupations: OSH benefits, risks and mitigation

AI application	OSH gains	OSH risks introduced or shifted	Implications for risk mitigation
Automation and robotics	Removes workers from hazardous tasks and environments, reduces physical strain and repetitive injury, automates risky operations	System malfunctions causing unexpected machine behaviour, deskilling and reduced capacity to respond to failures, ergonomic risks from human–robot interaction	Maintain human override capacity, preserve workers' independent task competency, conduct risk assessment before and after deployment
Smart monitoring and wearable systems	Real-time hazard detection (air quality, noise, fatigue, posture), predictive maintenance preventing equipment failure, continuous compliance monitoring	Alert fatigue reducing human vigilance, false sense of security, device malfunctions delaying warnings, privacy and surveillance concerns	Ensure human judgement complements automated monitoring, review alert relevance regularly, establish data protection safeguards
AI-assisted analysis and decision support	Supports diagnostic reasoning, identifies patterns for safer practice, enables evidence-based risk prevention	Automation bias deferring to AI outputs without verification, reduced professional reasoning when AI is unavailable	Train workers to verify AI outputs against professional standards before acting, build domain expertise sufficient to detect errors
AI-driven work coordination and remote monitoring	Optimizes scheduling and task allocation, enables remote safety oversight, can improve workload distribution	Work intensification from algorithmic performance targets, reduced on-site safety support, excessive surveillance causing stress, limited worker autonomy	Ensure scheduling respects OSH standards including rest periods, maintain access to on-site safety support, involve workers in technology implementation

Source: adapted from ILO (2025c).

Building independent judgement and verification

In safety-critical fields, the ability to perform core tasks without AI is a safety requirement. Programmes should therefore ensure that learners first demonstrate competency in manual diagnostics, physical inspection and procedural safety before AI-assisted methods are introduced. Building independent competency early is a precondition for safe AI use later, particularly because novice workers are more vulnerable to automation bias and less able to detect AI errors (Romeo and Conti, 2026).

Learners should also be able to verify AI-generated recommendations against the relevant technical standards, physical measurements and material conditions of the trade before acting on them. Because this verification has direct safety implications, it should be treated as an explicit learning outcome and assessed throughout the programme.

Maintaining hands-on competency alongside AI-enhanced simulation

AI-enhanced simulation has clear value in safety-critical training. It allows learners to practise procedures repeatedly and safely before encountering real conditions, and it extends practice opportunities that would otherwise be too dangerous or too costly. The risk, however, is that AI-mediated learning may gradually displace hands-on practice, leaving graduates with insufficient manual competence for safe independent work. Competency standards in safety-critical fields should therefore require demonstrated physical performance under real or closely replicated conditions, and assessment should verify that learners can exercise professional judgement without AI assistance. Trainers are advised to:

- Define minimum hours of unassisted hands-on practice for each safety-critical competency, distinct from AI-supported or simulated practice.
- Design assessment tasks that require demonstrated physical performance and professional judgement without AI assistance.
- Position AI-enhanced simulation as a preparatory stage, not a replacement for supervised practice with real equipment and conditions.
- Review the balance between simulated and real practice in consultation with industry partners.

Coordinating safety expectations in work placements

Many learners first encounter AI systems during work placements, where employers in safety-critical sectors increasingly use AI-driven monitoring, predictive maintenance and decision support tools. Institutions should ensure that learners are briefed on the operational boundaries, safety protocols and professional responsibilities that apply when working alongside these systems. Where institutions collaborate with employers on work-based learning, placement agreements should specify the oversight and safety arrangements governing learners' interaction with AI in safety-relevant tasks.

5.7 AI-enabled innovation and entrepreneurship in TVET

AI can widen participation in innovation and entrepreneurship by lowering some technical and financial barriers to developing products, services and solutions. GenAI, accessible machine learning platforms and data analytics can support market research, product design, content creation and business planning. For TVET learners, this can make vocational competencies more generative, enabling them to prototype locally relevant solutions in various sectors. TVET institutions can support this shift by building innovation capacity, strengthening entrepreneurial learning and linking projects to the economic, social and environmental needs of surrounding communities.

Supporting institutional innovation with AI

AI creates opportunities for TVET institutions to expand applied learning opportunities and develop new services linked to local economies. Promising projects and individual initiatives are most effective when supported by institution-wide capacity.

The UNEVOC Innovation Framework, developed through UNESCO-UNEVOC's Skills for Innovation Hubs (i-hubs) initiative, provides one approach to building this capacity (UNESCO-UNEVOC, 2020b). It treats innovation as an institutional capability organized around four interdependent dimensions: strategy and management, teaching and learning, products and services, and ecosystem relationship management. These dimensions offer a useful lens for considering where and how AI may support innovation.

Dimension 1: Strategy and management concerns leadership commitment, organizational processes, planning, financing, human resources and internal monitoring. For AI-enabled innovation, institutions need to assess whether their strategy reflects a considered position on AI, whether budgets and staffing allow

responsible experimentation, and whether governance arrangements address data protection, transparency and human oversight.

Dimension 2: Teaching and learning concerns pedagogy, curriculum modernization, assessment and instructional methods. AI can support project-based and challenge-based learning where learners use AI tools to develop solutions, engage with users, and build technical and transversal competencies through real tasks. The value lies in the learning process, not AI use for its own sake. TVET teachers and trainers need to understand the tools, learners need to engage critically with AI outputs, and assessment should capture authentic problem-solving.

Dimension 3: Products and services concerns an institution's capacity to offer functions beyond conventional teaching, such as research and development, incubation, start-up support, consultancy and prototype development. AI may broaden these functions through AI-assisted prototyping, maker services, applied research or support for local small and medium-sized enterprises (SMEs). The scope depends on institutional resources, staff expertise, partnerships and local demand. Institutions should start from functions they can sustain and govern responsibly.

Dimension 4: Ecosystem relationship management concerns an institution's ability to engage external actors, monitor labour-market and societal change, involve partners in governance, and convert external signals into institutional action. For AI-enabled innovation, this includes partnerships with technology providers, employers, research institutions, public agencies and community organizations. Institutions may assess which partners offer the strongest combination of skills development commitment and innovation potential. This mapping should consider the partners' alignment with AI ethical standards as well as their willingness and capacity to support inclusive participation.

Regular self-assessment across these four dimensions can help institutions strengthen their innovation capacity over time. This iterative logic is important for AI-enabled innovation, where applications evolve quickly and institutional capability develops progressively. Inclusion also requires deliberate design in strategy, learner recruitment, project selection and partnership arrangements, so that women, rural learners, persons with disabilities and other underserved groups can access equal innovation opportunities.

BOX 11 Institutional practices in supporting AI innovation and entrepreneurship

TVET institutions are supporting AI innovation and entrepreneurship through different organizational arrangements. These three cases illustrate different approaches.

Institute of Technical Education, Singapore: SME-facing AI experimentation hub

The Institute of Technical Education (ITE) has established SME@AiTE jointly with the Association of Small & Medium Enterprises at ITE College Central. The centre provides SMEs with access to AI-related workshops, community resources and opportunities to test applications in a practical environment. The model is organized around enterprise engagement and applied use cases in sectors such as food and beverage, human resources (HR), accounting, retail, engineering and logistics, with student learning linked to real business contexts through projects and internships.

Seneca Polytechnic, Canada: Applied AI commercialization support

Seneca Polytechnic's Centre for Innovation in AI Technology operates as an applied research platform that supports SMEs and AI ventures at different stages of development. For firms at an early stage, the centre offers AI strategy development, including technical advice, gap assessments, benchmarking, opportunity identification and planning. For firms that already have AI products, it provides commercialization support through testing, validation, scaling up and early-adopter data to strengthen the go-to-market strategy.

Polytechnic University of the Philippines: AI entrepreneurship activation with an inclusion focus

At the Polytechnic University of the Philippines (PUP), the Technology Business Incubation and Development Office organized the SHE++ AI Learning Journey Masterclass and Tech Pitch Fest, which combined AI exposure, entrepreneurship learning and student venture pitching. The activities included hands-on engagement with AI and cloud-based tools, followed by pitch presentations by student teams. The event highlighted women's participation in technology entrepreneurship and presented innovation in relation to social and environmental concerns.

Sources: ITE (2025); Seneca Polytechnic (2024); PUP (2025).

AI in entrepreneurial learning

Where institutional innovation creates an enabling environment, entrepreneurial learning develops learners' capacity to recognize opportunities, create value and act. In TVET, entrepreneurship is understood broadly as a set of mindsets, competencies and methods that support employability, creativity, resilience and venture creation. Six core elements describe entrepreneurship as a process (Lindner, 2018; UNESCO-UNEVOC, 2020a):

- Check your own potential.
- See opportunities, including problems, trends, change of laws, technical development and market shifts.
- Develop ideas with value.
- Identify and manage risks.
- Know the necessary resources.
- Put ideas into action.

Integrating AI into this process requires institutional judgement about where AI adds genuine value to entrepreneurial learning and where it may short-circuit the development of competencies that learners need to build through their own effort.

For example, AI tools can help learners access market information, generate and compare business concepts, and model costs and risks. These uses are productive when they enable learners to engage with real-world problems and iterate on ideas. They become counterproductive if they replace the reasoning, creativity or practical experimentation that entrepreneurial learning is meant to develop. Institutions should therefore design learning activities in which AI serves as a resource in a structured process where learners evaluate and adapt the outputs they produce.

Entrepreneurial education also serves a broader developmental purpose. It helps cultivate a culture of entrepreneurial thinking and action and a culture of maturity, autonomy, personal responsibility and solidarity for society (Aff and Lindner, 2005). Developing learners' capacity to take initiative, work with others, exercise ethical judgement and contribute to their communities is central to TVET's role in an era of rapid technological transition.

Contributing to local and sustainable development

TVET's innovation and entrepreneurial capabilities can help institutions respond to local development needs. Institutions with established partnerships and applied learning programmes are well positioned to direct AI-enabled innovation towards challenges in their surrounding communities and regions. This requires working with local stakeholders to identify needs and co-develop responses. Stakeholder participation across the AI system life cycle is necessary for inclusive AI governance and for enabling benefits to be shared more equitably (UNESCO, 2022a). This principle also applies to AI-enabled innovation in TVET, as projects developed with the communities they serve are more likely to produce relevant and lasting outcomes.

AI-enabled entrepreneurship offers opportunities where institutions connect new ideas to sustainability challenges in areas such as public health, environmental monitoring, agriculture and renewable energy. Such work can extend beyond commercial enterprise to support environmental responsibility, social inclusion and active participation in local development.

BOX 12 Women-led AI entrepreneurship for sustainable development in Africa

Through the African Women in Tech and AI (AWITAI) initiative, UNESCO supports African women in developing practical uses of AI to address challenges affecting everyday life and public well-being across the continent. These entrepreneurship projects span areas including water treatment and management, health care, education, cybersecurity, disability and web accessibility, gender equality, agriculture, renewable and sustainable energy, and natural disaster risk mitigation.

In Benin, the WaTAIR project uses AI to support wastewater treatment and sanitation. The project applies AI to a basic service challenge with direct relevance for environmental management and public health, with the aim of improving water quality while lowering costs.

In Nigeria, the Fezzant project uses AI to make cybersecurity more accessible and inclusive. It includes an accessibility scanner that identifies gaps in cybersecurity tools and helps address them, supporting equitable participation in digital systems and services.

In Morocco, the MAEIA project uses AI models and installed sensors to detect leaks and prevent major water losses and related costs. By combining sensors with predictive analysis, the project supports earlier intervention and more efficient water management.

In Mauritius, the AlzMate project uses AI to support early detection and care management for Alzheimer's disease through a personalized app that acts as a digital companion. The app is designed to support more structured, compassionate and tailored care.

Source: UNESCO (2026b).

5.8 Monitoring and evaluation

AI integration is an ongoing institutional process, of which monitoring and evaluation (M&E) forms part. Effective M&E builds on systems that are already in place for institutional quality assurance. It provides a structured way for TVET staff and learners to ask how well current arrangements are working and where adjustment is needed. The value of M&E depends on broad participation in its design and use, which helps ensure that what is measured reflects shared institutional priorities.

M&E across the seven domains discussed in this chapter should draw on both structural and perceptual indicators (UNESCO-UNEVOC and Cedefop, 2024). Structural indicators show the existence of arrangements such as the adoption of an AI governance policy, the inclusion of AI competency objectives in curricula or the delivery of professional development activities. Perceptual indicators show how well these arrangements are working in practice. They may include staff views on their preparedness, learners' perceptions of AI-enhanced instruction and employers' views on whether graduates are prepared for AI-related demands in their sector. Both types of data are necessary to give a more reliable picture.

Annex C presents an indicator framework for M&E of AI integration in TVET institutions. Institutions may apply it selectively, in ways that reflect their context and stage of development. A focused set of indicators, reviewed against an appropriate baseline, is generally more useful than attempting to cover everything at once. Used together with the AI readiness self-reflection tool in Annex A, the framework supports continuous improvement in institutional AI practice.

6. Recommendations

The recommendations draw on the analysis in this guide and translate its main implications into priorities for action. They are organized into three stakeholder groups: policy-makers, TVET institutions and training providers, and TVET teachers and trainers. These groups operate at different levels, but their responsibilities intersect. Policy-makers set the regulatory, financing and system-level conditions for institutional action. Institutions create the governance, programmes and working conditions that shape professional practice. TVET teachers and trainers translate institutional strategy into teaching, training, assessment and learner support.

The recommendations are intended to support prioritization and adaptation to context. Starting points differ across countries, regions and institutions. Resource conditions, regulatory environments and levels of AI maturity all vary. Readers may therefore treat the recommendations as priorities to be calibrated to their own context rather than as a uniform sequence.

6.1 Recommendations for policy-makers

Include TVET explicitly in national AI strategies and related funding approaches. TVET remains under-represented in many national AI policies. Where governments invest in AI in education and training, national strategies need to make clear how TVET providers will be included. Funding models should account for recurrent costs, including licensing, cloud services, maintenance, technical support and staff development. Procurement rules must cover interoperability, data portability, vendor dependency, transparency requirements and long-term contractual sustainability.

Review occupational standards and qualification frameworks more regularly. AI is reshaping tasks in occupations faster than many qualification systems can respond. Governments should support more regular review of occupational standards and qualification frameworks, with the active involvement of qualification authorities, sector skills bodies, employers, trade unions, public employment services and labour-market intermediaries. These actors help translate changes in workplace tasks into updated competence requirements, recognition arrangements and reskilling pathways.

Strengthen labour-market intelligence for TVET policy and planning. More responsive TVET systems depend on timely evidence about how work, tasks and skills demands are changing. Labour-market foresight can draw on employer consultation, occupational analysis, graduate tracer studies, apprenticeship and placement data, and, where appropriate, AI-enabled analysis of job postings and sectoral data. This can help governments and TVET systems to identify emerging skills needs, target public investment and adjust programme priorities.

Ensure that regulatory and governance frameworks cover all TVET settings. Data protection requirements, safety standards and AI governance provisions need to apply across work-based learning, apprenticeships, enterprise-based training and institutional settings. In many TVET systems, a substantial share of competency formation takes place in workplaces and transition decisions are shared across institutions, employers and labour-market systems. Regulatory frameworks that overlook these settings leave significant gaps in learner protection and accountability.

Invest in enabling digital conditions for TVET. Reliable connectivity, adequate devices, secure data systems and technical support remain basic conditions for meaningful AI use. Where national policy encourages AI integration, that ambition needs to be matched by realistic support for under-resourced institutions. In low-connectivity contexts, priority should be given to infrastructure, off-line or low-bandwidth resources, teacher preparation and shared facilities before institutions are expected to adopt more complex AI systems.

Provide TVET institutions with the policy space to adapt. In many systems, public TVET institutions cannot modify curricula or assessment methods without national authorization. The same constraint often applies

to data governance procedures. Timely guidance and appropriate institutional autonomy can make adaptation more responsive while retaining coherence in national frameworks.

Promote open, interoperable and locally relevant AI solutions. Dependence on a narrow set of proprietary platforms can reduce institutional flexibility and raise concerns about affordability, data governance and long-term sustainability. Interoperability standards, open approaches where appropriate, and support for resources that reflect linguistic, cultural and occupational diversity can strengthen local relevance and reduce avoidable dependency.

Address equity in AI-related transitions. The effects of AI on employment and learning opportunities are unevenly distributed. Women face higher exposure to automation in some clerical and service occupations. Learners in rural areas and low-income settings face structural barriers to AI-related learning. Transition support, reskilling opportunities and infrastructure investment need to reach those most affected. Inclusive policy design also benefits from appropriate ways for young people to contribute, since their experience of AI often moves ahead of formal policy and institutional responses.

Strengthen international cooperation and partnerships for AI integration in TVET. AI use in workplaces and training is evolving faster than many national TVET systems can assess and respond to alone. Policy-makers should use regional and international platforms to compare approaches, improve policy design and develop common resources for responsible AI integration in TVET.

6.2 Recommendations for TVET institutions and training providers

Ground AI adoption in identified institutional needs. The starting point for AI integration is the problem an institution is trying to address, whether in teaching, assessment, administration or engagement with industry. Where AI does not serve a clear institutional or learning objective, adoption has limited value. In resource-constrained contexts, priority should be given to governance, staff capacity, lower-risk uses, safeguards for assessment and learner protection before moving to complex or data-intensive AI systems.

Embed AI governance in existing quality assurance structures. Institutional AI policy needs to address acceptable use, data protection, academic integrity, procurement and risk management. Governance is most effective when it is integrated into existing quality assurance processes rather than treated as a parallel initiative. The policy framework should be specific enough to guide consistent practice while leaving room for supervised experimentation. TVET teachers and trainers, learners, technical staff and industry partners should be consulted where appropriate, so that governance reflects pedagogical practice, learner experience and workplace realities.

Develop practical AI literacy among institutional leaders and managers. Institutional leaders need adequate understanding of AI capabilities and limitations to set priorities, evaluate proposals, oversee procurement and manage risks. This includes asking informed questions about data use, vendor claims, assessment integrity and the relationship between AI use and occupational competencies.

Integrate AI transversally across the curriculum. AI literacy and the capacity to work critically with AI tools need to be embedded in vocational fields rather than confined to isolated ICT provision. Learners need to understand how AI is reshaping tasks, workflows, tools and decision-making in their own area of practice. This keeps AI literacy connected to occupational practice.

Strengthen industry engagement for sector-specific AI integration. Institutions should work with employers, sector bodies and workplace learning partners to identify how AI-enabled tools, workflows and decision-support systems are changing occupational practice. These insights should inform curriculum, assessment, work-based learning and apprenticeship arrangements. Regular review cycles with industry partners can help institutions to keep programmes aligned with changing competence requirements. At the same time, they avoid overreliance on narrow employer preferences.

Redesign assessments to verify authentic vocational competency. GenAI has weakened the reliability of many traditional product-oriented assessment formats. This is one of the most urgent areas for institutional action. Greater weight is now needed on process evidence, practical demonstration and oral validation. Learners need to document which AI tools they used and explain how outputs were evaluated. Layered assessment strategies that combine reflective logs, project-based work and professional discussion provide a fuller picture of what a learner can genuinely do. Where foundational knowledge needs independent verification, unassisted formats remain appropriate.

Sequence learning so that foundational competency is established before structured AI use. Learners need to develop core skills, professional judgement and situational awareness before they work with AI tools that may automate or support parts of a task. Institutions should identify where unassisted practice, supervised performance and human oversight remain necessary in workshops, laboratories, assessment and workplace training. AI can support simulation, planning, diagnosis and feedback, but it does not replace repeated hands-on practice, material engagement or direct observation of performance.

Invest in sustained capacity development across the institution. AI competency development should extend beyond teaching staff. Leaders, technical personnel, career guidance officers, administrators, workshop technicians and assessment staff all require preparation matched to their roles. Professional development is most useful when it is trade-specific and progressive, moving from foundational orientation to applied use. Protected time for experimentation and peer learning strengthens the conditions for sustained change.

Evaluate AI integration through clear indicators and feedback loops. Institutions should define what successful AI integration means in their own context before scaling up new uses. Monitoring should combine evidence on access, staff preparedness, assessment integrity, learner outcomes, inclusion, data protection, cost sustainability and workload implications, with feedback from learners, staff and relevant partners. Institutions should select a manageable set of indicators linked to their priorities, review findings regularly and use the evidence to revise AI policies, procurement decisions and implementation plans.

Apply equity and inclusion criteria to every AI deployment decision. AI tools need to be assessed for accessibility, linguistic performance, cultural relevance, connectivity requirements and differential effects on learner groups before adoption. In multilingual TVET contexts, AI systems may perform less reliably in languages, dialects or occupational terminology that are under-represented in training data. Institutions should test tools in the languages of instruction and under realistic access conditions before deployment. AI integration needs to avoid creating new forms of exclusion for learners who are already at risk of marginalization.

Assess financial and environmental sustainability before scaling up. Institutions should consider the total cost of ownership, including licences, subscriptions, infrastructure, maintenance, technical support, staff time, data storage, hardware replacement and exit costs. AI systems also have environmental costs through energy consumption and hardware turnover. Priority belongs with uses that are justified, proportionate and educationally meaningful.

6.3 Recommendations for TVET teachers and trainers

Maintain professional authority in AI-supported teaching, training and assessment. TVET teachers and trainers should use AI in ways that support, rather than displace, their pedagogical role. AI may support selected tasks, but it should not determine learning priorities, replace direct observation of practical performance or substitute for professional judgement. Teachers and trainers remain responsible for interpreting AI outputs and deciding how they are used in teaching, training and assessment.

Use AI to strengthen the human dimensions of teaching and training. AI tools can support routine and preparatory tasks such as outlining lesson materials, suggesting practice exercises and preparing initial feedback on structured assignments. Teachers and trainers can use the time saved to work more directly with learners, coaching them through difficult problems, demonstrating skilled practice and providing targeted guidance.

Check AI outputs against occupational standards, evidence and professional judgement. AI-generated content can be plausible and inaccurate at the same time. TVET teachers, trainers and other relevant staff need the capacity to identify mistakes, omissions, bias and unsafe recommendations in AI-generated outputs. Outputs should be checked against occupational standards, safety requirements, current workplace practice, learner context and professional knowledge before they are used in teaching, training or assessment.

Adapt teaching to make learning processes visible. Learners may use AI to produce polished outputs without showing how they arrived at them. Teaching therefore needs stronger emphasis on documented problem-solving, oral explanation, collaborative work and practical demonstration. Foundational domain knowledge still requires direct learning. Unassisted tasks and assessments remain valuable where they confirm that learners have internalized core concepts before moving on to AI-supported higher-order work.

Support learner well-being and responsible AI use. Frequent use of AI tools may result in cognitive shortcuts and overreliance on generated answers. TVET teachers and trainers, guidance staff and other learner-support staff all have a role in helping learners develop independent judgement, sustained attention and responsible patterns of AI use. Decisions about when and how AI tools are introduced should take account of concentration, motivation, confidence and well-being.

Adapt AI use to the language of instruction and occupational terminology. Teachers and trainers should test AI outputs in the language of instruction. They should not assume that tools perform equally well across languages, dialects or sector-specific terminology. Where AI outputs are unreliable, they should be treated as drafts for professional review rather than as authoritative teaching or assessment materials.

Relate AI use to realistic work contexts. Many TVET learners enter small enterprises, informal-sector work or self-employment rather than large formal workplaces. Teaching examples should therefore include practical AI uses relevant to these contexts, such as costing, customer communication, inventory planning, documentation and entrepreneurship support. These applications should remain grounded in realistic local conditions and learner needs.

Engage in collaborative professional learning. Experimentation in isolation is difficult to sustain and even harder to consolidate. Communities of practice, cross-departmental exchange and peer mentoring provide stronger foundations for lasting change. Where learners have greater familiarity with specific AI tools, structured reverse mentoring can also be useful.

Embed ethical reasoning in everyday practice. Responsible AI use should be treated as part of routine professional judgement rather than as an isolated topic. Transparent engagement with AI includes discussing its limitations and biases with learners and addressing data privacy, academic integrity and accountability in routine teaching. Ethical reasoning belongs in everyday professional practice.

Apply precautionary standards when AI is used in safety-critical training. In occupations where errors can have physical consequences, AI-generated scenarios and recommendations need careful review before they are used in workshops or laboratories. Human oversight is essential for safety-critical tasks. Teachers, trainers, workshop technicians and relevant support staff have shared responsibilities for ensuring that AI does not compromise established safety practices.

7. Conclusion

This guide underlines a human-centred approach to AI integration in TVET to help institutions respond to the changes that AI is bringing to work, learning and social realms. The principles set out in this guide provide a basis for decisions about AI use in TVET. They affirm human agency and the professional authority of TVET teachers and trainers, place equity and non-discrimination at the centre of implementation, require AI to serve pedagogical purposes, and link transparency, accountability and data protection to everyday decisions about learning, assessment and institutional governance.

Responsible AI integration in TVET is a common obligation across institutions, workplaces and the wider systems that shape skills development. Because TVET connects learning with practical training and employment pathways, AI-related decisions need to remain relevant to workplace tasks and aligned with competence requirements across national, regional and sectoral contexts. Such coordination is needed to keep AI use connected to occupational practice and supported by appropriate system-level conditions.

Within institutions, AI integration is an institution-wide process across the domains of governance, programme design, teaching, training, assessment and capacity building, among others. These areas require purposeful and evidence-informed decisions, with close attention to hands-on learning, authentic performance and the credibility of competence assessment. Professional development is central. TVET leaders need sufficient AI literacy to guide strategy and culture, allocate resources and oversee the risks of AI integration. TVET teachers and trainers, assessors, curriculum staff, technical teams and learner support staff also need opportunities to develop AI-related competencies that reflect their roles and occupational contexts.

The development of AI and its applications in various sectors will continue to evolve faster than many TVET systems can fully anticipate. The guidance offered here should therefore serve as a basis for continued review and refinement through a participatory approach. Its relevance will depend on how it is applied in different TVET systems and occupational contexts, and on the insights that emerge from institutions, workplaces and policy dialogue. TVET institutions, stakeholders and partners involved in TVET and skills development are encouraged to test and adapt the guide, and to contribute evidence and experience that can help strengthen its future iterations.

8. Annexes

Annex A
AI readiness self-reflection and planning tool for TVET institutions

This tool is an indicative guide for TVET institutions to reflect on their AI readiness and identify practical next steps for responsible AI integration.

How to use this tool

Convene a small cross-functional team including representatives from institutional leadership, teaching and training staff, IT or technical support and, where possible, learners and industry partners. For each dimension:

1. Discuss the guiding questions as a group. Focus on those most relevant to your institution's context.
2. Agree on a maturity level for the dimension, based on the institution's current situation. Record key evidence or observations.
3. Identify a few priority next steps based on the main gaps and opportunities revealed by the discussion. The actions should be feasible considering the institution's current mandate and resources.

Early-stage institutions are encouraged to select a small number of first steps across the whole tool rather than trying to address every dimension at once.

Maturity levels

Level	Description
Not yet started	No activity or awareness in this area
Emerging	Some initial awareness or ad hoc activity, but no systematic approach
Developing	Deliberate efforts under way, with some structures or plans in place but not yet fully implemented
Established	Systematic practices in place, regularly reviewed and embedded in institutional operations

Dimension 1: Leadership, governance and ethics

Guiding questions

- Has the institution defined a clear vision and purpose for AI integration, and assessed how this aligns with its strategic priorities and broader planning processes?
- Is there a designated person, team or committee responsible for coordinating AI-related initiatives?
- Do institutional leaders have enough understanding of AI to make informed decisions about its adoption, governance and resource implications?
- Has the institution established policies on AI, covering acceptable use, transparency, data protection and academic integrity?
- Do institutional policies address AI use in TVET-specific settings, including workshops, practical training and work-based learning?
- Does the institution have a process for identifying and managing AI-related risks?
- Are governance arrangements aligned with applicable national regulations and data protection legislation?

Maturity level	Notes/evidence	Priority next steps, lead and time-frame
Not yet started		
Emerging		
Developing		
Established		

Dimension 2: Digital infrastructure and technical capacity

Guiding questions

- Do staff and learners have reliable access to devices and sufficient internet connectivity to support AI-enabled applications on campus and in work-based learning settings?
- Are existing digital systems (such as learning management systems and student information systems) capable of integrating with or supporting AI tools?
- Has the institution assessed what computational resources it would need to support its identified AI use cases, and are those resources available or accessible?
- Is there technical support capacity to deploy, maintain and troubleshoot AI-related technologies?
- Are cybersecurity measures in place to address the risks associated with AI tools, including data transmission and third-party integrations?

Maturity level	Notes/evidence	Priority next steps, lead and time-frame
Not yet started		
Emerging		
Developing		
Established		

Dimension 3: Data readiness and management

Guiding questions

- Does the institution collect and store learner data (such as performance records, attendance and assessment results) in structured digital formats?
- Are data from core institutional systems interoperable, or do they remain in disconnected silos?
- What is the quality of available data in terms of completeness, accuracy and consistency?
- Are there clear policies and processes for data classification, access authorization, storage, sharing and deletion?
- Are staff aware of the institutional data that exist, how they are governed and how they could be used to inform teaching, learning or institutional management?

	Maturity level	Notes/evidence	Priority next steps, lead and time-frame
	Not yet started		
	Emerging		
	Developing		
	Established		

Dimension 4: Human capacity and institutional culture

Guiding questions

Institutional leaders

- Do leaders have sufficient AI literacy to set strategic direction, evaluate proposals and engage with governance questions?

Teaching and training staff

- What is the current level of AI literacy among teachers and trainers?
- Are professional development opportunities on AI available or planned?
- Are teachers and trainers given time and support to explore whether and how AI tools could enhance their practice?

Learners

- What are the current levels of digital literacy among learners? Do learners have equitable access to devices and connectivity outside the classroom?
- Are learners aware of AI and its relevance to their fields of study and future occupations?
- Can learners critically evaluate AI-generated content?

Technical and administrative staff

- Do technical and administrative staff have the skills to support, maintain and troubleshoot AI systems?

Institutional culture

- Does the institution encourage experimentation and tolerate the setbacks that accompany adopting new technologies?
- Are there mechanisms for staff to share experiences with AI, such as communities of practice or peer exchange?

	Maturity level	Notes/evidence	Priority next steps, lead and time-frame
	Not yet started		
	Emerging		
	Developing		
	Established		

Dimension 5: Curriculum and training practice

Guiding questions

- Has the institution identified where in its curricula AI could add value, either as subject matter or as a tool to support teaching and learning?
- Have any programmes been reviewed to assess how AI is changing occupational practices and skill requirements in the sectors the institution serves?
- Are teachers already using AI tools in their daily work, whether formally or through informal experimentation? Has the institution taken stock of this activity?
- Has the institution considered where AI could meaningfully support practical training (including workshops, laboratories, simulation environments and work-based learning), and where it would not be appropriate?
- Has the institution considered how learner use of AI affects the integrity of assessment, particularly competency-based assessment?
- Has the institution assessed what level of AI literacy its learners need, given their fields of study and the occupations they are preparing for?

	Maturity level	Notes/evidence	Priority next steps, lead and time-frame
	Not yet started		
	Emerging		
	Developing		
	Established		

Dimension 6: Industry partnerships and ecosystem

Guiding questions

- Is the institution in active dialogue with industry partners about how AI is changing occupational practices and skill requirements in relevant sectors?
- Do industry partners contribute to curriculum development or assessment in ways that reflect AI-related changes in their sectors?
- Can industry partners support AI-related learning through work placements, shared facilities, access to real-world data or joint projects?
- Does the institution take part in professional networks or regional alliances focused on AI in education or TVET?
- Has the institution explored partnerships with technology providers or other organizations to access AI tools, platforms or expertise?

	Maturity level	Notes/evidence	Priority next steps, lead and time-frame
	Not yet started		
	Emerging		
	Developing		
	Established		

Dimension 7: Funding and sustainability

Guiding questions

- Is there a dedicated or identifiable budget for AI-related investments, covering tools, infrastructure, training and ongoing costs?
- Has the institution explored external funding sources, such as government programmes, development agency support, industry sponsorship or international cooperation?
- Are there in-kind resources available, such as free or open-source AI tools, donated equipment or shared infrastructure with partner institutions?
- Has the institution considered the recurrent costs of AI integration (including software licences, cloud services, maintenance and ongoing professional development) beyond initial acquisition?
- Is there a plan for sustaining AI investments within regular institutional budgets rather than depending on time-limited project funding?

	Maturity level	Notes/evidence	Priority next steps, lead and time-frame
	Not yet started		
	Emerging		
	Developing		
	Established		

Using the results

Use the completed self-assessment to identify a small number of priority actions. Institutions at an early stage can start by clarifying the vision and purpose of AI integration, assigning responsibility for AI-related work, mapping existing AI use, and identifying where AI is affecting relevant occupations and skills demand. They can then prepare interim guidance on acceptable AI use, plan AI literacy support for staff and learners, and select one low-risk pilot linked to a clear institutional need. Institutions with more established capacity may use the tool to review coherence across AI readiness dimensions and inform regular institutional planning processes.

Annex B
Illustrative AI risk register template for TVET institutions

This template provides a systematic tool for identifying, assessing and managing risks associated with AI integration in TVET institutions.

The first row is an illustrative example. Institutions should adapt or replace it when they complete the register. Institutions can expand the register by adding fields such as review date, status or comments if these are already used in existing institutional risk management processes.

Risk register template

Risk ID	Risk category	Risk description	Root cause	Existing controls	Impact	Likelihood	Risk score	Mitigation measures	Responsible unit	Monitoring indicator
Example R1	Assessment	AI use makes it difficult to verify whether learners can perform required occupational tasks independently.	Assessment relies mainly on submitted products, with limited practical demonstration or oral validation.	General assessment rules	High	Medium	Optional	Redesign assessment to include supervised practical tasks, process evidence and oral validation. Clarify permitted and restricted AI use.	Assessment unit, programme team	Share of assessments with AI-use conditions, AI-related integrity cases
R2										
R3										
...										

Source: adapted from Isakova (2026).

Note on use

Field	Guidance
Risk ID	Assign a simple reference code for each risk.
Risk category	Institutions may adapt the categories to their own context. Possible categories include pedagogical, assessment, governance, legal and ethical, equity, competency, safety and sustainability risks.
Risk description	Describe the specific risk clearly and concretely.
Root cause	Note the main factor or condition creating the risk.
Existing controls	Record any policy, procedure or practice already in place.
Impact	Estimate the likely seriousness of the consequences.
Likelihood	Estimate how likely the risk is to occur.
Risk score	Add a score if the institution uses one.
Mitigation measures	Record the actions needed to reduce or manage the risk.
Responsible unit	Identify the person, team or unit responsible for follow-up.
Monitoring indicator	State how progress or exposure will be monitored.

Annex C
Indicator framework for monitoring and evaluating AI integration in TVET institutions

This framework sets out indicators to support the monitoring and evaluation of AI integration across the seven implementation domains discussed in Chapter 5. Monitoring and evaluation is treated as a cross-cutting function that helps institutions to review progress.

Note on use

1. Monitoring and evaluating AI integration requires structural indicators (e.g. policies, records and procedures) and perceptual indicators (e.g. staff, learner and employer views). The potential data sources listed for each indicator suggest the main forms of evidence that institutions may draw on to review current practice and track progress.
2. The framework does not prescribe fixed benchmarks or targets. Institutions may adapt the framework by selecting the domains and indicators that are most relevant to their current stage of development, establishing a baseline, and setting realistic targets for improvement over time.
3. Institutions at an early stage of AI integration may begin with the indicators marked with an asterisk (*). These provide a starter set for establishing a baseline before using the full framework.
4. Monitoring and evaluation findings should be reviewed collectively by leadership, staff, learners and relevant external stakeholders to inform planning and decision-making.

Domain 1: AI governance, readiness and risk management

Sub-theme	Key indicator	Potential data sources
Governance and policy	* A formal institutional AI policy has been adopted and communicated	Policy documents, communication records
	The AI policy is reviewed and updated regularly	Policy version history
	A cross-functional governance body with broad institutional representation oversees AI adoption	Committee records
	Staff awareness of the AI policy and its implications for their work	Staff survey
	Learner awareness of the AI policy and its implications for their studies	Learner survey
Roles and responsibilities	* Responsibilities for AI oversight and policy enforcement are clearly documented and assigned	Role documentation
	Staff with AI oversight responsibilities are adequately prepared for their role	Staff survey
Risk management	* An AI risk register is maintained and updated regularly	Risk register
	Risk mitigation measures are in place across the main categories of AI-related risk	Risk register, policy documentation
	Reporting processes for AI-related concerns or incidents are accessible and understood	Policy documentation, learner survey, staff survey
Data and compliance	AI-related data practices comply with applicable data protection legislation and ethical standards	Data governance records
	Procurement decisions for AI tools include assessment of vendor data handling and transparency	Procurement records

Domain 2: Programme and curriculum development for AI-driven skills demand

Sub-theme	Key indicator	Potential data sources
Industry and labour market alignment	* Systematic processes are in place to consult employers and industry partners on AI-related skills demand	Consultation records
	Labour market intelligence is used to inform programme content and structure	Planning and review records
	Employer views on the institution's understanding of AI-driven skill changes in their sector	Industry partner survey
	Graduate views on how well training prepared them for AI-related aspects of their work	Graduate tracer survey
Programme provision	* The programme portfolio is reviewed in light of AI-driven occupational change	Programme review records
	Programme offerings reflect the range of AI integration levels relevant to the local labour market	Programme catalogue
	Flexible and modular credential options are available for incremental AI competency development	Qualification catalogue
Curriculum relevance	* AI knowledge and skills relevant to the occupational specialisms are incorporated into curriculum content	Curriculum documentation
	Curriculum is reviewed to identify tasks that are increasingly performed by AI and to reorient teaching accordingly	Curriculum review records
	Teacher and trainer views on whether AI-related curriculum content reflects current occupational realities	Staff survey
Qualification and credentialling	AI competence requirements are reflected in the occupational standards and qualification frameworks used by the institution	Qualification and standards documentation
	The institution engages actively with qualification authorities and sector bodies to support the updating of occupational standards	Correspondence and partnership records

Domain 3: AI-enhanced pedagogy and training delivery

Sub-theme	Key indicator	Potential data sources
Pedagogical design and practice	* Institutional guidance is available on integrating AI into learning activities at appropriate levels	Training and guidance records
	* AI-independent learning activities that build foundational skills are included in teaching and training	Lesson and session plan review
	Staff views on the adequacy of guidance and support for AI integration in teaching	Staff survey
	Learner views on whether AI tools strengthen engagement with teachers, trainers and practical work	Learner survey
Simulation and practical training	AI-enhanced simulation is sequenced to precede and complement supervised physical practice	Programme and assessment records
	Simulation and AI-supported learning tools are accessible to learners from underserved groups	Access and enrolment data
Work-based learning	AI tools are integrated into institution-based and workplace components of work-based learning	Programme documentation
	Learners feel prepared to work alongside AI systems encountered in work placements	Learner survey
	Employer views on whether AI tools used in work-based learning support the educational value of workplace experience	Employer survey
Teacher and trainer support	Structured opportunities are available for teachers and trainers to trial, reflect on and share AI-integrated approaches	Continuing professional development (CPD) and peer learning records
	Views of teachers and trainers on institutional support for developing AI-assisted pedagogical practice	Staff survey

Domain 4: Vocational assessment in the AI context

Sub-theme	Key indicator	Potential data sources
Assessment design and integrity	* Assessment tasks are reviewed to determine appropriate AI involvement, and conditions are clearly stated	Assessment documentation, assessment briefs
	* Assessment approaches are used that verify genuine competencies in contexts where AI tools are available	Assessment documentation
	Assessor views on whether current assessment designs verify genuine competencies effectively	Staff survey
	Learner views on the clarity and consistency of AI-related assessment rules	Learner survey
Occupational validity	Assessment tasks are aligned with occupational standards, including requirements for responsible use and critical evaluation of AI tools where relevant	Assessment documentation, occupational standards
	Assessment is reviewed in occupational areas where AI tools can generate outputs that previously served as evidence of learner competency	Assessment review records
	Direct practical demonstration remains the primary form of evidence in hands-on and safety-critical occupations	Assessment documentation
Fairness and accountability	Final summative judgements on competence and certification are made by qualified human assessors	Assessment policy
	AI tools used in assessment are reviewed for bias, validity and accessibility before deployment	Review and procurement records
	Clear processes are available for learners to question or appeal assessment decisions involving AI	Policy documentation
	Learners are confident that assessment outcomes reflect their actual competencies	Learner survey

Domain 5: AI competency development for TVET staff and learners

Sub-theme	Key indicator	Potential data sources
Leadership capacity	* Institutional leaders take part in AI literacy and governance development appropriate to their role	Training records
	Leaders feel prepared to make informed decisions on AI adoption, oversight and risk	Leadership survey
Staff professional development	* AI competency development is available to all staff groups, including teaching, technical, support and administrative staff	Programme documentation
	Professional development is differentiated by role and responsibility	CPD planning records
	AI competency development is embedded in ongoing continuing professional development structures	CPD records
	Staff views on whether professional development has improved their ability to use AI responsibly and effectively	Staff survey
	Staff views on institutional support for developing and applying AI competencies	Staff survey
Learner AI competency	* AI competency objectives are embedded across learner-facing programmes	Curriculum documentation
	Learner AI competency development is differentiated by occupational pathway	Programme documentation
	Learner views on how well training has prepared them to use AI responsibly and critically in their field	Learner survey
Inclusion and equity	AI competency development is accessible to all learner groups, including women, learners with disabilities, and those from low-income or rural backgrounds	Participation and enrolment data
	AI tools used for learning, guidance or assessment are reviewed for linguistic accessibility, cultural relevance and suitability for the institution's language(s) of instruction	Tool and output review records, learner and staff feedback

Domain 6: AI use in safety-critical and regulated occupations

Sub-theme	Key indicator	Potential data sources
Human oversight and accountability	* Task boundaries are documented for each safety-critical programme, specifying which activities may involve AI support and which require unassisted human performance	Programme regulations
	Teachers, trainers and workplace supervisors understand their authority and responsibility for safety-relevant decisions	Role documentation, staff survey
	Teachers, trainers and workplace supervisors feel confident in questioning or overriding AI-generated outputs when necessary	Staff survey
	Accountability for safety-relevant decisions and competency certification rests clearly with qualified human trainers	Policy documentation
Training design and sequencing	* Foundational embodied skills are demonstrated before AI-assisted methods are introduced	Programme and assessment records
	AI-enhanced simulation is positioned as preparation for, rather than replacement of, supervised physical practice	Programme documentation
	Learners feel ready to perform safety-critical tasks without AI assistance when required	Learner survey
Workplace safety arrangements	Learners are prepared for safety protocols and responsibilities when working alongside AI systems in placements	Placement preparation records
	Placement agreements specify oversight arrangements for learner interaction with AI in safety-relevant tasks	Placement agreement documentation
	Employer views on learner preparedness to work safely alongside AI systems	Employer survey
Regulatory compliance	AI use in safety-critical programmes is aligned with applicable occupational safety and health standards	Compliance records
	AI-generated content used in physical workshops or clinical settings is reviewed for consistency with safety protocols	Review records

Domain 7: AI-enabled innovation and entrepreneurship in TVET

Sub-theme	Key indicator	Potential data sources
Institutional innovation capacity	* Ethical governance and data protection requirements are applied to AI-enabled innovation activities	Governance documentation
	Institutional strategy includes a position on AI-enabled innovation, with allocated resources and governance arrangements	Strategy and budget documents
	Staff views on whether institutional structures support responsible experimentation and innovation	Staff survey
Entrepreneurial learning	AI-integrated entrepreneurial learning activities require learners to evaluate, adapt and justify AI outputs	Programme documentation
	AI-integrated entrepreneurial tasks are assessed in ways that require original reasoning and decision-making	Assessment documentation
	Learner views on whether AI-integrated entrepreneurial learning has strengthened their capacity to identify opportunities and take initiative	Learner survey
Inclusion and participation	Deliberate outreach supports the participation of women, learners with disabilities and learners from underserved communities in AI-enabled innovation activities	Participation records
	Participation in AI-enabled innovation and entrepreneurship activities reflects the diversity of the institution's learner population	Disaggregated participation data
Community and sustainable development	AI-enabled innovation and entrepreneurship activities are developed in collaboration with local stakeholders	Partnership and project records
	Partner views on the relevance of the institution's innovation activities to local economic, social or environmental priorities	Partner survey

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Integrating AI in TVET

A practical guide for institutions

Artificial intelligence (AI) is entering workplaces and learning environments faster than many systems are prepared to respond. In technical and vocational education and training (TVET), AI affects occupational competencies, qualification requirements and the institutional choices that shape how training is designed and delivered.

This practical guide helps TVET institutions to approach AI integration as a multistakeholder and institution-wide process. It shows how AI can be embedded across core areas of institutional practice to support meaningful change while mitigating risks. Grounded in UNESCO's work on AI ethics and education, the guide highlights human-centred, equitable and context-sensitive approaches that strengthen TVET's contribution to skills development, decent work and lifelong learning.

Jointly authored by:

OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

深圳職業技術大學 SHENZHEN POLYTECHNIC UNIVERSITY

Stay in touch

unevoc@unesco.org

https://unevoc.unesco.org

UNESCO-UNEVOC

unesco.unevoc.international

UNESCO-UNEVOC
International Centre for TVET
UN Campus
Platz der Vereinten Nationen 1
53113 Bonn
Germany

9 789231 008818

4 QUALITY EDUCATION

Sustainable Development Goals