

Engineering Malaysia's Competitive Edge: Prompt Engineering as Critical Skill for Future Workforce Development

Fairul Nazmie Osman, Ihsan Mohd Yassin*, Rahimi Baharom, Mohd Azri Abdul Aziz and Mohd Nasir Taib

Abstract—As AI technologies, especially AIs (Large Language Models, LLMs)—reshape global economies, Prompt Engineering (PE) is emerging as a vital skill for effective human-Artificial Intelligence (AI) collaboration. This paper positions PE as a strategic competency for Malaysia's workforce development, mapping it to Bloom's Taxonomy and identifying core skills such as language proficiency, creativity, critical thinking, and interdisciplinary knowledge. It examines implementation pathways across Malaysia's K-12 and tertiary education systems, highlighting challenges including digital divides, educator readiness, and sociocultural norms common in Asian contexts—such as deference to authority and aversion to questioning—that hinder the development of inquiry-based skills essential for effective PE. By analyzing international benchmarks and Malaysia's unique educational and cultural landscape, the paper argues that integrating culturally contextualized PE into national curricula is essential to democratize AI literacy, bridge skill gaps, and position Malaysia competitively in the AI-driven global knowledge economy.

Index Terms— Artificial intelligence, engineering education, large language model, prompt engineering

I. INTRODUCTION

Prompt Engineering (PE) is an increasingly critical skill in the realm of Artificial Intelligence (AI), particularly with the advent of AIs (Large Language Models, LLMs). It involves designing, testing, and optimizing prompts (questions) to elicit the most relevant, accurate, and useful responses from AI systems [1]. As LLMs like GPT-4, Claude, Gemini, and others become embedded in productivity tools, coding environments, customer service platforms, and educational technologies, the ability to guide these models effectively determines the quality of outcomes users can achieve [2]. Poorly crafted prompts often lead to vague, incorrect, or misaligned outputs, while precise and context-aware prompts can unlock the full potential of these systems. This makes PE a vital bridge between human intent

and machine execution. The techniques of PE range from basic trial-and-error phrasing to advanced methodologies such as chain-of-thought prompting [3], zero-shot vs few-shot learning [4], role-based framing, instruction tuning, context stacking [5], and many others. Effective prompt engineers also understand the model's limitations and biases, adjusting inputs accordingly to mitigate hallucinations (generate information that is false, misleading, or entirely fabricated, yet present it as factual) or ensure fairness. In research and real-world applications, well-engineered prompts can significantly enhance performance in tasks such as reasoning, classification, summarization, code generation, and multilingual translation—often without modifying the underlying model itself.

Despite the rising global importance of PE as a critical skill for interacting effectively with AI systems, many learners in Malaysia—and Asia more broadly—face significant sociocultural barriers to mastering this competency. The ability to ask precise, contextually grounded questions is essential in eliciting accurate responses from LLMs, yet this skill is often underdeveloped due to educational norms that discourage questioning, favor hierarchical deference, and prioritize group harmony over individual inquiry. As current curricula lack structured frameworks to teach PE, Malaysia risks falling behind in preparing a future workforce capable of leveraging AI tools for research, education, healthcare, and industry. There is an urgent need to reconceptualize questioning as a cognitive and technical skill, and to integrate PE training into educational systems to bridge cultural gaps, improve AI literacy, and enhance national competitiveness in the knowledge economy.

In this paper, the strategic importance of PE as a critical workforce skill for Malaysia's economic competitiveness is comprehensively examined. Through mapping PE skills to Bloom's Taxonomy, analyzing international approaches to AI education, and evaluating the Malaysian educational context, the research demonstrates how PE represents more than a technical skill—it's an essential cognitive framework for effective AI interaction across sectors. This paper identifies key implementation challenges including urban-rural technological disparities, cultural adaptation requirements, and potential obsolescence risks, while proposing strategic pathways for integrating PE across educational levels. By balancing technological advancement with educational equity considerations, the research argues that Malaysia's strategic investment in PE education offers significant opportunities to enhance its position in the global knowledge economy, provided implementation approaches remain inclusive and

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*Corresponding author
Email address: ihsan_yassin@uitm.edu.my

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aligned with broader national development priorities. There is a need for educational frameworks in Malaysia to teach PE effectively, as current curricula often lack comprehensive coverage of this skill [6], [7]. Developing such frameworks will not only equip students with essential skills for the future AI-driven job market but also foster a deeper understanding of AI technologies and their applications across diverse sectors.

The remainder of this paper is organized as follows: The methodology section is shown in Section II. Next, skills needed for effective PE are first examined, including language proficiency, creativity, knowledge of AI tools, and interdisciplinary skills (Section III). Section IV explores the relationship between PE and Bloom's Taxonomy is explored, with cognitive levels being mapped to PE applications. The Malaysian education system is then analyzed in Section V, and ways in which PE can be integrated through enhanced educator efficiency, improved student AI literacy, and strengthened STEM education are discussed. Following this, Section VII to VIII reviews approaches by other countries regarding AI integration in education are reviewed, strategic points for PE introduction in Malaysia's educational framework are identified, and the necessity for assessment method reformation is addressed. Considerations for future Malaysian workforce preparation through PE are presented in Section XI, while key challenges including industry skepticism, digital divides, cultural adaptation requirements, and technological limitations are critically evaluated. Finally, concluding remarks are presented in Section X.

II. METHODOLOGY

This study employed a qualitative, analytical methodology to investigate the strategic importance of PE for Malaysia's workforce development and its integration into the national education system. The research design was anchored in a systematic literature review and a multi-dimensional analytical framework, chosen specifically to address the complex intersection of technological innovation, educational policy, and sociocultural factors that characterize this emerging field.

The methodology involved a comprehensive, interdisciplinary literature review that established both theoretical foundations and empirical evidence across three key domains. First, the technical foundation was established by defining PE as the systematic process of designing and optimizing prompts for AIs (LLMs), while detailing advanced methodologies including chain-of-thought prompting, zero-shot learning, and iterative refinement. Second, the educational framework incorporated established pedagogical theories, with particular emphasis on Outcome-Based Education (OBE) principles and contemporary approaches such as inquiry-based teaching and constructivist learning methodologies.

Third, the sociocultural dimension drew from cross-cultural educational research to analyze Asian and Malaysian cultural contexts, specifically examining how traditional norms such as deference to authority and reluctance to question established knowledge might present barriers to effective PE skill development.

A. Analytical Framework Development

The core analysis was centered on a systematic mapping approach that positioned PE within established educational taxonomies. The primary analytical framework involved the systematic alignment of PE activities and competencies with Bloom's Taxonomy's six cognitive levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. This mapping process served as the methodological foundation for conceptualizing PE not merely as a technical skill, but as a hierarchical cognitive framework that encompasses lower-order factual recall through higher-order creative and evaluative thinking. This taxonomic analysis enabled the identification of specific learning objectives, assessment strategies, and pedagogical approaches appropriate for different educational levels.

B. Contextual Analysis of Malaysian Education System

Following the framework development, a detailed contextual analysis examined the Malaysian education system's current capacity for PE integration. This analysis systematically evaluated the structural characteristics, curriculum focus, and technological infrastructure across all educational stages from kindergarten through tertiary education. The methodology included assessment of existing national educational policies, particularly those emphasizing STEM education and digital literacy initiatives, while identifying systemic challenges including urban-rural technological disparities, educator preparedness gaps, and infrastructure limitations.

C. Comparative Policy Analysis

To establish international benchmarks and identify best practices, the study also conducted a comparative analysis of AI integration policies and educational initiatives across multiple countries and regions. This comparative methodology examined approaches in the United States, European Union, United Kingdom, Japan, South Korea, and India [48, 49, 50], focusing on policy frameworks, implementation strategies, and outcomes related to AI literacy and PE integration in educational contexts. This comparative lens provided crucial insights into successful models while highlighting potential adaptation requirements for the Malaysian context.

D. Synthesis and Strategic Recommendation Development

The final methodological component involved the systematic synthesis of findings from all analytical dimensions to develop evidence-based strategic recommendations. This synthesis process integrated insights from the literature review, framework mapping, contextual analysis, and comparative study to formulate specific, actionable proposals for PE integration across Malaysian educational levels. The methodology culminated in the development of concrete implementation strategies, including curriculum integration approaches, assessment methodology reforms, and specific learning activities aligned with the established taxonomic framework.

This research was conducted through secondary analysis. Its systematic synthesis of existing knowledge to construct a

comprehensive analytical framework, though empirical validation of the proposed strategies consideration for future research. The qualitative approach was chosen given its exploratory nature as an emerging educational domain spanning technological, pedagogical, and cultural factors.

III. THE ART OF ASKING QUESTIONS + ASIAN PERSPECTIVE

The technique of asking questions, while seemingly intuitive, is a nuanced and technically demanding skill, especially in the context of PE for LLMs. Effective questioning requires more than curiosity; it demands precision, contextual awareness, and a deep understanding of how AI systems interpret and respond to input. Unlike humans, LLMs operate within probabilistic frameworks that rely heavily on linguistic cues and structured patterns. Consequently, even minor ambiguities, assumptions, or poorly framed prompts can lead to sub-optimal or irrelevant outputs.

Crafting questions that are clear, unambiguous, and goal-aligned is critical for eliciting accurate, insightful, and actionable responses from these models. As a new 21st-century skill, PE is essential for personal and professional development. It involves understanding the structure of prompts, prompt literacy, and critical reasoning, which are crucial for effective AI interaction [6]. Well-crafted prompts (questions) significantly improve the quality of AI responses, making them more relevant and contextually appropriate. This is crucial in applications like conversational AI, where precise prompts lead to more engaging and meaningful interactions [8], [9]. In industrial settings, efficient prompts can optimize production processes, equipment maintenance, and data analytics, leading to increased productivity and reduced costs [8]. Recent research suggests that PE is becoming increasingly vital in various fields, including education, healthcare, and industry. For instance, in education, it helps gifted students engage more deeply with AI, enhancing their learning and problem-solving skills [10]. In healthcare, it aids medical professionals in effectively utilizing AI tools for better patient outcomes [11].

From a traditional Asian sociocultural perspective, including Malaysia, classroom and organizational dynamics often emphasize respect for authority [12], [13], [14], group harmony [15], [16], and deference over confrontation or individual expression [14]. This cultural orientation is deeply rooted in historical and social contexts, where hierarchical structures and collectivist values are prevalent. In educational and organizational settings, these cultural norms manifest in specific ways that influence behavior and interactions. As a result, questioning—particularly in public settings or toward perceived authority figures—is frequently viewed as impolite, disruptive, or even a sign of ignorance. This form of conditioning could lead to reduced participation in discussions, fewer clarifying inquiries, and an overall hesitancy to challenge or probe deeper understanding - the exact opposite of good PE skills that we should cultivate.

Respect for authority is a fundamental aspect of many Asian cultures, where it is often seen as a moral virtue and a religious duty. This respect is typically demonstrated through language and gestures, reflecting a deep-seated cultural value that

influences decision-making and social interactions [12], [13]. In Japan and China, for example, hierarchical social structures and a harmonious orientation are prevalent, reinforcing the importance of deference to authority in both personal and professional contexts [14]. Asian cultures, including Malaysia, often prioritize group harmony and collectivism over individual expression. This cultural orientation is reflected in educational settings, where students are encouraged to conform to group norms and respect authority figures, rather than assert individual opinions and achievements [15], [17], [18]. The emphasis on group harmony is also evident in organizational settings, where collective activities and hierarchical authority structures are designed to achieve organizational goals. This approach fosters unity and minimizes conflict within the workplace [16].

Similarly, in Malaysia, traditional values and beliefs can sometimes clash with Western educational models that prioritize individual autonomy and expression [19]. In the context of modern AI education and digital transformation, such behaviors pose a critical barrier: the reluctance to ask questions translates into under-utilization of powerful tools like LLMs, which rely on iterative, inquisitive engagement to deliver optimal results. Therefore, teaching the mechanics and value of asking questions must be an explicit component of AI literacy in Malaysia and similar contexts. Students and professionals need structured training not only in technical PE techniques, but also in meta-cognitive skills—knowing when and why to ask, what type of question suits a particular goal, and how to iterate based on responses. This re-framing must dismantle the stigma around questioning and reposition it as a form of strategic thinking rather than a challenge to authority. As AI systems become interactive collaborators rather than passive tools, the ability to ask purposeful, high-quality questions becomes essential not only for performance, but also for fostering innovation, critical reasoning, and self-directed learning in local education and professional ecosystems.

IV. WHAT SKILLS ARE NEEDED FOR EFFECTIVE PROMPT ENGINEERING?

The skills needed for effective PE are diverse, encompassing language proficiency, creativity, technological understanding, and critical thinking, as shown in Table I. Language proficiency is essential for clear and precise communication with AI models, including understanding prompt components like problem context and constraints. Creativity and critical thinking help design innovative prompts that yield high-quality outputs, especially in visual design. Knowledge of AI tools enables users to craft and refine prompts effectively through iteration and reflection. Interdisciplinary skills from fields like linguistics and information science further enhance the ability to structure information and interact with AI systems efficiently.

TABLE I. SKILLS NEEDED FOR EFFECTIVE PE

Skill	Description
Language Proficiency	The ability to use language effectively to communicate with AI models is crucial. This involves selecting the right words and structuring sentences to ensure clarity and precision [6]. Understanding the fundamental components of a prompt is essential. This includes knowing how to articulate a problem, its context, and the constraints of the desired solution to an AI assistant [6].
Creativity & Critical Thinking	Creativity is vital in formulating prompts that can generate innovative and high-quality outputs. This skill is particularly emphasized in visual communication design, where creative prompts can significantly enhance the quality of AI-generated visuals [20].
Knowledge of AI tools	Understanding and familiarizing how these tools work and their capabilities can help in crafting more effective prompts and iterating them to perfection [20]. This requires an understanding of how AI models interpret prompts and the ability to adjust them based on feedback [21]. The iterative modifications require a reflective approach to assess the effectiveness of prompts and make necessary adjustments [1], [6].
Interdisciplinary Skills	PE benefits from skills in linguistics and even fields like library and information science. These disciplines provide insights into how to structure information and interact with AI models effectively [1], [22].

A. Relationship to Bloom's Taxonomy

PE maps directly to several levels of Bloom's Taxonomy, particularly the higher-order cognitive skills (Table II, Fig. 1). The taxonomy consists of six levels: knowledge, understanding, application, analysis, synthesis, and evaluation, which guide educators in designing curricula and assessments that promote higher-order thinking skills. The cognitive domain is particularly emphasized, as it supports the development of critical thinking and problem-solving abilities in learners, from novices to experts [23], [24]. Explanation of Table II is as follows:

Remembering: At the Remembering level, users interact with AI systems by recalling basic information and simple commands. This level is foundational for PE, as it involves understanding the fundamental mechanics of how AI models process and respond to prompts. For example, remembering the structure of a well-crafted prompt or the syntax of specific commands is essential for effective interaction [25], [26].

Understanding: The Understanding level involves comprehending the purpose and functionality of prompts. Users at this level can interpret the outputs generated by AI models and use them to inform their next steps. For instance, understanding how to refine a prompt based on the AI's response requires a basic comprehension of the model's capabilities and limitations [25], [27].

Applying: At the Applying level, users begin to use prompts to solve specific problems or complete tasks. This involves applying knowledge of PE to generate outputs that are relevant and useful. For example, using a prompt to summarize a lengthy document or to generate code snippets for a programming problem demonstrates the application of this skill [26], [27].

Analyzing: The Analyzing level involves breaking down complex problems into smaller components and using prompts to address each part. This requires a deeper understanding of how AI models process information and how to structure prompts to elicit specific responses. For instance, analyzing the structure of a prompt and adjusting it to improve the accuracy of the AI's response demonstrates this level of cognitive engagement [26], [27].

Evaluating: At the Evaluating level, users assess the effectiveness of prompts and the responses generated by AI models. This involves making judgments about the quality of the outputs and determining whether they meet the desired criteria. For example, evaluating the relevance and accuracy of a generated response and refining the prompt accordingly demonstrates this level of critical thinking [25], [27].

Creating: This level involves designing new prompts or modifying existing ones to achieve innovative solutions. This requires a high level of cognitive engagement, as users must think creatively about how to structure prompts to elicit specific responses. For instance, creating a prompt that generates a unique solution to a complex problem demonstrates the highest level of PE cognitive ability [26], [27].



Fig. 1. Mapping PE to Bloom's Taxonomy

TABLE II. MAPPING PROMPT ENGINEERING TO BLOOM'S TAXONOMY

Cognitive Level	Activities	PE Specific Application	Ref.
Remembering	Recall of basic information and commands.	Remembering the structure of a well-crafted prompt or the syntax of specific commands. Comprehension of the purpose and functionality of prompts. Interpreting the output generated by AI models and using them to inform the next steps.	[25], [26]
Understanding	Grasp meaning, translate, interpret, and explain concepts.	Comprehension of how language influences AI behavior and how prompts shape outputs. This supports accurate interpretation of model capabilities and	[25], [27]

		constraints.	
Applying	Crafting prompts requires applying language and domain knowledge in real-world scenarios—formulating questions, setting context, and defining constraints.	Comprehension of the purpose and functionality of prompts. Interpreting the output generated by AI models and using them to inform the next steps. Comprehension of how language influences AI behavior and how prompts shape outputs. This supports accurate interpretation of model capabilities and constraints.	[26], [27]
Analyzing	Break down information into components to explore patterns and relationships and use advanced prompting techniques to solve complex problems.	Analyzing and refining prompt structures to improve AI accuracy by identifying hallucinations, irrelevant outputs, and the impact of phrasing on responses.	[26], [27]
Evaluating	Assessing the effectiveness of prompts and responses, make judgments based on criteria or standards.	Evaluating the relevance and accuracy of a generated response and refining the prompt. Iterative refinement involves critically assessing the quality, reliability, and alignment of outputs to objectives or ethical concerns.	[25], [27]
Creating	Designing new prompts or modifying existing ones to achieve innovative solutions.	Produce original work by integrating ideas or materials, creating prompts that generate unique solutions to a complex problem. Users generate novel, complex prompts that guide AI in producing creative or task-specific content, integrating multidisciplinary knowledge.	[26], [27]

V. THE MALAYSIAN EDUCATION SYSTEM

A. Introduction

The Malaysian education system is divided into four main stages: kindergarten, primary education, secondary education, and tertiary education. Each stage is designed to build foundational skills, promote holistic development, and prepare students for future challenges:

Kindergarten Education: Kindergarten education in Malaysia is optional but increasingly popular, focusing on early childhood development. The curriculum emphasizes play-based learning, social skills, and basic literacy and numeracy. Recent reforms have incorporated digital literacy and creativity to prepare young children for a technology-driven world [28], [29].

Primary Education: Primary education lasts six years and is compulsory for all children. The curriculum is structured around core subjects such as Malay, English, Mathematics,

Science, and Islamic education. The integration of digital tools and project-based learning has been introduced to enhance engagement and critical thinking [28], [30].

Secondary Education: Secondary education is divided into lower secondary (Forms 1-3) and upper secondary (Forms 4-5). The curriculum becomes more specialized, with students choosing between science, arts, or technical streams. The Ministry of Education has introduced initiatives to incorporate STEM education and higher-order thinking skills (HOTS) to align with global standards [31], [32].

Tertiary Education: Tertiary education in Malaysia includes certificate, diploma, and degree programs offered by universities and colleges. The curriculum is designed to produce industry-ready graduates, with a focus on digital literacy, critical thinking, and adaptability. Institutions have adopted outcome-based education (OBE) frameworks to ensure alignment with global standards [29], [33].

B. The Malaysian Education Policy

Malaysian educational policies are shaped by the Malaysia Ministry of Education and Ministry of Higher Education's vision to create a holistic and inclusive education system. Key policies include:

Outcome-Based Education (OBE): OBE focuses on measurable learning outcomes, ensuring that students achieve specific skills and competencies by the end of each program. This approach has been integrated into tertiary education to align with global standards [33], [34].

STEM Education: The Malaysian government has prioritized STEM education to prepare students for the demands of the Fourth Industrial Revolution (IR 4.0) and Society 5.0. Initiatives include the integration of STEM subjects into the national curriculum and the promotion of extracurricular STEM activities [31], [32].

Lifelong Learning and Flexible Assessments: In response to the COVID-19 pandemic, Malaysia has embraced lifelong learning and flexible assessments. This includes the adoption of online and blended learning platforms, micro-credentialing, and recognition of prior learning (RPL) [28], [35].

Technology appears to be a cornerstone of the Malaysian education system through various government initiatives, transforming teaching and learning processes. Key initiatives include:

ICT Integration: The use of information and communication technology (ICT) has been widely adopted in schools and universities. Tools such as learning management systems (LMS), online portals, and digital classrooms have enhanced student engagement and access to resources [33], [35].

TPACK Framework: The Technological Pedagogical Content Knowledge (TPACK) framework has been used to enhance teachers' digital literacy and pedagogical skills. This framework emphasizes the integration of technology into teaching practices to promote critical thinking and creativity [30], [36].

Digital Literacy: Digital literacy has been incorporated into the curriculum at all levels, from kindergarten to tertiary education. This includes skills such as information evaluation,

digital content creation, and online safety [29], [30].

Additionally, Malaysia's embrace of lifelong learning, flexible assessments, and digital transformation through ICT integration, the TPACK framework, and digital literacy initiatives positions its education system in step with international practices aimed at enhancing accessibility, adaptability, and technological proficiency [28], [29], [30], [35], [36]. These efforts collectively illustrate Malaysia's strategic alignment with global educational advancements.

In summary, the Malaysian government's education policies reflect a strong alignment with global standards, as demonstrated by its adoption of OBE, which emphasizes measurable competencies and ensures that graduates meet internationally recognized benchmarks [33], [34]. The emphasis on STEM education further underscores Malaysia's commitment to preparing students for the evolving demands of IR 4.0 and Society 5.0, mirroring global trends that prioritize science, technology, engineering, and mathematics in fostering innovation and economic resilience [31], [32].

C. Pedagogical Approaches

Bloom's Taxonomy has played a significant role in shaping the Malaysian education system, particularly in the development of curriculum and assessment strategies. Bloom's Taxonomy has been used to design curricula that promote higher-order thinking skills (HOTS). For example, in English language education, the taxonomy has been used to develop reading comprehension tests that assess critical thinking and analysis [37], [38]. The integration of Bloom's Digital Taxonomy has further enhanced the application of the framework in technology-enhanced learning environments. This approach emphasizes the use of digital tools to promote critical thinking, creativity, and collaboration [30], [36].

While Bloom's Taxonomy has been widely adopted, challenges remain in its implementation. These include the need for teacher training and the development of assessment strategies that accurately measure higher-order thinking skills [39], [40]. Malaysian educators have adopted a range of pedagogical approaches to foster the above. These include:

Project-Based Learning: Project-based learning has been introduced in secondary and tertiary education to encourage hands-on learning and problem-solving. This approach has been particularly effective in STEM education [34], [31].

Inquiry-Based Teaching: Inquiry-based teaching has been promoted as a way to encourage higher-order thinking skills (HOTS). This approach involves guiding students to explore and investigate real-world problems [40], [41].

Constructivist Learning: Constructivist learning emphasizes student-centered approaches, where students actively construct knowledge through experience and interaction. This approach has been integrated into the curriculum to promote deeper understanding and critical thinking [40], [36].

D. What have other countries done?

AI literacy is identified as a crucial component of modern education, encompassing an understanding of AI technologies and their societal impacts. This literacy is essential for fostering

critical thinking and enabling students to navigate AI-driven environments effectively [56].

The integration of AI and PE into educational curricula worldwide is a multifaceted endeavor involving policy frameworks, technological infrastructure, teacher training, and student engagement strategies. Various countries and organizations have developed guidelines to incorporate AI into education, emphasizing AI literacy, ethical use, and preparing students for an AI-driven workforce. For instance, the U.S. and several international bodies like UNESCO and OECD have issued guidance documents focusing on these themes, though they often lack specific implementation directives [48].

In India, the National Education Policy 2020 aligns with AI integration by promoting personalized learning and inclusivity, despite challenges like data privacy and infrastructure limitations [49]. The EU and countries like Japan and South Korea have adopted regulatory frameworks balancing innovation with risk management, emphasizing data privacy and personalized learning [50]. Teacher training is crucial, as highlighted by the need for comprehensive AI literacy programs to ensure educators can effectively utilize AI tools [51].

The UNESCO AI Competency Framework supports this by providing a foundation for AI literacy among teachers and students [52]. In terms of student engagement, AI tools are used to manage academic workloads and enhance personalized learning experiences, though concerns about critical thinking and ethical issues persist [53]. PE, particularly with generative AI like ChatGPT, is essential for educators to interact effectively with AI, requiring proficiency in crafting high-quality prompts [25]. Countries like Nigeria and regions such as the BRICS face unique challenges, including technological barriers and cultural diversity, necessitating localized training and infrastructure development [54], [55].

The international policies of leading countries are focused towards regulating frameworks favorable towards integration, regulation and data privacy [50]:

United States: The U.S. government promotes the development of AI in education to reduce disparities and protect the rights of educators and students. This involves integrating AI technologies to support personalized learning and alleviate teachers' workloads.

European Union: The EU has adopted a strict regulatory framework to manage potential risks associated with AI, ensuring that its integration into education is safe and equitable.

United Kingdom: The UK emphasizes data privacy and the effective use of AI to reduce teachers' workloads, reflecting a balanced approach between innovation and regulation.

Japan and South Korea: Japan implements AI policies tailored to different educational levels, highlighting AI literacy among educators. South Korea actively integrates AI into educational materials to personalize learning experiences.

Other works: In studies by [57], the concept of educational promptization is proposed to develop a student-centric media literacy, emphasizing relational engagement with AI models. This approach aims to equip students with the skills to design effective prompts and critically assess AI outputs. In [25],

educators are encouraged to adopt practical strategies for PE, such as using the PARTS and CLEAR frameworks to create effective prompts and the REFINE method to evaluate and improve AI outputs. A Swiss university case study highlights the integration of AI literacy and PE into curricula, demonstrating practical approaches to embedding these skills in educational settings [56]. These diverse approaches underscore the global recognition of AI's potential in education while also addressing ethical considerations and the need for robust guidelines to protect both students and educators.

VI. PREPARING THE FUTURE MALAYSIAN WORKFORCE

The future global trends in the workforce post-AI are characterized by significant transformations in work dynamics, skill requirements, and organizational structures. AI is set to dominate the future of work, reshaping how tasks are performed and creating new opportunities for human employment, although it also poses challenges such as job displacement and the need for skills adaptation [69], [70], [71].

The integration of AI and automation, accelerated by the COVID-19 pandemic, has led to a re-imagining of work, workers, and workplaces, necessitating innovative leadership and human resource strategies to ensure long-term success and sustainability [72], [73]. As AI technologies continue to evolve, the workforce faces unprecedented challenges and opportunities, requiring proactive measures to prepare for technological shifts and skill evolution [74]. Furthermore, the future of work will be influenced by broader societal factors such as diversity, equity, and inclusion, as well as environmental and governance considerations, which organizations must address to attract and retain a skilled workforce [69]. The shift towards more flexible work arrangements and the increasing prevalence of virtual work environments also demands new approaches to employee engagement and compensation systems [69].

Overall, following global trends, the future workforce will be shaped by a complex interplay of technological advancements, demographic shifts, and evolving societal expectations, requiring a balanced approach to harness the benefits of AI while mitigating its potential negative impacts on employment and economic inequality [70], [71], [75]. As technological transformations redefine job markets, roles such as data analysts and digital transformation specialists are becoming increasingly prominent, requiring skills in data analysis, digital literacy, and strategic thinking [76]. In tandem with these international trends, the future Malaysian workforce is poised to navigate a rapidly evolving landscape shaped by Industry 4.0 and AI advancements, necessitating a blend of technical and soft skills to remain competitive.

The Malaysian government has emphasized preparing youth for these changes, highlighting the importance of mastering a combination of skills to bridge the gap between current and future demands [77]. Critical skills such as complex problem-solving, critical thinking, creativity, and emotional intelligence, once considered soft skills, are now essential for thriving in the post-Industry 4.0 era [78]. Employers in Malaysia also prioritize a wide range of employability skills, including

communication, leadership, teamwork, and adaptability, which are crucial for new graduates entering the workforce [79], [80].

Additionally, the integration of technology skills with interpersonal competencies is vital, as it enhances graduate employability in technology-driven industries [81]. Continuous learning and the development of transferable skills are essential for building resilience in the workforce, enabling individuals to adapt to new technologies and remain relevant in the job market [82].

To summarize, by fostering a comprehensive approach that includes policy interventions, educational reforms, and inclusive strategies, Malaysia can ensure workforce readiness and inclusive growth in the AI-driven global economy [83]. This holistic strategy not only prepares graduates for immediate employment but also equips them with the necessary tools to navigate future challenges and opportunities in an ever-evolving technological landscape.

VII. SUGGESTED ADOPTION STRATEGIES

A. Integrating PE into the curriculum

As learners progress through the levels, they should develop a deeper understanding of how to design and optimize prompts to achieve specific outcomes. These teaching strategies can be tailored to different cognitive levels, from basic understanding to advanced problem-solving:

Remembering and Understanding: Educators can design activities that help learners remember and understand the fundamental concepts of PE. For example, providing examples of well-crafted prompts and having learners repeat and modify them can help reinforce basic understanding [25], [27].

Applying and Analyzing: To develop higher-order thinking skills, educators can create activities that require learners to apply and analyze prompts. For instance, providing learners with a complex problem and asking them to design a prompt to solve it encourages critical thinking and problem-solving [26], [27].

Evaluating and Creating: Advanced learners can be challenged to evaluate the effectiveness of prompts and create new ones. For example, asking learners to assess the quality of responses generated by different prompts and then design a prompt that improves upon them encourages creativity and innovation [25], [27].

Several PE learning activities are recommended to stimulate various Bloom's Taxonomy levels, as shown in Table 3. Active, inquiry-driven learning is stimulated by engaging students in synthesizing information and generating meaningful prompts. AI models offer immediate feedback, enabling iterative refinement that strengthens cognitive skills and deepens understanding. Real-time experimentation with prompts creates interactive, hands-on learning environments that promote critical thinking, problem-solving, and creativity. By aligning these activities with Bloom's Taxonomy, educators can design comprehensive experiences that not only build technical proficiency but also cultivate higher-order thinking—preparing learners to fully harness the potential of AI in an evolving technological landscape.

The integration of PE aligns with the Malaysian government's focus on digital literacy and future skills [29], [42]. PE should be introduced in tertiary education as this process requires critical thinking and problem-solving skills. At this stage, students have the cognitive maturity to understand the complexities of AI and its applications. Timely education at tertiary level equips students with the skills needed to work with AI tools, which are increasingly used in professional settings. However, PE could be introduced to earlier audiences to foster a foundational understanding of AI concepts and encourage innovative thinking from a young age, such as during kindergarten, primary and secondary education (Table IV).

TABLE III. RECOMMENDED LEARNING ACTIVITIES AND BLOOM'S TAXONOMY LEVELS

Activity	Name	Bloom's Taxo. Level	Objective
Prompt Dissection	Understand & Remember	Provide sample prompts and outputs; students analyze structure, intent and influence of phrasing. Students craft prompts to solve real-world tasks (e.g. summarization, decision support, document drafting)	Build foundational understanding of how prompts guide AI responses.
Prompt Application Scenarios	Apply	Students submit prompts to AI, critique output for relevance and hallucination, then iteratively refine the prompt.	Practise applying PE in open-ended, practical contexts.
Response, Critique & Revision	Analyze, Evaluate	In groups, students generate creative prompts for tasks (e.g. story generation or idea synthesis), then assess effectiveness using rubrics or peer-review.	Strengthen analytical thinking and develop prompt iteration skills.
Prompt Tuning Challenge	Create, Evaluate	Teams compete to solve complex multi-step problems using AI. Iterative submissions with checkpoints require justification and refinement of prompt strategies	Encourage creativity, precision, and evaluative decision-making.
Prompt Hackathon	All levels		Synthesize all PE skills under time constraints, reinforcing theory, strategy, and collaboration.

TABLE IV. KEY FEATURES OF THE MALAYSIAN EDUCATION SYSTEM AND POSSIBLE INTEGRATION STRATEGIES

Education Stage	Curriculum Focus	Technological Integration
Kindergarten	Play-based learning, social skills, basic literacy and digital literacy. Core subjects (Malay, English, Mathematics, Science), and project-based learning.	Introduction to generative AI tools for creative play, creating multimedia specialized towards early learning.
Primary Education		Use of AI tools for interactive learning and online resources. Generative AI tools for creative learning, creating multimedia. PE fundamentals.

Secondary Education	Specialization in science, arts or technical streams; focus on HOTS and STEM education.	Adoption of LMS, AI tools, and digital classrooms for enhanced learning experiences and collaborative learning.
Tertiary Education	Outcome-based education, digital literacy, and industry-relevant skills.	Adoption of LMS, AI tools, and digital classrooms for enhanced learning experiences.

The role of PE in education is multifaceted, as it not only aids in tailoring AI responses to better meet the specific needs of learners but also empowers teachers to create more engaging and personalized educational experiences:

Enhancing Educator Efficiency: PE can help educators in Malaysia create more effective interactions with AI tools, such as ChatGPT, by crafting precise and contextually relevant prompts. This can lead to more efficient lesson planning and resource generation, allowing educators to focus on personalized student engagement [25]. PE should be incorporated into teacher training programs to equip educators with the skills necessary to effectively use AI tools in the classroom. This includes understanding prompt structures and strategies, which help in crafting effective prompts for educational purposes [25].

Improving Student AI Literacy: By integrating PE into the curriculum, students can develop a better understanding of AI technologies and improve their ability to use these tools effectively. This was demonstrated in a study where students who received PE training showed increased AI self-efficacy and knowledge [7].

Supporting STEM Education: As Malaysia focuses on building a robust STEM education system, PE can be used to create interactive and engaging learning experiences. This aligns with the national strategy to enhance STEM education and prepare a skilled workforce for future industries [32], [43]. The current level of digital competency for Malaysia teachers is primed for this transformation, as shown in Fig. 2 [133].

Outcome-Based Education (OBE): The shift towards OBE in Malaysian engineering education emphasizes the need for innovative teaching methods. PE can support this by enabling educators to design AI-driven learning activities that align with OBE principles, thus enhancing student learning outcomes [44].

Bridging Educational Gaps: The integration of PE can help bridge the gap between current educational practices and the skills required for the 4IR. By facilitating the use of AI in problem-solving and critical thinking exercises, PE can contribute to developing future-ready engineering graduates [45]. Fig. 2 show the digital competency of teachers in 2021, with 297,018 teachers participating [133].

While PE offers numerous benefits, its implementation in the Malaysian education system must be carefully managed. Educators need adequate training to effectively utilize PE techniques, and there must be a focus on developing ethical guidelines for AI use in education. Additionally, the integration of PE should complement existing educational frameworks and

policies, such as the Malaysian Educational Blueprint and the TRIZ initiative, to ensure a cohesive approach to educational transformation [46], [47].

Introducing PE into the Malaysian education system should be strategically integrated across various educational levels to maximize its potential benefits. Given the increasing importance of AI in education, PE should be introduced as a fundamental skill in both K-12 (kindergarten to secondary), as well as higher education settings.

Educator Digital Competency

A 2021 study shows that while educators are gaining skills, a majority are still at a basic level, highlighting a critical need for upskilling.

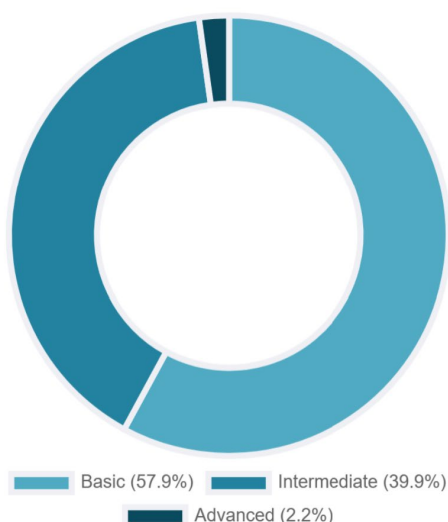


Fig. 2. The digital competency of teachers in 2021, with 297,018 teachers participating in the study [133].

In K-12 education, PE can be utilized to enhance STEM learning by using AI tools to simplify complex topics and create interactive learning experiences, thus making subjects more engaging and accessible for students [58]. For higher education, particularly in fields like medicine, PE can be used to deepen students' understanding and critical thinking by crafting precise prompts that encourage detailed exploration of topics [59].

Additionally, integrating PE into the curriculum can foster critical online reasoning and prompt literacy, essential skills for navigating the digital age [6]. The use of collaborative tools like PromptHive can further enhance the educational content creation process by involving subject matter experts, thereby ensuring that AI-generated content is accurate and tailored to specific educational needs [60]. By embedding PE into the educational framework, Malaysia can prepare students and educators to engage effectively with AI technologies, fostering a future-ready learning environment that promotes critical thinking, creativity, and problem-solving skills [57], [27].

B. We need to rethink our assessment methods

The rise of AIs (LLMs) like ChatGPT has disrupted traditional student assessment methods by making it increasingly difficult to determine whether submitted work reflects genuine student understanding or AI-generated output. As these tools become ubiquitous, our reliance on essays, take-home assignments, and rote-based evaluations is being challenged—forcing educators to confront a deeper question: are we assessing memory and output, or actual cognitive processes and learning skills? With LLMs capable of producing fluent, high-scoring responses, existing methods risk rewarding tool usage over critical thinking. This shift necessitates a reimagining of assessments that emphasize higher-order skills such as prompt crafting, evaluation of AI-generated content, reasoning, and ethical tool use. If education is to remain relevant in an AI-augmented world, assessments must evolve from measuring what students produce to how they think, ask, and adapt. To effectively structure assessments that enhance student understanding while allowing the use of AI and PE skills, educators must integrate these technologies into the learning process in a way that promotes critical thinking and problem-solving. Reviewed papers suggest that the integration of AI and PE into educational assessments is undergoing a shift towards a more dynamic and interactive learning environment [61].

By incorporating PE into assessments, educators can encourage students to develop skills in articulating problems and critically evaluating AI-generated outputs, thus fostering a deeper understanding of the subject matter [57], [62]. For instance, using AI-driven tools in STEM education can transform traditional learning by providing interactive and personalized learning experiences, where students engage with AI to explore complex topics and receive immediate feedback [58], [63]. This approach not only aids in understanding but also reduces the likelihood of academic dishonesty by focusing on the process of learning rather than rote memorization [58]. Furthermore, assessments can be designed to include tasks that require students to use PE techniques, such as prompt chaining and flipped interaction patterns, to solve problems and generate new questions, thereby enhancing their engagement and learning outcomes [10], [64]. This is beneficial for students who are developing skills in areas like programming and data analysis, as structured prompts can motivate and empower them to learn independently, as evidenced by significant improvements in task completion and test scores among engineering students [65].

Additionally, PE can enhance AI self-efficacy and knowledge, as demonstrated in a study where students showed improved understanding and skills after a PE workshop [7]. The integration of generative AI tools, such as EnSmart and TeacherGAIA, further supports self-directed learning by automating content generation and providing real-time feedback, which helps students manage their learning processes more effectively [66], [67]. Moreover, PE can tailor learning experiences to individual needs, promoting critical thinking and engagement through various strategies like role-playing and Socratic prompts [27]. In the context of K-12 education, PE can

simplify complex topics and create interactive learning experiences, making subjects like STEM more accessible and interesting to students [58]. Overall, PE enhances the educational experience by making AI more relevant and personalized, while supporting the development of essential skills for navigating and leveraging AI technologies effectively [8], [68]. By aligning PE with educational standards and learning objectives, educators can create assessments that not only test knowledge but also develop essential skills for navigating the "knowledge multiverse" of the future [64], [62].

VIII. CHALLENGES & CONSIDERATIONS

Overall, the integration of AI in education should be a Malaysian initiative requiring coordinated efforts in policy-making, infrastructure enhancement, and professional development to harness AI's potential while addressing ethical and practical challenges [84], [85]. Several factors that should be considered are shown here.

A. Industry Needs & Skepticism

Malaysian employers have consistently emphasized the importance of soft skills, such as communication, problem-solving, and teamwork, alongside technical expertise. For instance, a study highlighted that employers prioritize communication skills and problem-solving abilities as critical for engineering graduates, suggesting a balanced demand for both technical and soft skills [86], [81], [87]. However, there is a persistent gap between the skills employers expect and those that graduates possess, particularly in areas like English communication and critical thinking, which are crucial for effective PE [88], [89]. This gap suggests that while there is a demand for PE skills, the current educational framework may not fully equip graduates with these competencies, potentially leading to a skills bubble if not addressed. Some employers have expressed dissatisfaction with the current skill levels of graduates, indicating a need for educational institutions to update curricula to better align with industry requirements [90].

The emphasis on employability skills across various studies suggests that while PE skills are valued, they must be integrated with traditional technical qualifications to ensure graduates are well-rounded and capable of meeting the dynamic demands of the workforce [91], [92]. Therefore, while there is a clear demand for PE skills, the potential for a skills bubble exists if educational reforms do not keep pace with industry needs, underscoring the importance of a holistic approach to engineering education in Malaysia [93], [94].

B. Digital Divide & Equitable Technology Access

Introducing PE into the Malaysian education system can be strategically designed to avoid privileging already-advantaged urban and higher-income students by focusing on equitable access and inclusive educational practices.

The concept of *educational promptization* emphasizes a student-centric approach to AI literacy, which can be adapted to ensure that all students, regardless of their socioeconomic background, can engage effectively with AI technologies [57]. By integrating AI literacy and PE into the curriculum, educators

can provide students with the PE skills needed, fostering critical thinking and problem-solving abilities [56]. This approach can be particularly beneficial for students from disadvantaged backgrounds, as it can help bridge the digital divide by providing them with the necessary tools and knowledge to utilize AI effectively [95]. Moreover, prompt literacy, which involves crafting effective prompts in natural language, can democratize access to AI technologies, allowing students without programming expertise to benefit from AI's capabilities [96]. AI tools can be used to improve language skills, thus leveling the playing field for students from non-English-speaking backgrounds [97].

Additionally, AI-enhanced tools can be leveraged to overcome socioeconomic barriers by promoting equitable access and fostering inclusiveness in education [98]. Pilot studies have shown that educational interventions focusing on AI literacy can reduce negative sentiments towards AI and improve students' understanding of AI's limitations, which is crucial for fostering a balanced and critical engagement with AI [99], [100]. By ensuring that AI literacy programs are accessible to all students and providing adequate teacher training, the Malaysian education system can harness the potential of AI to promote equity and inclusion, ultimately contributing to a more just educational landscape [95], [101].

C. Cultural & Diversity Considerations

To adapt PE to respect Malaysia's multicultural and multilingual context, it is essential to integrate cultural insights into the design of AI interactions, moving away from Western-centric approaches. For example, research by [102] attempted to resolve this by employing strategies such as Multicultural Prompt Learning (MPL), which uses Chain of Thought (CoT) to gradually incorporate cultural nuances into AI prompts, thereby enhancing the AI's ability to understand and respect diverse cultural contexts. Additionally, PE should leverage educational promptization, which emphasizes relational and symmetrical engagement with AI models, allowing users to critically assess AI outputs and tailor interactions to reflect local cultural values [57].

The development of culturally responsive AI systems is further supported by the creation of a National AI Ethical Framework (NAIEF) that aligns with Malaysia's national values, as outlined in the Rukun Negara and Federal Constitution, ensuring that AI systems are both globally aligned and locally relevant [103]. Moreover, the integration of Malay socio-emotional aspects into AI systems, as seen in the Malay Artificial Wisdom System (AWS), can enhance the cultural sensitivity of AI interactions by modeling conversational strategies and emotional recognition based on Malay culture [104]. This approach is complemented by the use of clustering and semantic similarity techniques in prompt example construction, which can improve the quality and cultural relevance of AI outputs across different tasks [105].

Additionally, the fast-paced development of AI technologies means that skills in PE need constant updating. This poses a challenge for educational institutions to keep curricula relevant and up to date [107]. By embedding these culturally responsive

practices into AI development, Malaysia can ensure that AI systems are not only technologically advanced but also culturally attuned, promoting inclusivity and respect for its diverse cultural landscape [108].

D. Socioeconomic Considerations

Malaysian schools and universities are making significant strides in integrating technology to enhance educational practices. The Malaysian government's strategic initiatives, such as the Smart School project, aim to transition the educational system towards a more technologically literate workforce, emphasizing the integration of ICT to foster active and independent learning [109]. However, the digital divide in Malaysia is a persistent issue, with rural areas facing significant challenges in accessing Information and Communication Technology (ICT) facilities, which are crucial for digital education and skills development [110], [111]. The Malaysian government has been proactive in promoting digital skills through various initiatives, yet the pace of these efforts remains slow, necessitating more robust policies to bridge the divide [112].

To address the technological infrastructure disparities between urban and rural areas in Malaysia, a multifaceted approach is necessary. In higher education, institutions are incorporating ICT tools to support problem-solving and project-based learning, although issues like low internet speed hinder full integration [113]. The adoption of AI and ICT in Technical and Vocational Education and Training (TVET) is also advancing, with efforts to utilize AI-assisted learning tools to improve teaching and learning outcomes, despite challenges such as digital inequality and the need for skill enhancement [114]. Moreover, the introduction of digital portfolios in TVET education highlights the potential for personalized learning and improved employability, indicating a shift towards more individualized educational approaches [115].

The use of Virtual Learning Environments (VLEs) in schools, supported by the Ministry of Education, further exemplifies the commitment to embracing technological advancements, although these initiatives face challenges related to teacher training and technology adoption [116]. Additionally, the integration of AI in educational settings, as seen in Sabah, underscores the transformative potential of AI tools, while also highlighting the need for professional development and infrastructure support to address skill gaps among educators [117].

One effective strategy is the enhancement of digital infrastructure, as seen in the government's intensified efforts to provide broadband and faster internet, which is crucial for both students and educators in rural areas [118]. Additionally, community-based telecenters like "Kedaikom" have shown promise in engaging rural populations with ICT, thereby facilitating the diffusion of technology and narrowing the digital gap [119].

To prevent the widening of existing digital divides, it is essential to invest in digital literacy programs tailored to the needs of diverse student populations, including those with special needs [120], [121]. This includes enhancing teacher

training and professional development to equip educators with the necessary skills to support inclusive digital literacy [120]. Furthermore, public-private partnerships can play a significant role in fostering technological innovation and ensuring equitable access to digital resources [122]. By implementing these strategies, Malaysia can create a more inclusive educational environment that supports the initiative across socioeconomic and geographic boundaries, ultimately contributing to a more equitable, balanced and sustainable society [123].

IX. STRATEGIC IMPLEMENTATION FRAMEWORK & RELEVANCE TO MALAYSIAN GOVERNMENT POLICIES

This proposed framework suggests a strategic roadmap for integrating Prompt Engineering (PE) skills across all stages of the Malaysian education system. It is aligned and modeled after the six core thrusts of the Digital Education Policy (DEP) as shown in Fig.3 and is designed to cultivate a generation of digitally fluent, critical, and creative thinkers. Malaysia's existing DEP [133] offers an excellent and comprehensive foundation for this endeavor. Its six core thrusts—addressing students, educators, leadership, infrastructure, content, and partnerships—are precisely the pillars required for any successful technological integration.

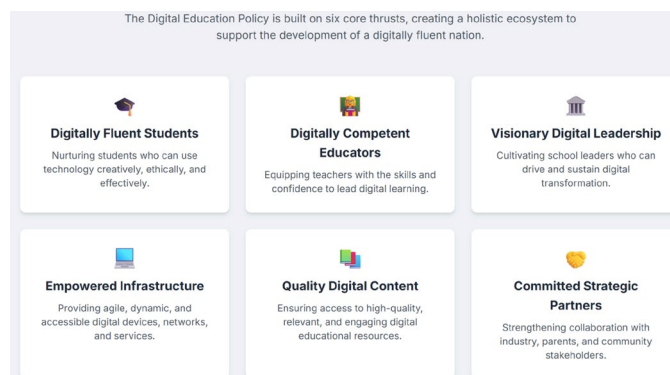


Fig. 3. The six core thrusts of the Malaysian Digital Education Policy [133].

A. Alignment with Malaysia's National Policies

The framework aligns directly with key national policies. The Malaysia Digital Economy Blueprint (MyDIGITAL), for instance, identifies the creation of a 'digitally-savvy and competent society' as a core objective [131]. PE is the practical skillset required to turn this vision into a reality, transforming citizens from passive technology consumers into active co-creators with AI. Specifically, fostering PE skills addresses Thrust Five of the blueprint, which aims to produce a future-ready digital workforce.

Furthermore, the National AI Roadmap (2021-2025) [132] calls for the cultivation of an 'AI-literate populace' and the development of specialized AI talent. Integrating PE into the curriculum is the most direct pathway to achieving these goals, providing a scalable method to enhance AI adoption and innovation across all sectors targeted by the roadmap. Moreover, recent 2023 reforms from the Ministry of Education,

such as the Dasar Pendidikan Digital (Digital Education Policy) (Fig.4) [133], emphasize the development of students who are not only digitally literate but also critical and creative thinkers. PE serves as a pedagogical bridge, providing a tangible method to develop these higher-order thinking skills using the very technologies the policy promotes.



Fig. 4. Malaysia's digital ambition based on the Digital Education Policy (2023) and National AI roadmap (2021).

B. Proposed Strategic Implementation Framework

Rather than reinventing the structure in IX-A, this framework is designed to latch onto it, building upon this strong foundation by providing specific, actionable strategies to embed PE skills within each of those existing thrusts. In essence, this document translates the "what" of the national policy into the "how" for this skill. This framework provides a strategic roadmap for integrating PE skills across all stages of the Malaysian education system. It is aligned with the six core thrusts of the Digital Education Policy (DEP) and is designed to cultivate a generation of digitally fluent, critical, and creative thinkers. The action framework is shown in Fig. 5 and described below.

1) Kindergarten (5-6 years old)

The foundational goal at the kindergarten level is to nurture curiosity and dismantle the cultural aversion to questioning. The action plan centers on integrating inquiry-based dialogue into daily routines. By using simple, voice-activated AI tools in a play-based context, such as a "Tanya Cikgu AI" (Ask Teacher AI) activity during story time, educators can normalize the act of asking "why" and "what if." This approach aligns directly with the communication and early science components of the Kurikulum Standard Prasekolah Kebangsaan (KSPK), making the development of inquisitiveness—the first step in PE—an intrinsic part of early learning.

2) Primary Education (7-12 years old)

In primary education, the focus shifts to building foundational AI literacy and the concept of structured prompts. The primary action plan is to implement project-based learning modules where students use basic AI tools for creative production, such as generating images or gathering information.

Within the existing Design and Technology (RBT) and ICT curriculum, activities like the "Digital Folk Tales" project would require students to craft an initial prompt and then iteratively refine it for a better outcome. This teaches the core PE skill of iterative refinement and demonstrates how the quality of input directly affects the quality of output, all within a familiar project-based framework.

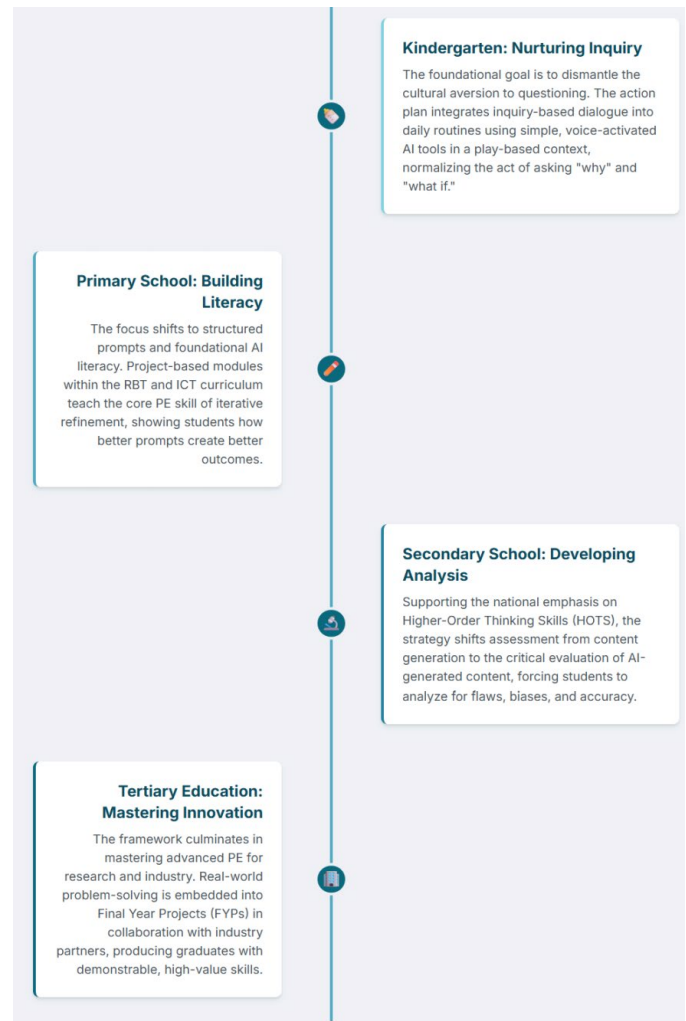


Fig. 5. Proposed implementation framework.

3) Secondary Education (13-17 years old)

At the secondary level, the framework aims to develop analytical and evaluative PE skills, directly supporting the national emphasis on Higher-Order Thinking Skills (HOTS). The strategic action plan is to shift assessment methods from content generation to the critical evaluation of AI-generated content. For instance, in a History or Science class, students would be tasked not with writing an essay, but with critiquing an AI-generated argument or experimental design for its flaws, biases, and accuracy. This method, applicable across all core subjects, ensures that students are not using AI to avoid thinking, but are instead using it as a tool to sharpen their analytical and ethical reasoning abilities.

4) Tertiary Education (18 - 22 years old, lifelong learning)

The framework culminates at the tertiary level with the objective of mastering advanced, specialized PE for research and industry innovation. The core action plan is to embed real-world problem-solving using advanced PE workflows as a mandatory component of capstone projects and research, in direct collaboration with industry partners. This aligns with Outcome-Based Education (OBE) principles and Final Year Project (FYP) requirements. Suggested activities include

having engineering students use PE to analyze operational data for a real factory or having research students design complex prompts to conduct automated literature reviews, producing graduates with demonstrable, high-value skills that are immediately applicable in the workforce.

X. CONCLUSION

PE represents a critical nexus between human cognition and AI, enabling individuals to harness the full potential of LLMs through precise, goal-oriented interaction. This paper has demonstrated that PE is not merely a technical skill, but a cognitive framework that fosters critical thinking, creativity, and cross-disciplinary fluency. By mapping PE to Bloom's Taxonomy, evaluating its pedagogical applications, and analyzing global and regional implementation models, we make the case that Malaysia stands at a decisive inflection point. Embedding PE into the national education system—from early schooling to tertiary levels—not only prepares the workforce for Industry 4.0 and Society 5.0 but also aligns with global educational trajectories that emphasize AI literacy as foundational.

However, for Malaysia to fully capitalize on this opportunity, systemic barriers must be addressed head-on. These include digital divides between urban and rural schools, the sociocultural stigma around questioning in classroom settings, and the need for educator retraining at scale. Without confronting these challenges, PE risks becoming an elite skill—accessible only to those with privilege and exposure—thus perpetuating existing inequalities. Moreover, PE must evolve in tandem with AI itself; static curricula risk obsolescence in the face of rapidly advancing multi-modal, self-improving AI systems. As such, a dynamic, feedback-driven implementation model—anchored in outcome-based education and supported by robust infrastructure, policy, and cultural reform—is imperative. Ultimately, Malaysia's competitive edge in the global AI economy will not be determined by passive technology adoption, but by its ability to cultivate a generation capable of co-creating with AI.

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