

A QF-Aligned Framework for AI-Oriented Language Trainer Development: Integrating Design Thinking and PRME Principles in Vocational Education

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Abstract

Artificial intelligence is reshaping educational practice and increasing the competency demands placed on language trainers in vocational education. However, limited research offers a development pathway that aligns AI-related pedagogical competence with formal qualification descriptors and ethical principles for trainer preparation. Addressing this gap, this study develops a Qualifications Framework (QF)-aligned framework for AI-oriented language trainer development by integrating design thinking and the Principles for Responsible Management Education (PRME). The study adopts a conceptual, practice-informed framework design based on an integrative synthesis of literature on AI in education, vocational training, design thinking, qualification frameworks, and responsibility-oriented pedagogy, together with a mapping of Hong Kong QF Level 5 descriptors and PRME principles. The findings indicate that trainer development can be organized through three dimensions: competency structure defined by QF descriptors, developmental progression guided by the five stages of design thinking, and ethical orientation informed by PRME principles. The resulting framework operationalizes AI-oriented pedagogical competence, critical AI literacy, and ethical responsibility within a pathway for vocational language trainer development. The study extends design thinking to trainer competency development and systematically demonstrates the application of qualification framework descriptors to AI-oriented development in vocational education.

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Introduction

Artificial intelligence (AI) is rapidly reshaping educational practices, fundamentally altering how knowledge is generated, accessed, and mediated within teaching and learning environments (Albedah, 2025; Crusan & Mohebbi, 2026; ÖZÇELİK, 2026; Wu & Zhang, 2025). In language education, AI-driven tools such as automated feedback systems, generative text platforms, and adaptive learning technologies are increasingly integrated into instructional design, assessment, and learner support (Karataş et al., 2024; Pitychoutis & Spathopoulou, 2026; Qin & Chuaychoowong, 2025; Su, 2026; Vogt, 2026). These developments extend beyond technological enhancement; they transform the pedagogical role of language trainers from knowledge transmitters to facilitators of critical engagement, ethical reasoning, and higher-order learning processes. As AI becomes embedded in everyday teaching practices, the expectations placed on language trainers have expanded significantly (Balikci, 2026). In addition to linguistic and pedagogical expertise, trainers are now required to demonstrate AI literacy, including the ability to evaluate AI-generated content, design AI-supported learning activities, and address issues of bias, originality, and ethical responsibility (Yan & Huang, 2025). This shift positions language trainers as mediators between human learning and machine-generated knowledge, requiring a more complex and integrated set of competencies that current trainer development structures are not yet systematically designed to support.

Despite the increasing centrality of AI in educational practice, there is no clearly defined and systematically structured pathway for developing AI-oriented pedagogical competencies among language trainers (Melo-López et al., 2025). Existing professional development initiatives tend to focus on short-term, tool-based training that emphasizes operational familiarity with AI technologies rather than their pedagogical integration or ethical implications (Metwally & Bin-Hady, 2025). Consequently, trainers often adopt AI tools in fragmented and inconsistent ways, without a coherent framework guiding their instructional use. This lack of structured development creates a critical disconnect between the evolving demands of AI-enhanced language education and the preparation of trainers (Kohout-Diaz, 2025). Without a clearly articulated pathway, trainers may struggle to align AI use with pedagogical objectives, learner needs, and broader educational values (Tan et al., 2025). This not only limits the pedagogical potential of AI but also introduces risks related to uncritical adoption, reduced learner autonomy, and insufficient attention to ethical considerations in language teaching practices.

Qualification frameworks such as the Hong Kong Qualifications Framework (QF) provide a comprehensive structure for defining learning outcomes and competency levels across educational and vocational domains. The QF outlines descriptors across domains including knowledge, intellectual skills, processes, autonomy, accountability, and communication, offering a robust basis for competency-based development (Tojimuxammadov, 2025). However, its application has predominantly focused on learner progression and programme accreditation rather than on the systematic

development of trainer competencies. In particular, the potential of the QF to support AI-oriented language trainer development remains underutilized. While the framework provides detailed competency descriptors, it does not explicitly translate these descriptors into pathways for integrating emerging pedagogical, technological, and ethical demands (Sun et al., 2026). Similarly, existing trainer development approaches tend to address AI skills, pedagogical strategies, or ethical considerations in isolation, rather than within a unified and structured model (Hackl et al., 2026). As a result, current approaches lack the coherence necessary to support the complex, multi-dimensional competencies required in AI-enhanced language education.

Given these limitations, there is a clear need for an integrated framework that systematically connects structured competency development with human-centered pedagogy and ethical responsibility in AI-enhanced language education (Aljabr & Al-Ahdal, 2024). Design thinking provides a relevant methodological foundation for such integration, as it emphasizes empathy, iterative problem-solving, and responsiveness to learner needs (Zou et al., 2025). In educational contexts, design thinking has been applied to curriculum innovation and learning design, suggesting its potential to inform trainer development processes that are adaptive, reflective, and context-sensitive. At the same time, the Principles for Responsible Management Education (PRME) offer a value-based framework that foregrounds ethics, sustainability, and social responsibility in educational practice. Although originally developed for management education, PRME principles provide a meaningful lens for addressing the ethical dimensions of AI integration in teaching, including accountability, inclusivity, and societal impact. However, these approaches have not been systematically integrated within qualification-based frameworks to support trainer development (Żammit, 2025). Consequently, there is a lack of an integrated framework that aligns QF competency descriptors, design thinking processes, and PRME principles to support AI-oriented language trainer development in vocational education.

In response to this gap, this study aims to develop a QF-aligned framework for AI-oriented language trainer development in vocational education by integrating design thinking and PRME principles (Ge et al., 2026). The study adopts a practice-informed conceptual approach to construct a structured pathway that translates qualification descriptors into pedagogical competencies relevant to AI-enhanced teaching contexts (Fang, 2026). The study is guided by the following research question: How can a QF-aligned framework integrating design thinking and PRME principles support AI-oriented language trainer development in vocational education?

This study makes both theoretical and practical contributions. Theoretically, it extends existing discussions of AI in education by moving beyond tool-focused perspectives to demonstrate how structured competency frameworks can be integrated with human-centered pedagogical approaches and responsibility-oriented principles (Mahmud et al.,

2025). It also contributes to the literature on qualification frameworks by showing how abstract competency descriptors can be operationalized into a coherent developmental pathway for language trainers. Practically, the study proposes a structured framework that can guide vocational institutions, trainer development programs, and accreditation bodies in preparing language trainers for AI-enhanced educational environments (Ilieva et al., 2025). By aligning QF descriptors with design thinking processes and PRME principles, the framework provides a systematic approach to developing pedagogical competence that is both technically informed and ethically grounded, directly addressing the identified gap in AI-oriented trainer development.

AI-Oriented Competencies in Language and Vocational Education

AI and Pedagogical Transformation

The integration of artificial intelligence (AI) into education has significantly reshaped pedagogical practices, particularly within language and vocational education contexts. AI-enabled tools, including automated feedback systems, generative text platforms, and adaptive learning environments, have expanded instructional possibilities by enabling personalized learning, real-time feedback, and data-informed decision-making (Pei et al., 2026). These developments signal a shift from content transmission toward learner-centered and technology-mediated engagement, where educators facilitate interaction, interpretation, and critical reflection rather than simply delivering knowledge.

The literature consistently highlights the functional benefits of AI in enhancing efficiency and scalability in teaching (Wang et al., 2024). However, the dominant pattern remains largely tool-oriented, focusing on the operational use of AI technologies rather than their pedagogical integration. AI is frequently positioned as an instructional aid rather than as a component that reshapes the structure of pedagogy itself (Sapawi & Yusoff, 2025). Consequently, while the transformative potential of AI is acknowledged, its implications for the systematic development of educator competencies particularly in language education remain insufficiently articulated. This indicates a critical limitation in current scholarship: the absence of structured models that define how trainers can develop pedagogical competencies aligned with AI-enhanced teaching.

Ethical and Responsibility-Oriented AI Use

Parallel to pedagogical transformation, the ethical dimensions of AI use in education have gained increasing attention. Issues such as algorithmic bias, data privacy, authorship, and academic integrity challenge established assumptions about knowledge production and evaluation (Giannakos et al., 2024). In language education, where meaning-making, originality, and communicative intent are central, AI-generated content introduces complex questions regarding authenticity and learner agency.

Existing research emphasizes the importance of developing critical AI literacy among both learners and educators, including the ability to evaluate outputs, recognize

limitations, and exercise ethical judgment (Kaplan & Meylani, 2025). However, ethical considerations are typically addressed as supplementary to technological adoption rather than embedded within pedagogical design. This creates a persistent separation between technical competence and ethical responsibility (Shezad et al., 2025). As a result, educators may acquire proficiency in AI tools without a corresponding capacity to address their ethical implications in practice. This structural disconnect highlights the need for integrated approaches in which ethical and responsibility-oriented principles are embedded within the development of AI-oriented pedagogical competencies. Recent studies published in 2026 provide a more differentiated understanding of the competencies educators require for responsible AI integration. Pei et al. (2026) conceptualized educator AI literacy through three interconnected dimensions: human–AI interaction, the effective use of AI tools, and awareness of ethical and societal implications. Similarly, Sun et al. (2026) proposed a generative-AI-responsive competency framework encompassing AI literacy, curriculum and learning design, teaching and learning, and assessment, with competency development progressing from basic awareness to critical and creative integration. In the specific context of foreign-language education, Ren and Li (2026) identified six interrelated dimensions of teacher AI literacy: conceptual understanding, technical proficiency, pedagogical integration, adaptive expertise, ethical reasoning, and self-efficacy. These findings indicate that AI-oriented competence cannot be reduced to operational proficiency but must integrate pedagogical judgment, disciplinary responsiveness, adaptive capacity, and ethical reasoning.

Recent research has also emphasized that educator AI competence should be organized as a developmental and context-responsive pathway. Yoon et al. (2026) developed a career-responsive framework comprising three dimensions, eight categories, seventeen competencies, and fifty-one behavioral indicators across induction, development, mastery, and leadership stages. Zhou et al. (2026) further demonstrated that teacher AI competence is shaped by interactions among individual beliefs, professional learning environments, disciplinary cultures, and broader institutional conditions. Collectively, these studies support multidimensional, progressive, and context-sensitive approaches to educator AI development. Nevertheless, they do not explicitly align AI-oriented competencies with formal qualification descriptors or systematically integrate design thinking and responsibility-oriented principles. This continuing limitation strengthens the rationale for a QF-aligned framework that connects competency standards, developmental processes, and ethical orientation within vocational language trainer development.

Design Thinking in Teacher and Trainer Development

Design Thinking as a Human-Centered Approach

Design thinking has emerged as a prominent framework for addressing complex, human-centered challenges across disciplines, including education. Structured around iterative

stages empathize, define, ideate, prototype, and test it emphasizes understanding user needs, generating innovative solutions, and refining approaches through feedback (Kamalov et al., 2023). In educational contexts, this approach aligns closely with learner-centered pedagogy by foregrounding empathy, adaptability, and contextual responsiveness.

The literature demonstrates that design thinking supports pedagogical innovation by encouraging educators to move beyond standardized instructional models toward more flexible and responsive practices (Casanovas, 2025). It promotes reflective teaching, collaborative problem-solving, and iterative refinement, all of which are increasingly relevant in dynamic educational environments (VanGronigen et al., 2022). However, despite its growing influence, design thinking has been primarily applied to curriculum design and classroom innovation rather than to the systematic development of trainer competencies. This indicates a conceptual limitation: its potential as a structuring logic for professional development particularly in technologically complex contexts remains underdeveloped.

Application in Educational Innovation

In practice, design thinking has been used to redesign learning experiences, foster interdisciplinary collaboration, and support creativity in both teaching and learning. Its application is particularly evident in contexts requiring adaptability and innovation, where traditional pedagogical models are insufficient (Blundell, 2022). Within vocational education, design thinking provides a mechanism for aligning training with real-world problem-solving and evolving industry demands.

However, these applications tend to be localized and project-based rather than embedded within systemic professional development frameworks. As a result, the use of design thinking remains fragmented, lacking integration with structured competency models or qualification systems. This limits its scalability and long-term impact on educator development (Eamcharoen, 2024). To address this limitation, design thinking must be integrated with formal frameworks that provide structural coherence and continuity in competency development.

Qualifications Frameworks and Competency-Based Development

Structure of the Hong Kong Qualifications Framework

Qualifications frameworks serve as structured systems for defining learning outcomes and competency levels across educational and vocational contexts. The Hong Kong Qualifications Framework (QF) is a seven-level hierarchy that organizes competencies across domains such as knowledge, intellectual skills, processes, autonomy, accountability, and communication (Eisenbart et al., 2022). It provides a standardized mechanism for ensuring consistency, transparency, and progression in educational qualifications.

The QF has been widely applied in programme accreditation and curriculum design, offering a robust foundation for competency-based development (Calasang et al., 2025). Its structured descriptors enable alignment between educational programmes and industry expectations, facilitating comparability across qualifications.

Table 1

Overview of QF Levels and Intellectual Skills

QF Level	Descriptor of Intellectual Skills
Level 1	Use basic intellectual skills in familiar, personal, and everyday contexts.
Level 2	Use a range of intellectual skills in familiar, personal, and everyday contexts.
Level 3	Use a broad range of intellectual skills in familiar but sometimes unfamiliar contexts.
Level 4	Use a wide range of largely routine and some specialized intellectual skills related to a subject, discipline, or sector.
Level 5	Use a wide range of specialized intellectual skills in support of established practices in a subject, discipline, or sector.
Level 6	Utilize highly specialized technical, research, or scholastic skills across an area of study.
Level 7	Make a significant and original contribution to a specialized field of inquiry or to broader interdisciplinary relationships.

QF Descriptors and Trainer Competency Development

Despite its structural strengths, the application of the QF has largely focused on learner outcomes rather than on the development of trainer competencies (Galeboe et al., 2025). While the framework provides detailed descriptors that could inform professional development, there is limited evidence of its systematic use in guiding trainer development pathways.

This limitation becomes more pronounced in the context of AI-enhanced education. Although the QF offers a comprehensive structure for defining competencies, it does not explicitly address how emerging technological and ethical demands can be integrated into trainer development (Ramaila, 2025). Existing approaches tend to treat technological skills, pedagogical strategies, and ethical considerations as separate domains rather than as interconnected components of professional competence. This fragmentation highlights a critical gap: the need to operationalize QF descriptors into a coherent model that supports integrated, AI-oriented trainer development.

PRME Principles and Responsibility-Oriented Pedagogy

Overview of PRME Principles

The Principles for Responsible Management Education (PRME) provide an internationally recognized framework for embedding ethics, sustainability, and social responsibility into educational practice. The principles emphasize values-based education, stakeholder engagement, and the role of education in addressing global challenges (Mhlongo et al., 2023). Although originally developed within management education, PRME offers a conceptual foundation for integrating responsibility-oriented perspectives into broader educational contexts.

The six PRME principles and their relationship to responsibility-oriented educational practice are summarized in Figure 1.

Figure 1

Representation of PRME Principles



PRME in Educational Practice

In practice, PRME principles have been used to guide curriculum design, promote ethical awareness, and support reflective learning processes. Studies indicate that PRME-informed approaches enhance learners' capacity to engage with complex social and environmental issues and encourage responsible decision-making (Morris, 2025). However, their application remains largely confined to management and business education, with limited integration into technology-enhanced or AI-mediated learning environments.

Moreover, PRME principles are rarely incorporated into structured competency frameworks or professional development models. This limits their practical impact in guiding educator behavior, particularly in contexts where technological innovation introduces new ethical challenges (McLaughlin et al., 2022). Consequently, there is a need to embed PRME principles within structured pedagogical and competency frameworks to ensure that ethical responsibility is systematically integrated into AI-oriented teaching practices.

Synthesis and Research Gap

Across the literature, several consistent patterns and limitations emerge. First, AI is widely recognized as transforming educational practice, yet its implications for structured trainer development remain insufficiently addressed. Second, design thinking provides a human-centered approach to pedagogical innovation, but its application as a

framework for professional development is limited. Third, qualification frameworks such as the QF offer structured competency descriptors, but their potential to guide trainer development particularly in AI-enhanced contexts remains underutilized. Finally, PRME principles provide a strong ethical foundation, but they are rarely integrated into models of technological and pedagogical development.

Taken together, these patterns reveal a critical and unresolved issue: there is no integrated framework that systematically aligns QF competency descriptors, design thinking processes, and PRME principles to support AI-oriented language trainer development in vocational education. This gap directly motivates the present study, which seeks to develop a coherent and structured framework that addresses this need.

Conceptual Framework

Core Constructs of the Study

This study develops a conceptual framework by integrating four core constructs identified from the literature: AI-oriented language trainer development, QF alignment, design thinking, and PRME principles. These constructs are selected because they directly address the identified gap namely, the absence of a structured, ethically grounded, and pedagogically coherent pathway for AI-oriented trainer development in vocational education. Each construct is defined to establish conceptual precision and ensure that all elements are later operationalized within the framework and results.

AI-oriented language trainer development refers to the systematic development of competencies that enable trainers to integrate artificial intelligence into language teaching in pedagogically meaningful and ethically responsible ways. This construct extends beyond technical proficiency to include three interrelated dimensions: pedagogical integration (designing AI-enhanced learning experiences), critical AI literacy (evaluating outputs and limitations), and ethical responsibility (ensuring appropriate and accountable use). This construct functions as the outcome of the framework, representing the capabilities that the model aims to develop.

QF alignment refers to the use of the Hong Kong Qualifications Framework as a structured system for defining and organizing trainer competencies. The QF provides hierarchical descriptors across domains such as knowledge, intellectual skills, processes, autonomy, accountability, and communication. Within this study, QF alignment serves as the structural dimension of the framework by specifying what competencies are required and how they progress across levels. This ensures that trainer development is not ad hoc but systematically organized and aligned with recognized standards.

Design thinking is conceptualized as the process dimension that operationalizes competency development. Structured around the stages of empathize, define, ideate, prototype, and test, it provides an iterative and user-centered approach to pedagogical

design. Within this framework, design thinking determines how competencies are developed, enabling trainers to engage in reflective, adaptive, and context-sensitive teaching practices in AI-enhanced environments.

PRME principles are conceptualized as the ethical and value-based dimension of the framework. The principles purpose, values, method, research, partnership, and dialogue provide a normative foundation for embedding responsibility, sustainability, and social accountability into educational practice. Within this study, PRME principles guide why and under what ethical conditions AI-oriented competencies are developed and applied, ensuring that technological integration remains aligned with broader societal and educational values.

Integrating Design Thinking, QF, and PRME

The conceptual framework is organized as an integrated system in which QF alignment defines what competencies are required, design thinking determines how these competencies are developed, and PRME principles guide why and under what ethical conditions these competencies are applied. This tripartite structure establishes a clear and coherent relationship among the constructs, transforming them from isolated concepts into an interconnected system.

These dimensions operate in a coordinated manner rather than independently. QF alignment provides a structured competency progression that ensures clarity and consistency in trainer development. Design thinking translates these competency requirements into iterative pedagogical practices, enabling trainers to develop skills through continuous engagement with real-world teaching challenges. PRME principles regulate both the development process and its outcomes by embedding ethical, sustainable, and socially responsible considerations into pedagogical decision-making.

This integration addresses the fragmentation identified in the literature, where technological skills, pedagogical practices, and ethical considerations are typically treated as separate domains. By aligning structure, process, and ethics within a single framework, the model ensures that AI-oriented trainer development is not only systematic but also pedagogically meaningful and ethically grounded.

Framework Architecture

The framework is structured as a three-layered system linking structure, process, and ethics to the outcome of AI-oriented language trainer development. At the structural layer, QF descriptors define competency expectations and progression pathways. At the process layer, design thinking operationalizes these competencies through iterative cycles of problem identification, solution development, and refinement. At the ethical layer, PRME principles guide the application of these competencies by embedding responsibility, sustainability, and accountability into teaching practices.

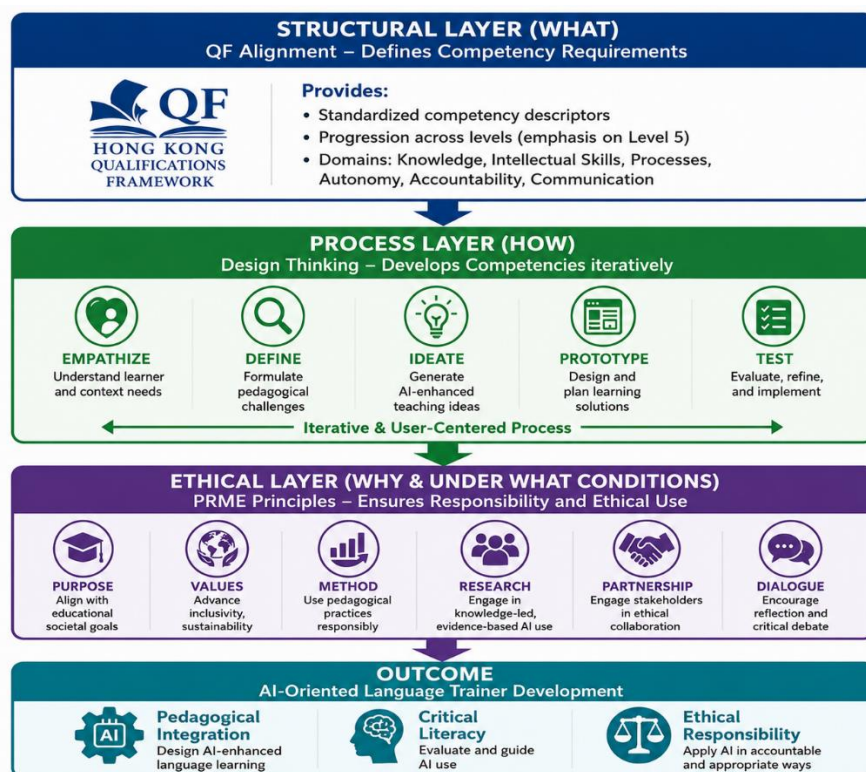
These layers interact dynamically rather than sequentially. Design thinking processes are informed by QF competency requirements, while PRME principles shape how these processes are enacted and evaluated. The competencies developed through this interaction are continuously refined through feedback and application, creating a recursive system of development. This dynamic interaction ensures that the framework remains adaptable to evolving technological and educational contexts.

The outcome of this integrated system is AI-oriented language trainer development, where competencies are not only acquired but applied in contextually appropriate and ethically responsible ways. This conceptual architecture directly responds to the research gap by providing a coherent and operationalizable model that aligns structured competency development with pedagogical processes and ethical principles. It also informs the operationalization presented in the results section, where QF descriptors, design thinking stages, and PRME principles are integrated into a structured competency framework.

The relationships among the QF competency structure, design thinking process, PRME ethical orientation, and AI-oriented language trainer development are illustrated in Figure 2.

Figure 2

Conceptual Model of the QF-Aligned AI-Oriented Language Trainer Development Framework



Methods

Research Design

This study adopts a conceptual, practice-informed framework development design to address a gap that cannot be adequately examined through isolated empirical variables or conventional hypothesis testing. Existing research on artificial intelligence in education has largely examined teachers' technological readiness, AI literacy, tool adoption, or attitudes toward AI. Although these studies identify important competencies, they generally do not explain how such competencies should be organized into a formal and progressive trainer development pathway. Similarly, qualification frameworks have primarily been applied to learner outcomes, curriculum accreditation, and programme-level standards, while their potential use in structuring the professional development of vocational language trainers remains underexplored. Design thinking has also been widely used in curriculum innovation and learner-centred instructional design, but it has rarely been operationalized as a developmental mechanism linked to formal qualification descriptors. In parallel, responsibility-oriented frameworks such as PRME have emphasized ethics, sustainability, and social accountability, yet these principles have seldom been integrated into AI-oriented language trainer competency models. Consequently, the existing literature remains fragmented across technological competence, pedagogical development, qualification alignment, and ethical responsibility.

The specific gap addressed by this study is therefore the absence of an integrated and operational framework that connects: (1) formal competency expectations derived from the Hong Kong Qualifications Framework, (2) an iterative developmental process based on design thinking, and (3) an ethical and responsibility-oriented foundation informed by PRME principles. This gap is particularly significant in vocational language education, where trainers are expected to respond simultaneously to technological change, learner diversity, industry-oriented outcomes, institutional accreditation requirements, and concerns regarding responsible AI use. Without an integrated structure, trainer development may remain short-term, tool-centred, and disconnected from recognized professional standards.

The study contributes to the field in four ways. First, it extends the application of qualification frameworks from learner progression and programme accreditation to the systematic development of trainer competencies. Second, it reconceptualizes design thinking as a professional development process through which trainers can identify learner needs, define AI-related pedagogical problems, generate instructional solutions, prototype AI-supported activities, and refine practice through evaluation. Third, it embeds PRME principles within the competency development process so that accountability, inclusivity, sustainability, stakeholder engagement, and ethical judgment are treated as integral components of AI-oriented pedagogy rather than supplementary considerations. Fourth, it produces an operational mapping that aligns QF Level 5

descriptors, AI-oriented trainer competencies, design thinking stages, and PRME principles within a single framework. This integrated mapping offers a structured basis for curriculum development, professional training, accreditation alignment, and subsequent empirical validation.

A conceptual, practice-informed framework development design is appropriate because the research question requires the systematic synthesis and integration of multiple established constructs rather than the testing of causal relationships. The design enables the study to translate abstract qualification descriptors, pedagogical processes, and ethical principles into a coherent and practically applicable trainer development model. The study is situated within vocational and language education systems operating under formal qualification structures, particularly those aligned with competency-based frameworks such as the Hong Kong Qualifications Framework, where AI integration, pedagogical competence, professional accountability, and ethical responsibility must be addressed together.

Data Sources and Knowledge Base

Literature Sources

The primary knowledge base consists of peer-reviewed academic literature on artificial intelligence in education, vocational training, design thinking, qualification frameworks, and PRME principles. These sources were used to identify core constructs, dominant patterns, and conceptual limitations relevant to the research question. The selection of literature followed a purposive logic, whereby studies were included if they directly contributed to understanding at least one of the core constructs and their potential integration. Priority was given to recent studies addressing AI-enhanced pedagogy, competency-based development, and responsibility-oriented education, ensuring both relevance and currency of the conceptual foundation.

QF Descriptor Analysis

A central analytical source in this study is the Hong Kong Qualifications Framework, with particular emphasis on the Generic Level Descriptors at Level 5. These descriptors were systematically examined to identify competency requirements across domains such as knowledge and intellectual skills, processes, autonomy and accountability, and communication, information technology, and numeracy. The analysis involved mapping QF descriptors onto AI-oriented trainer competencies, design thinking processes, and PRME principles. Through this mapping, formal qualification standards were translated into operational elements of trainer development, enabling structural alignment between institutional competency expectations and emerging pedagogical demands.

Practice-Informed Inputs

The study incorporates practice-informed inputs derived from professional experience and engagement in vocational and language education contexts. These include experience

in curriculum design and delivery, application of design thinking in training environments, alignment of programs with accreditation requirements, and practitioner insights into AI integration in education. These inputs are not treated as empirical data but as contextual knowledge used to validate the feasibility and applicability of the framework. They inform the structuring of competencies and ensure that the model reflects realistic training conditions.

Framework Development Process

Stage 1: Problem Definition (Empathize and Define)

The first stage involved identifying and defining the core problem through the synthesis of literature and practice-informed insights. This stage focused on understanding the challenges faced by language trainers in AI-enhanced environments, including fragmented competency development, lack of structured training pathways, and insufficient integration of ethical considerations. These issues were analyzed and consolidated into a clearly defined research focus, which guided the selection of constructs and the direction of framework development.

Stage 2: Framework Construction (Ideate and Prototype)

The second stage involved constructing the framework through iterative conceptual integration. QF descriptors were aligned with AI-oriented competencies, design thinking stages were mapped onto the processes of competency development, and PRME principles were embedded as ethical guidance. An initial model was developed based on a structure–process–ethics logic, where QF defines the structure of competencies, design thinking defines the developmental process, and PRME defines the ethical orientation. This model was refined through iterative conceptual testing to ensure coherence and alignment with the research objective.

Stage 3: Alignment and Validation (Test)

The final stage involved validating the framework through systematic alignment checks. This process included verifying consistency between constructs and their operational representation, ensuring integration across structural, process, and ethical dimensions, and assessing whether the framework adequately addresses the research gap. Validation in this study is conceptual rather than empirical, focusing on internal coherence, logical consistency, and applicability within the intended context.

Operationalization of Constructs

Operationalization in this study involves translating conceptual constructs into explicit framework components. AI-oriented language trainer development is operationalized as three interrelated competency dimensions: pedagogical integration, critical AI literacy, and ethical responsibility. QF alignment is operationalized through Level 5 descriptors, which define competency expectations and progression pathways. Design thinking is operationalized through its five-stage process empathize, define, ideate, prototype, and

test guiding the development of competencies. PRME principles are operationalized as ethical evaluation criteria embedded within training practices. This ensures that all constructs introduced in the conceptual framework are directly represented in the structure and logic of the model.

Analytical Procedures and Alignment Criteria

The analysis follows a deductive, construct-driven approach in which identified constructs are systematically mapped and integrated. Three alignment criteria guided the analytical process. Structural alignment ensures that QF descriptors define competency requirements clearly. Process alignment ensures that design thinking stages operationalize how competencies are developed. Ethical alignment ensures that PRME principles guide how competencies are applied responsibly. These criteria ensure coherence across all components and maintain conceptual integrity throughout the framework.

Rigor and Trustworthiness

Rigor is established through conceptual transparency, internal consistency, and alignment with established frameworks. Conceptual transparency is achieved by clearly defining all constructs and maintaining their consistent use throughout the study. Internal consistency is ensured through systematic alignment between the conceptual framework and its operational representation. Trustworthiness is further strengthened through the triangulation of multiple knowledge sources, including literature, qualification descriptors, and practice-informed insights, which enhances the robustness and credibility of the framework.

Analytical Integrity

Analytical integrity is maintained through consistency, transparency, and systematic alignment across all components of the study. The analysis ensures that constructs retain stable meanings from conceptualization to operationalization. The coherence of the framework is evaluated through alignment checks across structure, process, and ethical dimensions, ensuring that the analytical approach supports the claims made. This minimizes conceptual ambiguity and enhances the validity of the framework.

Ethical Considerations

Although this study does not involve human participants or empirical data collection, ethical considerations are embedded within the research design. The study adheres to academic standards of citation and transparency, and the framework itself incorporates PRME principles to ensure that AI-oriented trainer development is guided by responsibility, sustainability, and ethical accountability.

Methodological Limitations

As a conceptual, practice-informed study, the framework is not empirically tested within this research. While it is theoretically grounded and systematically developed, its effectiveness in practice requires further empirical validation. Future studies should apply the framework across different educational contexts to assess its impact and generalizability.

Results

Mapping Design Thinking to Trainer Development

The framework development process produced a structured mapping between the five stages of design thinking and AI-oriented language trainer competencies. Each stage corresponds to a defined function in trainer development, consistent with the process operationalization described in the methodology.

The empathize stage is associated with the identification of learner needs, contextual teaching conditions, and AI-related considerations. This stage includes engagement with learner profiles, technological environments, and ethical factors relevant to AI use. The define stage is associated with the formulation of pedagogical problems and competency requirements. At this stage, identified needs are translated into structured instructional objectives related to AI-supported teaching.

The ideate stage corresponds to the generation of instructional strategies and AI-supported solutions. This stage includes the development of alternative approaches to integrating AI into teaching activities, assessment, and feedback processes. The prototype stage is associated with the development of initial instructional models and learning tasks. These include pilot activities incorporating AI tools for instructional implementation.

The test stage corresponds to the evaluation and refinement of instructional approaches. This stage includes assessment of learner responses, review of AI outputs, and adjustment of teaching strategies. This mapping presents the design thinking process as the operational mechanism through which AI-oriented trainer competencies are developed.

QF Level 5 Alignment with Trainer Competencies

The analysis of QF Level 5 Generic Level Descriptors resulted in the identification of competency domains relevant to AI-oriented language trainer development.

The descriptors include competencies related to the analysis of abstract information, application of specialized skills, and the exercise of professional judgment. These competencies align with requirements identified for AI-oriented trainer development,

including the evaluation of AI-generated outputs, integration of AI into pedagogical practice, and management of ethical considerations.

Table 2

QF Level 5 Generic Descriptors

Domain	Descriptors
Knowledge & Intellectual Skills	Generate ideas through the analysis of abstract information and concepts; command a wide range of specialised technical, creative, and conceptual skills; identify and analyse routine and abstract professional problems and formulate evidence-based responses; critically analyse, evaluate, and synthesise information from multiple sources.
Processes	Utilise diagnostic and creative skills in technical, professional, or managerial functions; apply appropriate judgment in planning, design, and supervisory activities related to products, services, or operations.
Application, Autonomy & Accountability	Perform tasks involving planning, design, and technical execution with some management responsibility; accept accountability for personal and group outcomes within defined parameters; operate under professional guidance while addressing ethical considerations appropriately.
Communication, IT & Numeracy	Use routine and advanced communication skills to present ideas to diverse audiences; participate in discussions on complex topics; apply information technology tools to support work; interpret and evaluate numerical and graphical data to achieve objectives.

The QF domains of knowledge and intellectual skills, processes, autonomy and accountability, and communication provide the structural categorization used in the framework. These domains correspond directly to the competency structure defined in the methodology.

Integration of PRME Principles into Trainer Development

The integration of PRME principles resulted in the inclusion of ethical and responsibility-oriented components within the framework. Each principle is represented as part of the competency system. The purpose and values principles are represented through alignment with sustainability, inclusivity, and societal considerations in AI-supported teaching contexts. The method and research principles are represented through the inclusion of reflective instructional practices and evidence-based approaches to AI integration. The partnership and dialogue principles are represented through collaborative learning environments and interaction among learners, institutions, and stakeholders. These components are incorporated into the framework as part of the ethical dimension defined in the methodology.

The QF-Aligned AI-Oriented Trainer Development Framework

The integration of QF descriptors, design thinking processes, and PRME principles resulted in a structured framework for AI-oriented language trainer development.

Table 3*The QF-Aligned AI-Oriented Language Trainer Development Framework (Level 5)*

QF Domain	QF Level 5 Descriptor (Baseline)	AI-Oriented Competency Extension	Design Thinking Alignment	PRME Integration
Knowledge & Intellectual Skills	Generate and analyse abstract information; apply specialised knowledge and critical thinking	Evaluate AI-generated content; develop critical AI literacy; apply AI tools to support knowledge construction and pedagogical decision-making	Empathize; Define	Purpose; Values (ethical awareness, responsible knowledge use)
Processes	Apply diagnostic and creative skills; exercise judgment in planning and instructional design	Design AI-supported learning tasks; integrate AI into teaching, assessment, and feedback processes	Ideate; Prototype	Method; Research (reflective, evidence-based pedagogy)
Application, Autonomy & Accountability	Perform complex tasks with responsibility; operate within defined parameters; address ethical issues appropriately	Apply AI in real teaching contexts; manage risks such as bias, over-reliance, and misuse; demonstrate responsible and accountable decision-making	Prototype; Test	Practice (ethical application, accountability, sustainability)
Communication, IT & Numeracy	Communicate effectively; use IT tools; interpret and evaluate data in professional contexts	Use AI tools for communication, feedback, and collaboration; interpret AI-generated outputs and data; facilitate technology-supported learning environments	Test	Partnership; Dialogue (collaboration, stakeholder engagement)

The framework presents the alignment of QF Level 5 descriptors with AI-oriented competencies and PRME principles. Each competency domain is linked to corresponding design thinking stages, reflecting the process through which competencies are developed. The framework structure follows the alignment criteria defined in the methodology, including structural alignment (QF descriptors), process alignment (design thinking stages), and ethical alignment (PRME principles). These components are represented within a single integrated model.

Key Features of the Framework*AI-Oriented Pedagogical Competence*

AI-oriented pedagogical competence is represented within the framework through the integration of AI tools into teaching practices. This includes the design of AI-supported learning activities, evaluation of AI-generated outputs, and application of AI in instructional processes. These elements correspond to competency domains defined under knowledge, intellectual skills, and processes.

Ethical and Responsibility Integration

Ethical and responsibility components are represented through the integration of PRME principles across competency domains. These include considerations of accountability, sustainability, and inclusivity in the application of AI. These elements correspond to domains related to autonomy and accountability.

Structured Development Pathway

A structured development pathway is represented through the alignment of QF levels with design thinking stages. Competency development is organized as a progression from problem identification to evaluation and refinement, consistent with the process structure defined in the methodology.

Discussion

The conceptual analysis indicates that AI-oriented language trainer development requires the integration of technological, pedagogical, professional, and ethical competencies rather than the isolated acquisition of AI tool skills. This interpretation is consistent with recent competency research showing that educator AI competence involves human–AI interaction, effective technology use, pedagogical design, assessment, ethical reasoning, and adaptive expertise (Pei et al., 2026; Ren & Li, 2026; Sun et al., 2026). The emergence of this multidimensional structure can be explained by the changing role of language trainers in AI-supported learning environments. Trainers are no longer expected merely to operate digital tools; they must determine whether AI-generated content is pedagogically suitable, linguistically accurate, culturally appropriate, transparent, and consistent with learner needs. Consequently, technical proficiency alone is insufficient because the educational value of AI depends on the professional judgment through which it is selected, interpreted, adapted, and evaluated. The proposed framework addresses this complexity by organizing trainer development around three interdependent dimensions: the competency structure provided by the Hong Kong Qualifications Framework, the developmental process provided by design thinking, and the ethical orientation provided by PRME principles. This integration is necessary because the three components address different limitations in existing trainer development approaches. Qualification descriptors can define the expected level of professional performance, but they do not independently explain how trainers should acquire emerging AI-related capabilities. Design thinking provides an iterative learning process, but without formal competency standards it may remain a localized or project-based innovation exercise. PRME contributes an ethical and responsibility-oriented perspective, but its principles require operational links to observable pedagogical practices. The framework therefore derives its value not from any individual component, but from the way the components compensate for one another's conceptual and practical limitations.

The alignment with QF Level 5 provides a formal baseline for critical analysis, specialized professional practice, instructional planning, accountability, communication, and the use of information technology. Applying these descriptors to trainer development extends the role of qualification frameworks beyond learner assessment and programme accreditation. This extension is theoretically significant because trainer competence is often assumed rather than explicitly specified within qualification systems. When trainers are responsible for preparing learners to work in AI-influenced professional environments, the absence of clearly articulated trainer standards may create an inconsistency: learner outcomes are formally regulated, while the competencies required of those responsible for developing these outcomes remain comparatively under-defined. The proposed framework addresses this inconsistency by translating broad qualification descriptors into AI-related pedagogical actions, including evaluating generated content, designing AI-supported tasks, exercising professional judgment, interpreting data, and accepting accountability for instructional decisions.

However, QF alignment should not be interpreted as implying that AI-oriented competence can be reduced to compliance with fixed descriptors. Qualification frameworks provide stability and comparability, but AI technologies evolve more rapidly than formal standards are typically revised. There is therefore a potential tension between standardization and adaptability. QF descriptors can establish the level and complexity of expected performance, but the specific tools, risks, and instructional applications associated with AI will require continuing revision. For this reason, the framework uses QF Level 5 as a competency baseline rather than as a complete or permanent specification of AI-oriented professional practice. This interpretation preserves the value of formal qualification standards while acknowledging the need for ongoing professional learning.

Design thinking functions within the framework as the mechanism through which formal competency expectations can be translated into situated professional practice. The stages of empathize, define, ideate, prototype, and test encourage trainers to begin with learner needs, formulate pedagogical problems, develop alternative solutions, trial AI-supported activities, and refine those activities through feedback. The importance of this process lies in its capacity to prevent technology-first instructional decisions. AI tools are frequently introduced because they are available, efficient, or institutionally promoted, rather than because they address a clearly defined learning problem. Beginning with empathy and problem definition reverses this sequence by requiring trainers to establish the educational need before selecting the technological response. This helps explain why design thinking is particularly relevant to AI-oriented trainer development: it positions AI as one possible component of pedagogical problem-solving rather than as the predetermined focus of instructional innovation.

The iterative structure of design thinking also reflects the unstable and context-dependent performance of AI systems. AI-generated feedback or learning materials may differ according to prompts, languages, disciplinary contexts, learner proficiency, and platform design. Accordingly, effective AI integration cannot be based on a single decision made during initial lesson planning. It requires repeated testing, evaluation, and refinement. The prototype and test stages encourage trainers to examine whether an AI-supported activity actually improves learning, whether generated outputs introduce inaccuracies or bias, and whether learners remain intellectually engaged rather than becoming dependent on automated assistance. This iterative logic provides a reasoned explanation for the framework's emphasis on adaptive expertise: trainers must be able to revise practice when the educational consequences of AI use differ from their original expectations.

Nevertheless, design thinking also presents implementation challenges. Its iterative and reflective nature may demand time, institutional support, access to technologies, opportunities for experimentation, and tolerance for instructional failure. Trainers working under rigid curricula, limited resources, heavy workloads, or highly standardized assessment systems may find it difficult to complete repeated cycles of prototyping and testing. Thus, the framework should not be treated as a simple sequence that trainers can enact independently of their institutional conditions. Its effectiveness is likely to depend on organizational arrangements that provide professional learning time, technical support, collaborative communities, access to appropriate AI systems, and mechanisms for sharing evidence from practice. This qualification is consistent with Zhou et al. (2025), who emphasized that teacher AI competence is influenced by professional learning environments, disciplinary cultures, and institutional conditions rather than by individual knowledge alone.

The inclusion of PRME principles responds to the risk that AI competence may be defined primarily through efficiency, innovation, or technical performance. Purpose, values, method, research, partnership, and dialogue introduce broader questions concerning why AI is used, whose interests it serves, what consequences it creates, and how affected stakeholders participate in decision-making. This ethical layer is particularly important in language education because language learning involves identity, authorship, cultural representation, communicative agency, and the production of meaning. An AI system may generate grammatically acceptable material while reproducing stereotypes, privileging dominant linguistic norms, obscuring sources, or reducing opportunities for learners to develop independent expression. Ethical trainer competence therefore involves more than avoiding misconduct; it requires trainers to evaluate how AI-supported pedagogy influences learner autonomy, inclusion, cultural responsiveness, and access to educational opportunities.

PRME provides a useful responsibility-oriented lens, but its application outside management education must be approached critically. Its principles are broad and normative, and they do not automatically provide measurable criteria for evaluating AI-supported language teaching. Terms such as sustainability, responsibility, partnership, and dialogue may be interpreted differently across institutions and educational cultures. The framework therefore treats PRME as an ethical orientation that must be translated into context-specific indicators, such as transparency regarding AI use, procedures for checking bias and inaccuracies, protection of learner data, inclusive access to technologies, preservation of learner authorship, and consultation with relevant stakeholders. Without this operational translation, PRME risks becoming an aspirational statement rather than an effective guide for professional practice.

The integration of QF, design thinking, and PRME also clarifies the contribution of the proposed model in relation to recent AI competency frameworks. Recent studies have developed increasingly comprehensive classifications of educator AI competence and have shown that competency priorities may vary across professional stages (Pei et al., 2026; Sun et al., 2026; Yoon et al., 2026). The proposed framework does not seek to replace these competency models or claim that it identifies an entirely new set of AI capabilities. Its distinctive contribution lies in connecting competency expectations to a recognized qualification level, an iterative process of professional development, and an explicit ethical orientation. In other words, the framework shifts attention from identifying what AI competencies educators should possess to explaining how those competencies may be structured, developed, applied, and reviewed within vocational language education.

For language trainers, this integrated structure offers a basis for moving from episodic tool training toward sustained professional development. Trainers may use the framework to diagnose learner needs, identify pedagogical problems suitable for AI support, design and test instructional activities, evaluate AI-generated content, and reflect on ethical consequences. However, progression through the framework should not be interpreted as strictly linear. Trainers may need to return repeatedly to earlier design thinking stages when learner needs change, a tool produces unreliable outputs, an ethical concern emerges, or institutional policy is revised. Competence is therefore better understood as recursive and developmental rather than as the completion of a fixed training sequence. This interpretation is compatible with the career-responsive perspective advanced by Yoon et al. (2026), although the present study focuses specifically on Level 5 vocational trainer performance rather than on an entire professional career continuum.

For vocational institutions, the framework can inform programme design, professional learning activities, assessment criteria, and accreditation documentation. Institutions could translate the four QF domains into learning outcomes, use design thinking stages

to organize workshops and practice-based projects, and apply PRME-derived criteria when evaluating the responsibility of proposed AI-supported activities. The framework also implies that institutions should not hold trainers individually accountable for responsible AI integration without providing the necessary governance and infrastructure. Ethical and pedagogically sound practice depends on institutional policies concerning approved tools, data privacy, intellectual property, learner disclosure, accessibility, quality assurance, and procedures for responding to harmful or inaccurate AI outputs. Thus, trainer competence and institutional responsibility should be treated as mutually dependent rather than separate concerns.

For accreditation and qualification bodies, the framework suggests that existing descriptors may be sufficiently broad to accommodate emerging AI-related capabilities without requiring the creation of entirely separate qualifications. At the same time, merely inserting the term “AI” into existing standards would be inadequate. Meaningful alignment requires observable evidence of performance, such as the ability to evaluate AI outputs critically, justify the pedagogical selection of tools, manage risks, communicate AI-related decisions, and demonstrate accountability for learning outcomes. Accreditation standards should therefore assess not only whether AI is included in a programme but also whether trainers can explain its educational purpose, evaluate its consequences, and revise its use on the basis of evidence.

The framework also has limitations that restrict the strength of the conclusions that can presently be drawn. It was developed through conceptual synthesis and practice-informed reasoning and has not yet been evaluated through expert consensus, trainer participation, programme implementation, or learner-outcome assessment. Accordingly, the study establishes conceptual coherence rather than empirical effectiveness. The mapping presented in the framework shows that the selected constructs can be logically integrated, but it does not demonstrate that their integration will improve trainer competence or learner performance in practice. The focus on Hong Kong QF Level 5 also limits direct transfer to other qualification levels and national systems, while differences in institutional resources, AI access, policy, language, and educational culture may affect implementation.

Future research should therefore examine both the validity of the framework and the conditions under which it can be applied effectively. Expert review, Delphi studies, and content-validity assessment could evaluate the relevance and clarity of the proposed competency extensions. Pilot programmes could investigate how trainers engage with the design thinking process and whether PRME-oriented criteria influence their decisions about AI use. Longitudinal studies could assess changes in trainer competence, instructional design, learner autonomy, ethical awareness, and learning outcomes. Research should also examine possible unintended consequences, including whether formalizing AI competence increases administrative burden, encourages superficial

compliance, privileges institutions with greater technological resources, or reinforces dependence on commercial platforms. Such examination is necessary because a competency framework should not be evaluated only by whether it promotes AI adoption, but also by whether it supports equitable, educationally justified, and responsible practice.

Overall, the conceptual analysis suggests that a structured approach to AI-oriented language trainer development requires more than adding technological skills to existing professional development programmes. Its central implication is that responsible AI integration emerges from the interaction of formal competency expectations, iterative pedagogical inquiry, ethical judgment, and enabling institutional conditions. By connecting QF Level 5 descriptors, design thinking processes, and PRME principles, the framework offers a preliminary basis for organizing this interaction. Its practical value, however, will depend on subsequent empirical validation, contextual adaptation, and the development of observable assessment indicators.

Conclusion

This study addressed the lack of a structured pathway for developing language trainers capable of responding to the pedagogical and ethical demands of AI-integrated education. While existing research has emphasized the importance of AI-related competencies, it has not systematically aligned these competencies with formal qualification frameworks or integrated them with structured pedagogical processes and responsibility-oriented principles. In response, this study developed a QF-aligned framework that integrates design thinking and PRME principles to support AI-oriented language trainer development in vocational education. The findings demonstrate that trainer development can be organized through the alignment of three interrelated dimensions: qualification structure (QF Level 5 descriptors), developmental process (design thinking stages), and ethical orientation (PRME principles). This integrated model provides a coherent approach to addressing the identified gap by linking competency standards with pedagogical practice and responsibility-based education. The contribution of the study lies in operationalizing qualification frameworks for trainer development and embedding ethical considerations directly within AI-oriented competency structures. The significance of this contribution lies in its ability to provide a structured yet adaptable pathway for developing trainers who can integrate AI into teaching practices while maintaining accountability, inclusivity, and sustainability. Rather than treating technical, pedagogical, and ethical competencies as separate domains, the framework demonstrates how these elements can be systematically aligned within a single model. This alignment supports both institutional requirements and evolving educational demands in the AI era.

As a conceptual and practice-informed model, the framework provides a foundation for further empirical investigation. Future research may examine its application across

different educational contexts and qualification levels to assess its adaptability and effectiveness. Overall, the study demonstrates that effective language trainer development in the AI era requires not only the acquisition of new competencies but also the structured integration of those competencies within established educational frameworks and ethical principles.

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Generative AI Use Disclosure Statement

During the preparation and revision of this manuscript, the author used OpenAI's ChatGPT for language refinement, structural organization, and editorial assistance. The author critically reviewed, verified, and revised all AI-assisted content. Generative AI was not used to collect or analyse empirical data, make autonomous scholarly decisions, or assume responsibility for the interpretation and conclusions of the study. The author takes full responsibility for the accuracy, integrity, originality, and final content of the manuscript.

Ethics Declarations

World Medical Association (WMA) Declaration of Helsinki–Ethical Principles for Medical Research Involving Human Participants

This study was conceptual and practice-informed and did not involve human participants, identifiable human data, biological materials, clinical interventions, or experiments involving humans. Therefore, institutional ethical approval, informed consent, and compliance assessment under the World Medical Association Declaration of Helsinki were not applicable.

Competing Interests

The author declares that there are no financial, professional, personal, or institutional competing interests that could have influenced the research, interpretation, or presentation of this work.

Data Availability

No empirical dataset was generated, collected, or analysed in this conceptual framework-development study. The study was based on published literature, publicly available Hong Kong Qualifications Framework descriptors, PRME principles, and the author's practice-informed conceptual analysis. The materials supporting the framework are identified in the manuscript and its reference list.

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