Mapping Global Digital Competency Frameworks to Malaysian Teacher Education: A Comparative Analysis of Digcompedu, ISTE, UNESCO ICT-CFT, and SQD2 Models

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ABSTRACT

With the advent of the Fifth Industrial Revolution (5IR), the integration of digital technologies within teacher education becomes not just desirable but a strategic imperative. National policies in Malaysia, like the Dasar Pendidikan Digital and the Malaysia Education Blueprint 2015-2025 (Higher Education), have emphasized the agenda of developing high-level digital capacities for the future teachers. However, such.teacher preparation programs not infrequently focus on skills development only technically, with little room for approaches toward pedagogical integration. Using a qualitative comparative methodology underpinned by the revised Synthesis of Qualitative Data, SQD2 model, this paper identifies lessons learned from three internationally recognised digital competency frameworks that could best inform the development of pre-service teachers within Malaysian Institutes of Teacher Education (IPGs). Three key frameworks are presented for analysis: UNESCO's ICT Competency Framework for Teachers (ICT-CFT), the European Commission's DigCompEdu, and the ISTE Standards for Educators. These are interrogated at the systemic, institutional, and classroom levels. The findings stress the need for a pedagogy-first approach, collaborative professional learning environments, learner-centered strategies, and the development of students' own digital competencies. This paper concludes with a three-tier model for the localization of these global practices within Malaysia's teacher education landscape.

Keywords: Pre-service teachers, Digital Competency, Malaysian Institutes of Teacher Education (IPGs), Comparative Analysis, UNESCO ICT-CFT, DigCompEdu, SQD2-Model.

INTRODUCTION

The contemporary digital era, driven by the transformative force of the Fourth Industrial Revolution (4IR), has fundamentally reshaped all aspects of modern society. This technological shift has created a critical imperative for educational systems worldwide to adapt, innovate, and prepare a citizenry that is not only digitally literate but digitally fluent. In response to this global challenge, international bodies and national governments have begun to develop strategic frameworks designed to articulate, cultivate, and measure the digital competencies required of educators and learners. These frameworks serve as vital roadmaps for guiding educational reform and ensuring that teaching practices evolve in lockstep with technological advancement.

This study situates itself within this global movement by focusing on the specific context of Malaysia. The nation has clearly articulated its educational ambitions through foundational policy documents, including the Malaysia Education Blueprint 2015-2025 (Higher Education) [MEB (HE)] and the Dasar Pendidikan Digital (DPD). These policies set a clear national objective: to produce a "digitally fluent generation" and develop "holistic, entrepreneurial, and balanced graduates" who are equipped to thrive in and contribute to the global economy. While Malaysia's policy landscape articulates a clear vision for holistic, digitally fluent graduates, a critical disconnect emerges between these national ambitions and the practical task of preparing educators to achieve them, revealing an urgent need for a coherent teacher competency model aligned with both local context and global best practices.

The Problem Statement

Aligning Global Frameworks with National Ambitions

A clear delineation of the research problem is essential to justify this comparative analysis, as it highlights the critical gap between Malaysia's strategic educational aspirations and the current challenges in preparing a cadre of digitally competent teachers. This section maps the ideal state of teacher competency against the current reality, examines the limitations of previous efforts, and outlines the consequences of this misalignment.

The Ideal Situation: The Digitally Competent Malaysian Teacher

The ideal digitally competent teacher in the Malaysian context is one whose practice is deeply aligned with national values and holistic student development. The MEB (HE) outlines six primary graduate attributes that form the bedrock of this ideal: ethics and spirituality, leadership skills, national identity, language proficiency, thinking skills, and knowledge. Furthermore, the Malaysian Qualifications Agency's (MQA) Education Programme Standards (EPS) promotes the concept of the "scholar-teacher"—a professional who is not merely a technician, but a reflective practitioner engaged in the continual pursuit of knowledge and pedagogical excellence. The ideal teacher, therefore, is one who can skillfully leverage digital technologies not as ends in themselves, but as powerful tools to cultivate these holistic attributes, thereby nurturing graduates who are ethically grounded, innovative, and proudly Malaysian. A narrow focus on technical proficiency alone is fundamentally insufficient to realize this multifaceted vision.

The Current Reality and Its Shortcomings

The current reality in teacher education often actively prevents the development of this ideal scholar-teacher by prioritizing technical skills over pedagogical depth. This challenge is affirmed in recent literature; Tondeur et al. (2025), for example, corroborate earlier research indicating that teacher training institutions often emphasize technical aspects while overlooking necessary pedagogical support (Scherer et al., 2021; Starkey, 2020). While Malaysia has established strong policy drivers in the MEB (HE) and DPD, there remains a discernible lack of a unified, actionable roadmap for integrating global best practices into the local teacher education curriculum, as defined by the MQA's regulatory EPS. This disconnect between policy ambition and curricular implementation means that pre-service teachers may graduate with technical know-how but lack the pedagogical and ethical frameworks to use technology for cultivating the holistic graduate attributes central to the national vision. This constitutes not merely a skills gap, but a gap in values and educational philosophy.

LITERATURE REVIEW

Past efforts to define and develop teacher competencies, while valuable, have historical limitations in the current context. The influential Synthesis of Qualitative Data (SQD) model proposed by Tondeur et al. in 2012, for instance, is now over a decade old, predating many contemporary technological and pedagogical shifts. Similarly, Malaysia's own MEB (HE) represents a significant evolution from its precursor, the Pelan Strategik Pengajian Tinggi Negara (PSPTN), establishing a new policy landscape. While robust international frameworks like the UNESCO ICT-CFT and the European DigCompEdu have emerged, there is a distinct absence of a systematic comparative analysis that maps these contemporary global models directly onto Malaysia’s specific, updated policy imperatives and regulatory structures.

The consequences of this misalignment between global standards, national goals, and teacher preparation are significant. Without a clear comparative map to guide them, efforts by Malaysian teacher education institutions may remain fragmented and inconsistent. This can lead to the inefficient allocation of resources, duplication of efforts, and, most critically, a failure to produce educators fully capable of achieving the national vision outlined in the MEB (HE) and DPD. In the long term, this could impede the development of a high-quality future workforce, impacting Malaysia's economic resilience and its competitiveness on the global stage. This situation underscores the urgent need for a structured analysis to bridge the gap between policy and practice.

The Research Gap and Proposed Contribution

Having established the broader problem of aligning teacher preparation with national goals, this section pinpoints the precise, unaddressed question in the existing literature that this study will answer. By doing so, it clarifies the study's unique scholarly contribution and its practical value to stakeholders in Malaysian education.

The historical limitations of previous models and policies have created a contemporary knowledge vacuum. While numerous studies have individually explored influential digital competency frameworks such as DigCompEdu, the UNESCO ICT-CFT, ISTE Standards, and the updated SQD2 model, a critical knowledge gap persists. To date, no systematic comparative analysis exists that maps these four influential models against the specific policy imperatives (MEB HE, DPD) and regulatory requirements (MQA EPS) governing Malaysian teacher education. This gap exists at the crucial intersection of established global standards and the localized implementation needs defined by Malaysia's multi-layered policy ecosystem. The absence of such a study leaves Malaysian policymakers and curriculum developers without a clear, evidence-based guide for navigating the complex landscape of international best practices.

Justification

This comparative analysis is necessary to move beyond broad policy statements toward strategic, actionable implementation. This study will provide an evidence-based guide for key Malaysian stakeholders, including policymakers at the Ministry of Education, curriculum developers at Teacher Education Institutes (Institut Pendidikan Guru Malaysia, IPGM), and academic leaders within university Faculties of Education. The primary contribution of this research will be a clear, structured analysis that enables these stakeholders to strategically select, adapt, and integrate elements from leading global frameworks. The study will provide the analytical blueprint required to build a coherent, effective, and contextually relevant digital competency model for Malaysian pre-service teachers—one that is not only aligned with international benchmarks but is also purpose-built to achieve the nation's unique educational aspirations.

Theoretical

To ground the comparative analysis in established theory and provide a clear conceptual structure, this section briefly introduces the four primary global frameworks under investigation. These models represent diverse and influential approaches to defining educator competency in the digital age. Furthermore, the findings of SQD2 model is presented as the overarching analytical lens guiding this study's approach.

The analysis will focus on the following four frameworks:

1) **The European Framework for the Digital Competence of Educators (DigCompEdu):** A highly granular and prescriptive model from the European Commission's Joint Research Centre, this framework specifies 22 educator-specific competences organized into six distinct areas. A key feature of DigCompEdu is its six-stage progression model (A1-C2) designed to map specific educator actions and development.

2) **The UNESCO ICT Competency Framework for Teachers (ICT-CFT):** In contrast, this framework functions as a high-level, adaptable policy tool designed for national-level implementation. It is intended to be adapted by UNESCO member states to support their national goals, structuring competencies across three levels of increasing pedagogical sophistication—Knowledge Acquisition, Knowledge Deepening, and Knowledge Creation—and is explicitly aligned with the United Nations' Sustainable Development Goals (SDGs).

3) **The International Society for Technology in Education (ISTE) Standards:** As a practice-oriented international standard, this framework holds direct, pre-existing influence in the Malaysian system. Malaysia's Dasar Pendidikan Digital explicitly references the ISTE Standards as a basis for its Smart School Qualification Standards (SSQS), signaling its endorsement and integration into the national educational ecosystem.

4) **The Synthesis of Qualitative Data 2 (SQD2) Model:** This is a research-driven, evolving model from Tondeur et al. (2025) that builds upon a widely regarded 2012 framework. The SQD2 model is notable for introducing new strategies for reflection that differ significantly from its predecessor, incorporating contemporary pedagogical themes such as the affective dimension of technology use, the integration of research projects into practice, and the development of teachers' digital identity.

Research Aim and Objectives

This paper seeks to explore how global best practices in digital teacher competency can inform and enhance pre-service teacher education in Malaysia. The guiding research question is:

"What are the best practices derived from international digital competency frameworks that can support the development of pre-service teachers in Malaysian Institutes of Teacher Education (IPGs)?"

To address this question, the study sets out to:

- Conduct a comparative analysis of the UNESCO ICT-CFT, DigCompEdu, and ISTE Standards for Educators.
- Organize this analysis according to the SQD2 model's macro (policy), meso (institutional), and micro (classroom) levels.
- Identify recurring strategies that constitute effective practice.
- Propose a localized implementation model aligned with Malaysian educational policies and institutional contexts.

Understanding Teacher Digital Competency

Digital competency for educators is a broad construct that extends beyond operational skills with digital tools. It reflects an integrated set of knowledge, skills, and attitudes that enable teachers to design, facilitate, and assess technology-enhanced learning. Crucially, digital competency supports the creation of inclusive, student-centered learning environments where technology serves pedagogical goals.

A foundational theory that supports this understanding is the Technological Pedagogical Content Knowledge (TPACK) framework, developed by Mishra and Koehler. TPACK emphasizes the interconnection between three key domains: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Effective teaching with technology happens at the intersection of these domains, where educators can select and apply appropriate tools in ways that align with content and learning objectives.

Further extending this view, recent research by Tondeur et al. (2025) stresses the importance of teachers' beliefs and attitudes—referred to as the affective dimension—as a significant factor in determining whether and how educators adopt digital practices. Positive perceptions about the value of technology are often a prerequisite for successful and sustained integration in the classroom.

Structuring Digital Competency Development: The SQD2 Model

To analyze how teacher education institutions can foster digital competency among pre-service teachers, this study uses the updated Synthesis of Qualitative Data (SQD2) model as a guiding framework. Originally introduced by Tondeur et al. (2012) and revised in 2025, this model offers a structured approach by organizing competency development into three interrelated levels: macro, meso, and micro.

- **Macro Level (Systemic and Policy Alignment):**

  At this level, emphasis is placed on coherence between national policies, curriculum reforms, and strategic institutional planning. A key objective is ensuring that initiatives to integrate technology are grounded in educational theory and aligned with system-wide goals.

- **Meso Level (Institutional Capacity):**

This level focuses on internal institutional factors, such as leadership commitment, infrastructure readiness, continuous professional development for teacher educators, and fostering a collaborative organizational culture. Institutional readiness plays a pivotal role in shaping the environment where pre-service teachers are trained.

- **Micro Level (Classroom and Pedagogical Practice):**

The micro level encompasses the direct experiences of pre-service teachers in their training programmes. The original SQD model outlined six strategies for building digital teaching competency: using experienced role models, encouraging reflection, engaging in authentic design tasks, promoting collaboration, providing scaffolded learning opportunities, and offering timely feedback. The SQD2 update introduces additional components, such as involving pre-service teachers in practice-based research and helping them develop a professional digital identity. These enhancements aim to better connect theory with practice and prepare teachers to navigate complex digital learning environments.

By applying this model, the study is able to systematically examine how international frameworks approach digital competency and identify practices that are most relevant for contextualization within Malaysian Institutes of Teacher Education.

METHODOLOGY

This study adopts a qualitative comparative approach to explore how digital competency frameworks can inform the preparation of pre-service teachers in Malaysia. Qualitative comparison allows for in-depth examination of the structures, aims, and competency elements across selected global frameworks. Rather than assessing effectiveness quantitatively, this design emphasizes the interpretive synthesis of document-based insights into actionable practices. The approach aligns with the meta-aggregative strategy used in prior research (e.g., Tondeur et al., 2025), where findings from multiple sources are synthesized into generalizable, practice-oriented conclusions. This method was selected not only for its capacity to identify thematic consistencies but also to enable policy translation—the process of adapting global standards into locally relevant practices for Malaysian teacher education institutions.

The analysis was conducted through a systematic mapping process, in which each framework's content was aligned with the three-tiered structure of the SQD2 model: macro (policy), meso (institutional), and micro (pedagogical). Each competency domain and descriptor was classified based on its level of implementation and relevance to either systemic alignment, institutional practice, or classroom teaching strategies. This categorization enabled cross-framework comparisons and the identification of common patterns, distinctive strengths, and potential gaps.

The process involved three main stages:

1) Document Analysis – Extracting key constructs, competencies, and implementation strategies from each framework.

2) SQD2 Alignment – Mapping these components to the respective SQD2 levels based on content focus and intended application.

3) Thematic Synthesis – Grouping similar strategies across frameworks to identify recurring best practices relevant to pre-service teacher preparation.

This methodology supports a comprehensive comparative review that not only distinguishes the unique contributions of each framework but also highlights overlapping strategies that can be adapted to the Malaysian context.

FINDINGS

A. Comparative Analysis of Global Framework

Macro-Level Analysis: Systemic and Policy Alignment

The macro-level analysis evaluates how each framework addresses systemic educational reform and supports integration with national policy. This level is crucial for ensuring that efforts to develop teacher competency are aligned with broader national goals and are sustainable over the long term.

	Abstract, Index Terms	
UNESCO ICT-CFT	**DigCompEdu**	**ISTE Standards for Educators**
The framework's highest level, **Knowledge Creation**, explicitly tasks expert teachers with contributing to policy. Competencies include the ability to **critique institutional and national education policies**, suggest revisions, and design improvements. This positions highly competent teachers as agents of systemic change.	Area 1, **Professional Engagement**, emphasizes educators' role within the broader educational community. It includes competencies for **Organizational Communication** and contributing to the development of the organization's digital policies and practices through **Continuous Professional Development**.	The **Leader** standard calls on educators to "advocate for equitable access to educational technology...and for the development of policies...that support the vision." The **Collaborator** standard encourages educators to "dedicate time to collaborate with both colleagues and students to...solve problems."

The analysis shows a consensus that advanced digital competency involves educators becoming agents of systemic change, capable of influencing institutional and national policy.

Meso-Level Analysis: Institutional Capacity and Support

The meso-level analysis examines how the frameworks guide institutional factors such as leadership, resource planning, and staff development. At the meso-level, all three frameworks converge on the need for institutional support, though they emphasize different mechanisms. The UNESCO ICT-CFT frames this through the lens of creating 'Learning Organizations,' a top-down strategic goal that tasks expert educators with devising institutional technology strategies. In contrast, DigCompEdu and the ISTE Standards highlight bottom-up, collaborative mechanisms, such as fostering professional learning communities (ISTE 'Collaborator' standard) and a culture of continuous professional development (DigCompEdu Area 1), which collectively build institutional capacity from within.

Micro-Level Analysis: Pedagogical and Classroom Strategies

The micro-level analysis is the most granular, examining the specific pedagogical strategies each framework advocates for enhancing teaching, learning, and assessment in the classroom. This level provides concrete guidance for what pre-service teachers must learn to do in their future practice.

Micro-Level Theme	UNESCO ICT-CFT	DigCompEdu	ISTE Standards for Educators
Teaching & Guidance	Focuses on using digital tools as part of whole-class, group, and individual activities. Progresses from	Area 3, Teaching and Learning, includes specific competencies for "Teaching" (orchestrating	The Designer standard requires educators to design authentic, learner-driven activities. The Facilitator

	basic digital literacy to complex problem-solving and managing student-led activities.	digital interventions) and "Guidance" (using digital services to enhance interaction and offer timely support).	standard focuses on using technology to support learning goals and manage student learning strategies.
Collaborative Learning	Advocates for using digital communication tools to support student collaboration within and beyond the classroom. The Knowledge Creation level emphasizes designing digital "knowledge communities."	Area 3.3, Collaborative Learning, explicitly tasks educators with using digital technologies to foster and enhance learner collaboration and enable collaborative knowledge creation.	The Collaborator and Facilitator standards emphasize using digital tools to broaden student perspectives, foster collaboration with others, and manage collaborative learning activities.
Assessment Strategies	Includes using ICT for student assessment, progressing from traditional methods enhanced by technology to using technology for complex, authentic assessment of student-generated products.	Area 4, Assessment, is dedicated to this theme, covering "Assessment strategies" (using digital tech for formative and summative assessment), "Analysing evidence," and "Feedback and planning."	The Analyst standard requires educators to use assessment data from digital tools to drive instruction and provide relevant feedback, and to design or adapt a variety of formative and summative assessments.
Empowering Learners (Accessibility & Personalization)	Emphasizes supporting students of different abilities, ages, genders, and backgrounds. Promotes Universal Design for Learning (UDL) and the use of assistive technologies to ensure equitable access.	Area 5, Empowering Learners, is a core component, with specific competencies for "Accessibility and inclusion" and "Differentiation and personalisation" using digital technologies.	The Designer standard requires educators to create learning experiences that are accessible and personalized to accommodate learner differences. The Citizen standard promotes managing personal data to protect digital privacy.
Facilitating Learners' Digital Competence	The framework's goal is to enable students to be "effective learners and productive members of society." At higher levels, teachers guide students in creating knowledge and using digital tools for pervasive learning.	Area 6, Facilitating Learners' Digital Competence, explicitly requires educators to teach students digital skills, covering "Information and media literacy," "Digital communication & collaboration," and "Digital content creation."	The Citizen standard requires educators to mentor students to become responsible digital citizens. The Creative Communicator standard involves empowering students to choose appropriate platforms to create and communicate effectively.

This granular comparison demonstrates a shared focus on leveraging technology to transform core pedagogical practices, from collaborative learning and assessment to empowering learners with personalized and accessible educational experiences.

The comparative analysis reveals a clear evolution in thinking across the global frameworks. At the macro level, all frameworks converge on the idea that digitally competent educators must become agents of systemic change. At the meso level, they agree on the necessity of institutional support, whether through top-down strategy (UNESCO) or bottom-up collaboration (DigCompEdu, ISTE). The micro-level analysis shows the most

significant philosophical shift: from an initial focus on integrating ICT tools (foundational levels of UNESCO ICT-CFT) to a more holistic pedagogical approach where educators are tasked with designing empowering learning environments and explicitly developing students' own digital competencies (the core of DigCompEdu and the ISTE Standards). This evolution provides a clear directional mandate for modernizing teacher education.

DISCUSSION

Synthesis of Best Practices

This analysis of three leading global frameworks, viewed through the lens of the SQD2 model, allows for the distillation of recurring, high-impact strategies. The following synthesized best practices represent a consensus on what is required to effectively prepare pre-service teachers for the digital age.

1. **Adopt a Multi-Level (Macro, Meso, Micro) Implementation Strategy:** A successful strategy must be comprehensive, addressing competency development at the macro (policy alignment), meso (institutional support), and micro (pedagogical practice) levels simultaneously. This reflects the structure of the SQD2 model and ensures that classroom innovations are supported by institutional capacity and aligned with national goals.

2. **Anchor Digital Competency in Pedagogy, Not Just Technology:** The most effective frameworks, particularly DigCompEdu and principles from Tondeur et al. (2025), emphasize that technology is a tool to enable powerful pedagogical strategies. The focus should be on enhancing collaborative learning, self-regulated learning, and differentiated instruction, not merely on technical skill acquisition.

3. **Cultivate a Culture of Professionalism and Collaboration:** A consistent theme across all three frameworks is the critical importance of continuous professional learning, digital collaboration among educators, and reflective practice. Preparing pre-service teachers involves modeling these professional behaviors and creating communities of practice.

4. **Prioritize Learner Empowerment and Accessibility:** A core objective of digital education is to create more inclusive and personalized learning experiences. This requires a focus on differentiation, personalization, and accessibility, as detailed in DigCompEdu's Area 5 and UNESCO's principles of Universal Design for Learning (UDL).

5. **Establish Learners' Digital Competence as a Core Pedagogical Goal:** Advanced frameworks explicitly charge educators with the responsibility of teaching their own students digital literacy, responsible online communication, and digital content creation skills. This moves the teacher's role from a user of technology to a facilitator of their students' digital citizenship (DigCompEdu Area 6, ISTE Citizen Standard).

Contextualizing Best Practices for Malaysian Institutes of Teacher Education (IPGs)

These global best practices provide a robust foundation, but their successful implementation depends on careful adaptation to the specific context of Malaysian IPGs.

- **Macro-Level Alignment:** The synthesized best practices are strongly aligned with the national vision articulated in the MEB 2015-2025 (Higher Education) and the Dasar Pendidikan Digital. Adopting a multi-level competency model directly supports the goals of Shift 2 (Talent Excellence) by providing a clear framework for developing high-quality educators. Similarly, prioritizing pedagogy that leverages technology for collaborative and personalized learning helps achieve the vision of Shift 9 (Globalised Online Learning), moving beyond content delivery to creating engaging and globally-connected learning experiences.

- **Meso-Level Implementation in IPGs:** For IPG leadership, these practices call for strategic planning in technology integration, infrastructure development, and, most critically, lecturer professional

development. The MEB Annual Report 2023 notes the ongoing transformation of IPGs and the need to strengthen lecturer competencies; implementing these best practices provides a clear roadmap for this transformation. Crucially, this transformation requires that IPG lecturers themselves develop and model the advanced digital competencies outlined in the global frameworks. They must become the 'role models' that the SQD2 model identifies as a core micro-level strategy for pre-service teachers, thereby creating a sustainable cycle of professional development. The IPG curriculum must be designed to integrate these digital competencies while adhering to the national Education Programme Standards (EPS) set by the Malaysian Qualifications Agency (MQA), ensuring both quality assurance and innovative practice.

- **Micro-Level Integration into Teacher Training:** At the micro-level, this requires moving beyond a sole reliance on 'stand-alone ICT courses'—a practice often critiqued for its limited impact on pedagogical integration—and instead embedding digital pedagogy across all subject-matter curricula within the IPG. Pre-service teachers should engage in design-based activities where they create technology-enhanced lesson plans (as advocated by Tondeur et al., 2025). They need opportunities for reflective practice about their professional digital identity and the ethical dimensions of technology use. Furthermore, integrating experiential learning, a core principle of MEB (HE) Shift 1, through scaffolded teaching practice with technology is essential to bridge the gap between theory and classroom reality.

This contextualized approach ensures that the adoption of global best practices is not merely a technical exercise but a strategic initiative that supports Malaysia's national aspirations and empowers the next generation of teachers.

CONCLUSION

This comparative analysis of the UNESCO ICT-CFT, DigCompEdu, and ISTE frameworks, structured by the SQD2 model, has identified a set of robust, globally-recognized best practices for developing the digital competencies of pre-service teachers. The primary findings indicate a clear consensus on the need for a holistic, multi-level approach that prioritizes pedagogy, fosters professional collaboration, empowers learners, and tasks teachers with developing their students' own digital fluency. The main contribution of this study is the provision of a contextualized roadmap for Malaysian Institutes of Teacher Education. By bridging these global best practices with Malaysia's national policy directives and institutional realities, this paper offers actionable guidance for IPGs to enhance their teacher education programs, thereby ensuring that the nation's future educators are fully prepared to lead learning in the digital age.

Limitations and Future Research

This study is based on a qualitative documentary analysis of frameworks and policy. A key limitation is that it does not measure the on-the-ground implementation or impact of these frameworks in practice. Therefore, future research should focus on empirical studies within Malaysian IPGs to assess the effectiveness and challenges of implementing the proposed best practices. Further research could also focus on the development of valid and reliable assessment tools to measure the digital competency of pre-service teachers within the specific Malaysian context, providing valuable data for continuous program improvement and policy refinement.

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