



# Harnessing Artificial Intelligence for Vocational Guidance: Opportunities, Challenges, and Implications for Technical and Vocational Education and Training (TVET) in Nigeria

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## ABSTRACT

The rapid advancement of Artificial Intelligence (AI) is reshaping educational systems and workforce development practices, with significant implications for vocational guidance within Technical and Vocational Education and Training (TVET). This study adopts a systematic conceptual review methodology to synthesise existing theoretical, empirical, and policy-oriented literature on the application of AI in vocational guidance. Drawing on Human Capital Theory and Social Cognitive Career Theory, the review examines how AI-enabled tools support personalised guidance, labour market alignment, and scalable career support services. The findings indicate that AI technologies such as labour market analytics, recommender systems, and intelligent virtual assistants offer substantial opportunities to enhance guidance effectiveness, improve employability outcomes, and strengthen school-to-work transitions. However, the review also identifies critical challenges, including ethical concerns, algorithmic bias, limited explainability, loss of human-centered counselling, and persistent digital divide constraints, particularly in developing countries contexts. The study argues that AI should function as an augmentative tool that complements, rather than replaces, professional guidance Counsellors. By synthesising key themes and identifying gaps in current research, this article contributes a conceptual framework to inform policy development, institutional practice, and future empirical research on AI-enabled vocational guidance in TVET systems.

**Keywords:** Vocational guidance, AI-enabled career guidance, TVET systems, Labour market analytics

## INTRODUCTION

In the 21st century, vocational guidance has become a cornerstone of educational and workforce development strategies (OECD, 2023). Technical and Vocational Education and Training (TVET) systems are designed to equip learners with industry-relevant skills and facilitate smooth school-to-work transitions (World Bank, ILO, & UNESCO, 2023). However, rapid technological changes, automation, and shifting labour market dynamics have rendered traditional approaches to vocational guidance increasingly inadequate (UNESCO, 2025). The International Labour Organisation projects that by 2030, technological transformation will result in widespread occupational shifts, requiring millions of workers to reskill and upskill to remain employable (International Labour Organisation [ILO], 2025). In this context, effective vocational guidance is more critical than ever to ensure that learners are adequately prepared for evolving employment landscapes (UNESCO-UNEVOC, 2021).

Despite its recognised importance, vocational guidance remains underdeveloped in many TVET systems, particularly in developing countries (World Bank, ILO & UNESCO, 2023). Structural challenges such as low counsellor-to-student ratios, limited access to real-time labour market information, and the continued reliance on generic, “one-size-fits-all” career counselling approaches significantly undermine the effectiveness of guidance services (International Labour Organization & UNESCO-UNEVOC, 2025). In countries such as Nigeria, guidance counsellors are scarce in many secondary schools and vocational institutions, restricting students’ ability to make informed career choices that align with labour market demands (Okolie et al. 2020).



Furthermore, globalisation and digitalisation are increasing the complexity and volatility of labour markets, thereby necessitating vocational guidance systems that are dynamic, data-driven, and responsive to emerging skills requirements and employment opportunities (UNESCO IIEP, 2025).

Rapid advances in artificial intelligence (AI) are reshaping career development processes by enabling personalised, adaptive, and data-driven guidance systems (Lin et al., 2025). In vocational and technical education contexts, AI applications such as recommender systems and predictive analytics have demonstrated potential to improve alignment between learner competencies and labour market demands (Boccuzzi et al., 2025). In many developing countries, including Nigeria, vocational guidance systems remained misconceived and under resourced, contributing to skills mismatch and weak school-to-work transitions (Rabiu et al., 2025). Moreover, artificial intelligence (AI) enables scalability in vocational guidance delivery, allowing educational institutions to serve larger student populations while reducing pressure on limited human and financial resources (Kull, 2025). Virtual career assistants powered by AI chatbots can provide on-demand career information and preliminary counselling support, thereby complementing the work of human guidance counsellors rather than replacing them (Sisodiya et al., 2025). At a systemic level, AI-driven tools are capable of monitoring labour market trends in real time, enabling TVET institutions to align curricula with evolving industry requirements and supporting policymakers in forecasting future skill needs more accurately (World Economic Forum, 2023).

Nevertheless, the integration of AI into vocational guidance raises significant ethical and practical concerns that need to be settled. Issues related to algorithmic bias, data privacy, and transparency remain central to the debate on AI adoption in education and career development (European Commission, 2022). Many empirical studies indicate that algorithmic decision-making systems may reproduce or exacerbate existing social inequalities when trained on biased or incomplete datasets, particularly affecting learners from disadvantaged backgrounds (Kleinberg et al., 2018). Concerns have also been raised regarding the potential over-reliance on automated systems at the expense of the relational and empathetic dimensions of human counselling (OEB Insights, 2023). Furthermore, the persistent digital divide in many developing and resource-constrained contexts limits equitable access to AI-enabled guidance services, thereby posing challenges to inclusive implementation within TVET systems (World Bank, 2022).

Given these opportunities and challenges, there is a pressing need to examine the evolving role of AI in vocational guidance, with particular emphasis on TVET. This study seeks to address three guiding questions:

1. What roles can AI play in enhancing vocational guidance within TVET systems?
2. What challenges and risks are associated with AI adoption in this context?
3. What framework can guide policymakers, educators, and industries in responsibly integrating AI into vocational guidance?

This study contributes to the growing body of literature by synthesising insights from recent research, situating AI-enabled guidance within established theoretical frameworks, and proposing a conceptual model that balances technological innovation with ethical considerations. The paper is significant for policymakers seeking to improve workforce readiness, educators aiming to enhance learner outcomes, and industry stakeholders striving to bridge the education-employment gap. By critically examining the opportunities and limitations of AI in vocational guidance, the study underscores the importance of human-AI collaboration in shaping the future of TVET. AI should not be viewed as a replacement for prevailing traditional counselling but rather as an augmentative tool that enhances personalisation, efficiency, and labour market alignment. The subsequent sections of this paper reviewed existing literature, present a conceptual framework, and offer recommendations for research and practice aimed at maximising the benefits of AI-enabled vocational guidance.

## LITERATURE REVIEW

### Vocational Guidance in TVET

Vocational guidance plays an essential role in TVET systems, enabling learners to make informed career decisions that align with their abilities, interests, and labour market opportunities. Traditionally, vocational guidance involves career counselling sessions, aptitude testing, and exposure to occupational information. In



TVET, this guidance is particularly important given the strong linkage between training and employability outcomes (Okolie et al. 2020). However, vocational guidance within TVET systems has long been constrained by structural and institutional challenges, particularly in developing countries (World Bank, ILO, & UNESCO, 2023). Many TVET systems suffer from an acute shortage of professionally trained guidance counsellors, leading to high counsellor-to-student ratios and limited access to career guidance services for learners (ACET/YESPACT, 2024). These shortages restrict opportunities for individualised and continuous career support and contribute to inequities, as learners in rural and underserved communities often receive little or no formal guidance (Farao, & Plessis, 2024).

In the Nigerian context, empirical studies have identified the inadequate availability of trained guidance counsellors in vocational and technical institutions as a significant barrier to aligning students' career aspirations with labour market realities and industry needs (Kennedy, 2025). Beyond issues of access, traditional models of vocational guidance are frequently criticised for being reactive rather than proactive, with guidance activities focused primarily on short-term decisions such as trade or specialisation selection rather than long-term career development, employability, and adaptability (Kennedy, 2025). This limitation is particularly problematic in the context of rapid technological changes and evolving skills requirements, where individuals are increasingly expected to reskill and upskill multiple times over the course of their working lives (World Bank, ILO, & UNESCO, 2023).

### **The Rise of AI in Education**

AI has been increasingly integrated into educational systems through intelligent tutoring systems, recommender platforms, and predictive analytics. Empirical evidence from higher and vocational education show that AI-driven systems enhance personalisation, learner engagement, and institutional responsiveness to labour market needs (Mohd Fahimey, et al., 2025). In vocational contexts, AI supports workforce development by translating labour market intelligence into actionable guidance frameworks for learners and institutions (UNESCO IIEP, 2025). In the context of Technical and Vocational Education and Training (TVET), artificial intelligence (AI) has increasingly been identified as a strategic tool for bridging the gap between training provision and evolving labour market needs (Berigel, et al., 2025). AI-powered analytics are capable of processing large-scale labour market information, including job postings and skills demand data, to identify emerging competencies, thereby enabling TVET institutions to update curricula in a more timely and responsive manner (World Economic Forum, 2023). In addition, AI-driven chatbots and recommender systems are being explored as mechanisms for enhancing learner support services by providing personalised guidance, feedback, and career information beyond traditional classroom settings (Monika & Balaji, 2025).

The growing prominence of generative AI technologies, such as large language models, further expands these opportunities within vocational guidance and career development (International Labour Organisation [ILO], 2025). Generative AI applications can synthesise occupational information from multiple sources, simulate interview and workplace scenarios, and generate personalised career narratives to support learners' decision making and employability skills development (World Economic Forum, 2023). However, the adoption of generative AI in vocational guidance also raises critical ethical and professional concerns, particularly related to the risks of misinformation, algorithmic bias, data privacy, and the potential erosion of human interaction in sensitive career counselling processes (European Commission, 2022).

### **AI in Vocational and Career Guidance**

A growing body of literature demonstrates the application of machine learning and decision-support systems in vocational and career guidance. A scoping review by Boccuzzi et al. (2025) shows that AI-enabled systems can effectively recommend post-diploma career pathways by integrating learner data and labour market intelligence. However, concerns remain regarding algorithmic opacity and trust, underscoring the importance of explainable AI in guidance systems (Kumawat, & Shaktawat, 2025). Explainability has emerged as a critical concern in the application of artificial intelligence (AI) to vocational guidance and career prediction. Many AI-based career recommendation systems function as "black boxes," making it difficult for learners and counselling practitioners to understand how recommendations are generated or justified (European Commission, 2022). Research on explainable artificial intelligence (XAI) suggests that increasing the transparency and interpretability of



algorithms can enhance user trust, ethical accountability, and acceptance of AI-supported decision-making in vocational and career guidance contexts (Arrieta et al., 2020; Kleinberg et al., 2018).

At a systemic level, AI has also been conceptualised as an enabler of sustainable career ecosystems. Within the sustainable career ecosystem framework, careers are viewed as dynamic and continuously evolving, shaped by interactions between individuals, institutions, labour markets, and technology (De Vos et al., 2020). AI-driven labour market intelligence can support this ecosystem by continuously tracking skills demand and matching learners with emerging employment opportunities, thereby transforming vocational guidance from a one-time intervention into an ongoing process of career navigation and adaptability (World Economic Forum, 2023). Nevertheless, scholars caution against uncritical adoption of AI in vocational and career guidance. Over-reliance on automated systems risks depersonalising vocational and career support and overlooking the emotional, psychological, and contextual dimensions that are central to effective career decision-making (Eze, et al. 2025).

As a result, there is growing consensus in the literature that AI should function as an augmentative tool that enhances, rather than replaces, the professional judgment, empathy, and relational role of human guidance Counsellors (European Commission, 2022).

### **Theoretical Frameworks for Understanding AI in Vocational Guidance**

The integration of artificial intelligence (AI) into vocational guidance can be theoretically grounded in established career and education theories that emphasise skill development, decision-making processes, and lifelong adaptability. Human Capital Theory (HCT) posits that education and training are investments aimed at improving individual productivity and economic returns (Babatunde, et al. 2025). In contemporary vocational guidance contexts, AI-enabled labour market analytics operationalise this principle by aligning learners' skills development with current and anticipated labour market demands, thereby enhancing the efficiency and relevance of training investments (UNESCO IIEP, 2025).

Social Cognitive Career Theory (SCCT) further explains how individuals form career interests, make occupational choices, and achieve performance outcomes through the interaction of self-efficacy beliefs, outcome expectations, and personal goals (Lent et al., 1994). AI-driven guidance platforms can support these processes by delivering personalized feedback, career simulations, and predictive insights that strengthen learners' confidence in their abilities while clarifying the likely consequences of different career pathways (Joseph, & Bukar, 2025). In addition, Lifespan Career Development Theory emphasises that career development is a continuous process unfolding across multiple life stages and shaped by changing personal and contextual factors (Super, 1980). From this perspective, AI-enabled guidance systems align well with the need for ongoing, adaptive career support by providing continuous access to labour market information, reskilling recommendations, and career planning tools beyond traditional school-to-work transition points.

Taken together, these theoretical perspectives provide a robust framework for analysing the role of AI in vocational guidance. They suggest that AI technologies can effectively complement human-led counselling by enhancing data-driven decision support, personalisation, and continuity of guidance services. At the same time, they draw attention to critical tensions, particularly the need to balance algorithmic recommendations with individual agency, ethical considerations, and the contextual sensitivity that human Counsellors uniquely provide.

### **Research Gaps**

Despite growing interest, empirical evaluations of AI-enabled vocational guidance remain limited, particularly in developing countries contexts. Existing research is heavily concentrated in high-income economies, leaving African TVET systems under-represented (Okolie et al., 2020). Moreover, although ethical challenges such as bias and transparency are widely acknowledged, few studies empirically assess the implementation of ethical AI frameworks in vocational guidance (Isaifan, et al., 2025). Addressing these gaps is essential for realising the full potential of AI in vocational guidance. The next sections of this paper therefore build upon this literature to propose a conceptual framework for AI-enabled vocational guidance and discuss its implications for TVET policy and practice.

## METHODOLOGY

This study adopts a conceptual review methodology aimed at synthesising existing knowledge on the role of artificial intelligence (AI) in vocational guidance within Technical and Vocational Education and Training (TVET) contexts. Conceptual reviews are particularly appropriate for examining emerging and rapidly evolving fields where empirical evidence is limited, fragmented, or theoretically underdeveloped (Jabareen, 2009; Snyder, 2019). Rather than seeking to evaluate intervention effectiveness or produce statistical generalisations, this methodological approach focuses on integrating theoretical perspectives, empirical insights, and policy-oriented literature to identify dominant themes, research gaps, and conceptual relationships relevant to AI-enabled vocational guidance (Snyder, 2019).

### Research Design

The study follows a systematic conceptual review design, consistent with best practices for theory-oriented synthesis in interdisciplinary research (Schreiber & Cramer, 2024). While the review process was structured and transparent, the primary objective was conceptual integration and theory development, rather than quantitative aggregation or meta-analysis. In line with standards commonly observed in Scopus- and Web of Science-indexed publications, the review emphasised peer-reviewed journal articles indexed in Scopus and Web of Science and published between 2015 to 2025. Thematic synthesis was employed to integrate conceptual, empirical, and review-based studies, enabling the identification of patterns and relationships across the literature rather than the measurement of effect sizes. This approach supports analytical rigor while remaining appropriate for an emerging field where large-scale empirical evidence remains limited.

The review was guided by the following research questions:

1. What roles can AI play in enhancing vocational guidance within TVET systems?
2. What challenges and risks are associated with AI adoption in vocational guidance?
3. How can AI be integrated responsibly with human counselling to support vocational and career development?

These questions guided the selection, analysis, and synthesis of the literature throughout the review process.

### Data Sources and Search Strategy

A structured literature search was conducted to enhance transparency and comprehensiveness. The primary databases consulted were Scopus and Web of Science, selected due to their broad coverage of high-quality, peer reviewed journals in education, artificial intelligence, and vocational training (Mongeon & Paul-Hus, 2016; Gusenbauer & Haddaway, 2020). To complement database searching and reduce the likelihood of omitting influential studies, backward and forward citation tracking was conducted by reviewing reference lists and citation links of key articles (Wohlin, 2014).

**Keywords** used in the search included combinations of the following terms:

- i. *“Artificial Intelligence” OR “AI” OR “machine learning” OR “generative AI”*
- ii. *“Vocational guidance” OR “career counselling” OR “career guidance”*
- iii. *“TVET” OR “technical and vocational education and training” OR “vocational education”*
- iv. *“Employability” OR “career pathways”*
- v. *“Nigeria”*

Boolean operators (AND/OR) were applied to refine results. Searches were limited to publications between 2015 to 2025 to capture the most recent trends in AI applications relevant to vocational guidance.

## Inclusion and Exclusion Criteria

To ensure relevance and quality, the following inclusion criteria were applied:

1. Peer-reviewed journal articles published between 2015 to 2025.
2. Articles focused on AI applications in education, vocational guidance, or career counselling.
3. Studies situated in TVET or equivalent vocational education settings, including post-secondary training contexts.
4. Conceptual, empirical, or systematic review studies published in English language.

### Exclusion criteria include:

1. Articles unrelated to vocational guidance or TVET.
2. Studies focusing solely on K-12 education without relevance to career guidance.
3. Non-peer-reviewed publications, editorials, or opinion pieces without supporting evidence.

In view of this, figure 1 presents a PRISMA flow diagram illustrating the stages of literature identification, screening, and inclusion (Page et al., 2021). A total of 230 records were initially identified, comprising 225 records from database searches and five additional records identified through citation tracking. After removing duplicates, 218 records remained for screening. At the title and abstract screening stage, 143 studies were excluded due to limited relevance to AI or vocational guidance. Sixty-four full-text articles were subsequently assessed for eligibility, of which 36 were excluded due to insufficient focus on TVET, limited relevance to AI enabled vocational guidance, or conceptual weakness. Consequently, 28 articles met the inclusion criteria and were retained for qualitative thematic synthesis.

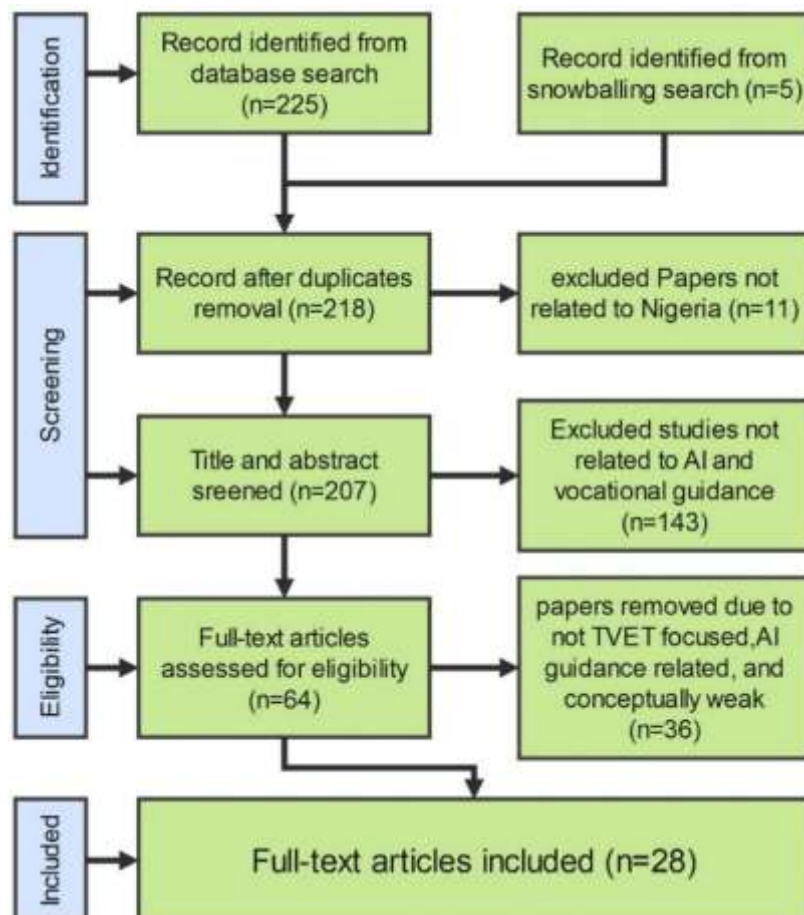


Figure 1: PRISMA data selection procedure.

**Analytical Approach: Thematic Synthesis**

The selected literature was analysed using thematic synthesis, a method suitable for integrating diverse conceptual and empirical studies (Thomas & Harden, 2008). Thematic synthesis involves three stages:

1. **Coding:** Key findings, arguments, and frameworks from each article were extracted and coded according to their focus on AI application, challenges, opportunities, or theoretical grounding.
2. **Developing Descriptive Themes:** Codes were grouped into broader descriptive themes as shown in Table 1.
3. **Generating Analytical Themes:** Higher-level analytical insights were derived, connecting descriptive themes to theoretical perspectives (Human Capital Theory, Social Cognitive Career Theory, Lifespan Career Development Theory) and developing a conceptual framework for AI-enabled vocational guidance.

Table 1 Themes, sub-themes, codes, and articles matrix

<b>Theme 1: Opportunities of AI in Vocational Guidance</b>		
<b>Sub-themes</b>	<b>Codes</b>	<b>Articles</b>
<b>Personalisation of guidance</b>	AI-driven career recommendations; adaptive guidance systems; learner profiling; intelligent decisionsupport; individualised pathways.	Chen, et al. (2025); Yulastri, et al. (2025); Boesl et al. (2024); Zabokritskaya, et al. (2022); Herath, et al. (2024) Boccuzzi et al. (2025). Eze, et al. (2025); Gutierrez et al. (2025).
<b>Labour market alignment</b>	Skills matching; employability analytics; workforce alignment; demand-driven guidance; TVET– industry linkage.	Hong, (2025); Achigbe, (2016); Olaniyan, (2025); Okolie, et al. (2020); Singh, et al. (2022); Ritz, et al. (2025).
<b>Accessibility and scalability</b>	Digital career platforms; scalable guidance systems; remote access; lifelong learning support; ecosystem-based guidance.	Hughes et al. (2025); Tang et al. (2025); Yulastri, et al. (2025). Li, (2022). Özeydin and Siyez, (2025).
<b>Theme 2: Challenges of AI in Vocational Guidance</b>		
<b>Sub-themes</b>	<b>Codes</b>	<b>Articles</b>
<b>Ethical and bias concerns</b>	Algorithmic bias; fairness; transparency; explainability; ethical AI governance.	Sobana et al. (2025); Kanont, (2024); Alshabani, (2020); Olaniyan, (2025).
<b>Loss of human touch in counselling</b>	Reduced Counsellor interaction; over-automation; psychological limitations; human-AI balance.	Stan, (2016); Valach, (2021); Rochat, (2024); Santilli et al. (2022).
<b>Digital divide and infrastructure constraints</b>	Limited ICT infrastructure; access inequality; institutional readiness; capacity gaps.	Tumwebaze-Alicon, (2023); Alshabani, (2020); Milot-Lapointe, (2020).
<b>Theme 3: Implications for Policy, Education, and Industry</b>		
<b>Sub-themes</b>	<b>Codes</b>	<b>Articles</b>
<b>Policy implications</b>	AI governance frameworks; national guidance policy; regulation of AI systems; publicsector coordination.	Litoiu, (2015); Olaniyan, (2025); Achigbe, (2016); Boesl et al. (2024).



<b>Educational implications</b>	Curriculum integration; Counsellor training; AI literacy; institutional transformation.	Okolie, et al. (2020); Litoiu, (2015); Zahour et al. (2019); Chen, et al. (2025).
<b>Industry implications</b>	Industry-education collaboration; workforce planning; employability enhancement; skills forecasting.	Hong, (2025); Okolie et al. (2020); Achigbe, (2016); Olaniyan, (2025).

The analysis emphasised comparison across studies to identify convergences, divergences, and gaps, with particular attention to contextual differences between high-resource and low-resource settings relevant to TVET in developing countries.

### Rationale for Methodology

The conceptual review methodology is appropriate for this study because AI-enabled vocational guidance remains an emerging field with limited empirical validation, particularly within TVET contexts. This approach enables:

- i. Integration of conceptual, empirical, and policy-oriented literature.
- ii. Identification of research gaps and directions for future empirical investigation.
- iii. Development of a theoretically informed framework that balances technological innovation with human centered counselling principles.

By combining a structured search strategy, clearly defined inclusion criteria, and thematic synthesis, the methodology provides a rigorous and transparent foundation for the findings and discussion that follow, while remaining aligned with the study's conceptual aims.

## FINDINGS AND DISCUSSION

The synthesis of recent literature highlights the transformative potential of Artificial Intelligence (AI) in vocational guidance, while also underscoring several challenges that must be addressed for effective implementation. This section presents the key findings from the conceptual review, organised into three thematic areas: opportunities, challenges, and implications for policy, education, and industry. The findings are global, but the implications are specifically relevant to developing TVET systems.

### Opportunities of AI in Vocational Guidance

#### Personalisation of Guidance

The literature consistently indicates that AI enables a high degree of personalisation in vocational guidance, a feature largely absent in traditional counselling models. AI-driven systems can analyse learner profiles, including interests, competencies, and behavioural data, to generate individualised career recommendations and learning pathways (Chen, et al. 2025; Yulastri, et al. 2025; Boesl et al. 2024). This personalised approach is particularly valuable in TVET contexts, where learners often possess heterogeneous skill sets and career aspirations (Boccuzzi et al. 2025). Studies further demonstrate that adaptive guidance systems improve decision making by aligning learner characteristics with suitable vocational options and training trajectories (Herath et al., 2024). Recent evidence also suggests that advanced recommender systems enhance engagement and employability outcomes by offering context-sensitive and learner-centered guidance (Boccuzzi et al., 2025; Eze, et al. 2025; Zabokritskaya, et al. 2022). However, several authors caution that personalisation mechanisms must be carefully designed to avoid reinforcing historical labour market biases embedded in training data (Gutierrez et al. 2025).

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## Labour Market Alignment

A major opportunity identified across the literature is AI's capacity to enhance alignment between TVET programmes and labour market needs. AI-powered labour market analytics enable institutions to monitor Realtime employment trends, emerging skills, and workforce demands, thereby supporting demand-driven guidance and curriculum adaptation (Hong, 2025; Singh, et al. 2022; Ritz, et al. 2025). This functionality is particularly important in addressing persistent skills mismatches between vocational training outcomes and industry expectations (Okolie et al., 2020). By integrating AI insights into guidance services, learners can be advised on high-demand occupations and targeted upskilling opportunities, strengthening employability and workforce relevance (Achigbe, 2016; Olaniyan, 2025).

## Accessibility and Scalability

AI also enhances the accessibility and scalability of vocational guidance services. Digital platforms, virtual Counsellors, and AI-supported guidance ecosystems allow institutions to extend services beyond physical counselling centres, reaching larger and more diverse learners' population (Li, 2022; Özeydin and Siyez, 2025). Several studies emphasised the value of AI-enabled guidance in expanding access for rural and underserved learners, particularly in contexts characterised by limited counselling personnel (Tang et al. 2025; Yulastri, et al. 2025). Scalable AI systems further support lifelong learning by providing continuous guidance across different career stages (Hughes et al. 2025).

## Challenges of AI in Vocational Guidance

### Ethical and Bias Concerns

Despite its potential, the literature highlights ethical risks associated with AI-driven vocational guidance. Algorithmic bias, lack of transparency, and limited explainability are frequently cited concerns, particularly when AI systems rely on historically skewed labour market data (Sobana et al. 2025). Empirical and conceptual studies warned that biased algorithms may reinforce gender, socio-economic, or regional inequalities if fairness and accountability mechanisms are not embedded into the system design (Kanont, 2024; Alshabani, 2020). Consequently, explainable AI and ethical governance frameworks were emphasised as prerequisites for a responsible implementation (Olaniyan, 2025).

### Loss of Human Touch in Counselling

Another recurring concern is the potential erosion of the human element in vocational guidance. While AI enhances efficiency, it lacks the emotional intelligence, empathy, and contextual sensitivity that characterised effective counselling relationships (Valach, 2021; Rochat, 2024). Over-automation may reduce meaningful Counsellor-client interactions and lead to mechanistic decision-making, undermining client agency (Stan, 2016). Scholars therefore, advocate for a balanced human-AI collaboration model in which AI augments, rather than replaces, professional Counsellors (Santilli et al. 2022).

### Digital Divide and Infrastructure Constraints

The effectiveness of AI-enabled vocational guidance is strongly conditioned by digital infrastructure and institutional readiness. Limited access to internet connectivity, devices, and digital skills constrains implementation in many developing contexts (Tumwebaze-Alicon, 2023). The literature warns that unequal access to AI tools may exacerbate existing disparities in guidance provision, particularly for marginalised learners (Alshabani, 2020). Addressing these constraints requires investment in infrastructure, capacity building, and inclusive technology deployment strategies (Milot-Lapointe, 2020).

## Implications for Policy, Education, and Industry

### Policy Implications

At the policy level, scholars emphasised the need for governance frameworks that regulate AI use in vocational guidance, ensuring data protection, transparency, and accountability (Litoiu, 2015; Olaniyan, 2025). Coordinated

public-sector oversight is required to align AI systems with national skills strategies and labour market priorities (Achigbe, 2016; Boesl et al. 2024).

### **Educational Implications**

For TVET institutions, AI adoption necessitates curriculum transformation, Counsellor upskilling, and institutional capacity development (Okolie, et al. 2020; Litoiu, 2015). Educators must develop AI literacy to critically interpret AI outputs and integrate them effectively into guidance and counselling practices (Zahour et al. 2019; Chen, et al. 2025).

### **Industry Implications**

Industry stakeholders benefit from AI-enabled guidance by gaining access to a talent pool whose industry actors benefit from AI-enabled guidance through improved workforce planning, skills forecasting, and stronger education-industry linkages (Achigbe, 2016; Olaniyan, (2025). Collaborative use of AI supports employability enhancement and ensures that guidance and counselling programmes remain grounded in real labour market conditions (Hong, 2025; Okolie et al. 2020).

### **Critical Synthesis**

The review indicates that AI holds significant potential to personalise guidance and counselling, enhance labour market alignment, and expand accessibility, particularly in resource-constrained TVET contexts. However, realising this potential requires careful attention to ethical governance, digital inclusion, and human-AI collaboration. While the literature provides conceptual and exploratory evidence of AI's benefits, there is lack of large-scale empirical studies, especially in developing countries. This gap suggests the need for longitudinal research assessing AI's impact on vocational outcomes, learner satisfaction, and equity. In summary, AI should be viewed not as a replacement for traditional vocational guidance and counselling but as a strategic augmentative tool that complements human Counsellors, strengthens system responsiveness, and enhances employability outcomes in TVET systems.

### **Proposed Conceptual Framework for AI-Enabled Vocational Guidance**

The synthesis of literature demonstrates the transformative potential of AI in vocational guidance, but also highlights critical challenges related to ethics, accessibility, and human involvement. To address these opportunities and challenges, this paper proposes a conceptual framework that integrates AI technologies into TVET vocational guidance systems, emphasising human-AI collaboration. The framework adopts an Input Process-Output (IPO) structure, widely used in educational and organisational research for modelling system functionality (Ilgen et al., 2005).

### **Framework Overview**

The proposed framework consists of three interconnected components:

1. **Input:** This component represents the data and resources necessary for AI-enabled vocational guidance. Inputs include:
  - i. **Clients' Profiles:** Academic records, psychometric assessments, skills inventories, interests, as well as vocational and career aspirations.
  - ii. **Labour Market Data:** Employment trends, skill demand analyses, industry forecasts, and regional labour statistics.
  - iii. **Institutional Resources:** TVET infrastructure, availability of human Counsellors, digital platforms, and technological tools.

Inputs provide the foundational information that AI systems analyse to generate personalised guidance recommendations.

2. **Process:** The process component outlines the mechanisms through which AI analyses inputs and produces outputs. Key processes include:
- Data Integration and Cleaning:** Harmonising learners, labour market, and institutional datasets to ensure accuracy and completeness.
  - AI-Driven Analysis:** Application of machine learning algorithms, predictive analytics, and generative AI to identify optimal career pathways.
  - Decision Support for Counsellors:** AI outputs are presented in interpretable formats to support human Counsellors in advising learners, ensuring transparency and ethical oversight.
  - Feedback Loops:** Continuous monitoring of learner progress and labour market trends allows the system to update recommendations dynamically, supporting lifelong career development.

This process emphasises human-in-the-loop AI, ensuring that Counsellors and educators interpret and contextualise AI-generated recommendations before delivering guidance to clients.

3. **Output:** The output component represents the results of AI-enabled vocational guidance, including:
- Personalised Career Pathways:** Recommendations tailored to individual client profiles and labour market realities.
  - Upskilling and Reskilling Opportunities:** Identification of training modules, micro-credentials, and certifications aligned with emerging skill demands.
  - Enhanced Employability Outcomes:** Improved alignment between TVET graduates' skills and industry requirements.
  - Data-Driven Policy Insights:** Aggregate insights on skill gaps and labour market trends to inform TVET policy and curriculum development.

The outputs are designed to benefit multiple stakeholders: clients receive personalised guidance, Counsellors gain actionable decision support, institutions improve programme relevance, and policymakers access evidence for strategic planning.

### Diagram of the Conceptual Framework

The framework can be visually represented as a flow diagram presented in Figure 2.

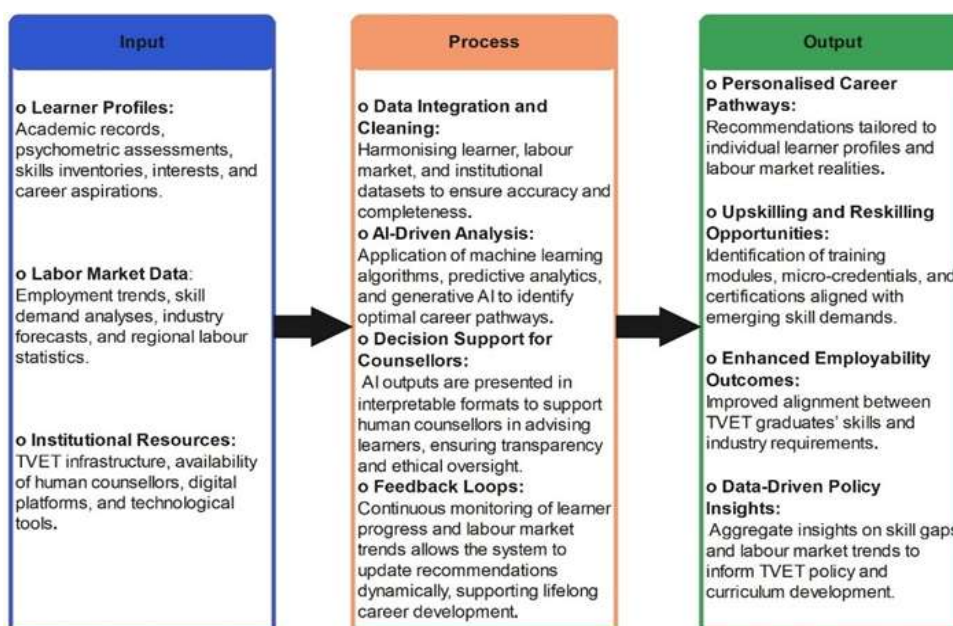


Figure 2. AI-Enabled Vocational Guidance Conceptual Framework



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## Theoretical Integration

This framework aligns with the Human Capital Theory, emphasising education, training and skills as investments that enhance productivity, and Social Cognitive Career Theory, highlighting client self-efficacy, goal setting, and outcome expectations (Lent et al., 1994). By integrating AI within a human-centered system, the framework supports lifelong career development while maintaining equity, transparency, and personalised guidance and counselling.

## Practical Implications

- a. **For TVET Institutions:** Implement AI tools alongside human counselling to enhance learner support and improve programme relevance.
- b. **For Counsellors:** Utilise AI-generated insights to focus on nuanced, personalised guidance and counselling rather than routine data processing.
- c. **For Policymakers:** Leverage aggregated outputs for labour market planning and TVET curriculum reform.
- d. **For Clients:** Gain access to personalised, adaptive career pathways that reflect both individual abilities and labour market realities.

By situating AI within this Input-Process-Output framework, vocational guidance becomes a dynamic, scalable, and contextually informed process, balancing technological innovation with ethical and human-centered principles.

## CONCLUSION AND RECOMMENDATIONS

### Conclusion

This conceptual review has examined the evolving role of Artificial Intelligence (AI) in vocational guidance, with a particular focus on Technical and Vocational Education and Training (TVET) systems. The synthesis of recent literature (2015-2025) demonstrates that AI has the potential to transform vocational guidance by enabling personalisation, labour market alignment, and scalable access. AI-driven tools such as machine learning algorithms, predictive analytics, chatbots, and generative AI can complement human Counsellors, providing tailored career recommendations, identifying skills gaps, and facilitating lifelong career development. However, the integration of AI into vocational guidance is not without challenges. Ethical considerations, including algorithmic bias, transparency, and data privacy, must be addressed to ensure fair and equitable outcomes. The digital divide and limited technological infrastructure in many developing countries may also restrict access to AI-enabled guidance services, potentially exacerbating existing inequalities. Furthermore, over-reliance on AI risks reducing the human-centered aspects of counselling, such as empathy, motivation, and contextual understanding, which are critical to effective career guidance.

In response to these findings, this paper proposes a conceptual framework for AI-enabled vocational guidance, structured around an Input-Process-Output (IPO) model. The framework emphasises the integration of client profiles, labour market data, and institutional resources as inputs; AI-driven analysis, human-in-the-loop counselling, and feedback loops as processes; and personalised career pathways, upskilling opportunities, enhanced employability, and policy insights as outputs. By embedding human oversight within AI processes, the framework ensures ethical, transparent, and contextually informed vocational guidance.

### Recommendations

To ensure successful integration of Artificial Intelligence (AI) into vocational guidance, the following recommendations for different institutions and stake holders were proffered:

1. **For TVET Institutions:** Integrate AI tools with existing counselling services, train Counsellors in AI literacy, and ensure curricula are updated using labour market insights generated by AI systems.
2. **For Policymakers:** Develop regulatory frameworks that safeguard data privacy, promote algorithmic fairness, and support equitable access to AI-enabled guidance practices.



3. **For Industry Stakeholders:** Collaborate with TVET institutions to co-design AI-informed training programmes, ensuring that graduates possess skills aligned with current and future labour market demands.
4. **For Researchers:** Conduct empirical studies to evaluate the effectiveness of AI-driven vocational guidance in diverse TVET contexts, including longitudinal studies on learner outcomes, equity impacts, and cross-cultural applicability.

In conclusion, AI offers a promising avenue for enhancing vocational guidance in TVET, but its success depends on appropriate human-AI collaboration, ethical governance, and equitable access. By leveraging AI as an augmentative tool rather than a replacement for human Counsellors, stakeholders can ensure that vocational guidance remains effective, inclusive, and responsive to the evolving demands of the 21st-century labour market.

### Conflict Of Interest

No potential conflict of interest.

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