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Developing K-12 AI Literacy in Different Countries: Approaches and Challenges

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Abstract: As artificial intelligence (AI) becomes increasingly pervasive across sectors, AI literacy has emerged as foundational for K-12 learners worldwide. How are education systems around the world addressing this challenge? This panel brings together representatives from India, Philippines, Singapore, Thailand, and the US to examine their strategies for advancing AI literacy through curriculum design, pedagogical innovation, professional development, and policy frameworks. The panelists will discuss their national approaches against the backdrop of initiatives such as India's AI Samarth program reaching over five million participants, Hong Kong's integration of AI modules into computational thinking curricula, Singapore's coordinated AI for Everyone strategy, Thailand's national AI curriculum development, Philippines' pilot efforts with the Education Center for AI Research (E-CAIR), and the US's 2025 executive order establishing AI education as a federal priority. Despite varied implementation pathways, shared challenges persist: preparing learners equitably, defining learning goals and developmentally appropriate AI concepts, addressing teacher readiness, aligning curricula with evolving frameworks, and ensuring that ethical dimensions receive adequate attention alongside technical competencies. Panelists will explore design principles, opportunities, and challenges in building inclusive, human-centered AI literacy that prepares students to thrive in an algorithmically mediated world.

Keywords: AI Literacy, global perspective, AI education, AI in education

1. Introduction

The development of "AI Literacy" has gained significant global momentum as artificial intelligence (AI) becomes an increasingly pervasive force across sectors shaping many aspects of civic life. It is now emerging as foundational for learners across disciplines and contexts. In the context of K–12 education, AI literacy refers not only to students' conceptual understanding of AI, but also to their ability to critically evaluate its applications, engage ethically with its use, and participate meaningfully in a world shaped by algorithmic systems.

Recognizing this growing imperative, the OECD, in collaboration with the European Commission and Code.org, recently released a draft AI Literacy Framework (OECD, 2025) for primary and secondary education. The effort follows similar, earlier efforts by global organizations such as UNESCO that released AI competency frameworks for students (cite) and teachers (cite). The OECD framework outlines the essential knowledge, skills, and attitudes students need to navigate AI-rich environments. It is organized into four core strands along with ethics being a cross-cutting competency: *Engaging with AI* which involves recognizing AI and using AI as a tool to access new content or recommendations. (2) *Creating*

with AI which involves guiding and refining AI output through prompts and feedback. (3) *Managing AI* which entails intentionally choosing how AI can support and enhance human work. (4) *Designing AI* empowers learners to understand how AI works and connect it to its social and ethical impacts by shaping how AI systems function. The framework is intended to guide national efforts, and will inform the upcoming PISA 2029 Media and AI Literacy test.

Within this emerging international consensus, countries and regions have begun taking concrete steps to integrate AI literacy into K–12 education systems. In India, the AI Samarth initiative represents the country's first large-scale AI literacy program for school-aged learners, providing a multilingual, open-source curriculum reaching over five million students, parents, and educators. In Hong Kong, AI modules have been integrated into existing computational thinking efforts such as CoolThink@JC (https://coolthink.hk/en), with support from the Education University of Hong Kong in designing tools and professional learning experiences for teachers. In the Philippines, the Department of Education's Center for AI Research (E-CAIR) aims to revitalize education by developing AI-driven tools that enhance teaching, learning, and school administration. Singapore continues its coordinated efforts under the AI for Everyone and AI for Students programs, embedding AI literacy in its broader Smart Nation (https://www.smartnation.gov.sg/) and digital readiness strategy. Thailand's main national-level effort is to develop and implement an AI curriculum from primary to secondary school, train thousands of teachers nationwide, and integrate AI literacy across subjects. In the United States, there have been concerted efforts at the federal as well as the state level since 2023. A 2025 executive order formally established AI education as a national priority, catalyzing federal investment in teacher training, ethical guardrails, and equitable access to AI tools in schools.

While the pathways differ across national and regional contexts, shared challenges remain. These include defining developmentally appropriate AI concepts, addressing teacher readiness, aligning curricula with evolving frameworks, and ensuring that ethical and societal dimensions of AI are addressed alongside technical ones. As with earlier waves of K-12 computing education and Computational Thinking efforts, the implementation of AI literacy calls for research-informed guidance, sustained investment, and collaboration among educators, policymakers, and researchers.

In this panel, representatives from six countries will share a glimpse of approaches in each of their geographies to advancing AI literacy through curriculum design, pedagogical strategies, professional development, and policy innovation. The following section shares brief abstracts of their presentations. Their experiences, albeit not exhaustive in terms of efforts in their respective countries, reflect both the local specificity and global urgency of equipping learners with the knowledge and dispositions needed to thrive in a world increasingly shaped by AI. The goal is to contribute to a deeper understanding of the design principles, opportunities, and challenges involved in building inclusive, human-centered AI literacy in schools.

2. Abstracts of Individual Panelists' Presentation

2.1 AI Literacy in India (Balaraman RAVINDRAN)

The Wadhwani School of Data Science and AI at IIT Madras, in collaboration with the Central Square Foundation, has developed AI Samarth—an open AI literacy curriculum framework for students, parents, and educators in government and affordable private schools. Grounded in a comprehensive curriculum landscaping study, the framework focuses on: (1) foundational AI concepts and limitations, (2) human agency and critical thinking, (3) real-world applications, (4) ethical and responsible use, and (5) meaningful, critical engagement with AI tools. The curriculum also incorporates sector-specific AI examples relevant to Indian contexts and bilingual resources to improve accessibility. Teacher capacity-building modules and ready-to-use classroom activities support effective implementation.

Key learning outcomes include understanding AI systems, recognising ethical issues, exercising judgment to avoid over-reliance, and applying AI to address real-world challenges while upholding human-centred values. Developed with input from educators, academics, and practitioners, and reviewed by K–12 teachers, AI Samarth is practical, relevant, and designed for scalable adoption across diverse school settings.

2.2 AI Literacy in Hong Kong (Siu-Cheung KONG)

Traditional education emphasizes guiding students to actively inquire, develop concepts, and construct their own knowledge. However, the operation of generative AI chatbots, based on large language models, differ significantly from this. These tools do not merely provide information; instead, they directly generate complete answers to specific questions. These “answer-oriented” responses, while convenient and efficient, also harbours the risk of weakening students’ abilities for independent thought and inquiry (Kong & Yang, 2024). One of the core objectives of education is to cultivate students’ ability to ask profound questions and to deepen their understanding through further questioning (Kong & Yang, 2025). If students become accustomed to easily obtaining ready-made answers from generative AI, their motivation and opportunities for deep thinking, critical evaluation of information, and even active questioning may diminish. Recent trends in the development of generative AI, such as features that automatically break down and refine a user’s question into multiple sub-questions, may seem helpful but take over the thinking and questioning processes that students ought to complete themselves. This developmental trend appears to run counter to the fundamental educational goal of inspiring thought and fostering a spirit of independent inquiry.

For learners aged 6 to 18, whose cognitive and thinking abilities are still developing, a great deal of practice is required. If AI tools designed for adults are applied indiscriminately to primary and secondary school students, it may hinder the development of students’ thinking skills. The education sector must be highly vigilant to prevent depriving students of the opportunity to experience necessary intellectual struggles and thereby build deep understanding and capabilities. Therefore, the application of generative AI in primary and secondary education settings must ensure that the locus of control for thinking and inquiry remains with the students (Kong et al., 2024) The role of generative AI tools should be to assist, not to replace. Opportunities should be provided for students to ask questions and find answers based on their own learning contexts and needs. In this process, if generative AI can provide options or initial responses, students must still bear the responsibility of integrating, evaluating, and deepening their understanding, transforming it into a part of their own knowledge system.

To address the teaching and learning challenges and responsibly integrate generative AI into basic education, a framework comprising three core dimensions is proposed: 1. Understanding the technology: popularising foundational knowledge of AI. 2. Using the technology: making good use of generative AI in teaching and learning. 3. Unleashing the potential of students: enhancing independent learning and thinking abilities (Kong, 2025). We need to cultivate students who not only know how to use generative AI, but who can also understand it, critique it, and ultimately, with its help, become more passionate and independent lifelong learners and unleash their potential. This requires teachers to possess the corresponding competencies and teaching strategies to guide students in the age of AI, enabling them to master technology while maintaining and developing unique human wisdom and judgement. This is a formidable but extremely important task, crucial for the core competitiveness of the next generation and the future development of society.

2.3 AI Literacy in the Philippines (Dr. Maria Mercedes T. RODRIGO)

In international standardized tests such as the PISA and the TIMSS, Filipino learners are among the poorest performers. In the 2018 PISA, Filipino students scored an average of 340 points in reading literacy, 353 points in math, and 357 points in science. In contrast, OECD countries averaged 487, 489, and 489 in the same areas respectively. As part of a

multipronged educational intervention effort, both the public and private sector are turning to AI to improve learning outcomes.

AI applications in education have three general orientations: student-facing, teacher-facing, and system-facing. Student-facing applications support learning by providing personalized learning paths and feedback. Teacher-facing applications provide assistance with lesson planning, classroom management, and student assessment. System-facing applications assist with data management and support data-driven decision making. We present examples of ways in which the Philippine educational system is attempting to integrate these three AI application orientations to support K12 education.

One application that is both student- and teacher-facing is Khan Academy. In 2023, Geraldine Acuna-Sunshine established Khan Academy Philippines (KAP), a non-profit organization with the goal of empowering Filipino learners with foundational and lifelong learning skills using Khan Academy as a platform. Khanmigo, Khan Academy's AI assistant, is the key technology powering the intervention. Khanmigo provides students with localized content and personalized tutoring in a number of local languages. Khanmigo also supports teachers by automating lesson planning, student progress tracking, and plagiarism detection. In partnership with the Philippines Department of Education (DepEd), KAP began with an initial cohort of 34 schools and 3000 learners in 2023 and has since extended its reach to over 1500 schools and 1.4 million learners in 2025.

Other examples of AI-based, student- and teacher-facing applications are the Reading Progress and Reading Coach systems of Microsoft. These applications enable teachers to assign reading assignments by uploading new material or selecting from a catalog. They allow customization of assignments based on learner needs. They also automate measurement of reading accuracy, speed. DepEd launched the use of Reading Progress and Reading Coach in schools in June 2025.

An initiative that addresses all three types of applications is DepEd's Education Center for AI Research (E-CAIR). E-CAIR's mission is to "[revitalize] basic education by developing AI-driven tools that enhance teaching, learning, and school administration." (DepEd, 2025). Among its programs are the systematic use of DepEd data to identify schools with infrastructure needs, the use of computer vision to screen undernourished children, enhanced detection of learners with disabilities, determination of training needs for faculty and administrators, and optimization of strategic public-private partnerships.

2.4 AI Literacy in Singapore (Lung-Hsiang WONG)

Singapore's approach to AI literacy in K–12 education reflects a hub-and-spoke ecosystem, where government, universities, industry, and schools contribute through differentiated yet interconnected initiatives. While there is no standalone national AI literacy curriculum, multiple entry points have emerged to embed AI-related competencies within existing educational structures. At the national level, AI Singapore—a government-funded national programme—offers a "LearnAI Student Outreach Programme", aimed at secondary and tertiary students. The programme introduces foundational concepts such as how AI works, its applications and limitations, and real-world ethical dilemmas. Sessions are delivered by trained AI Singapore ambassadors and adapted to school-specific contexts. For the general public, the "AI for Everyone" (AI4E) programme includes a free online AI Ethics & Governance for Youths course, targeting learners aged 16–19, and covering topics like algorithmic bias, privacy, and human-AI responsibility.

AI literacy has also been embedded into existing STEM and computational thinking efforts through programmes such as the Applied Learning Programmes (ALPs). Originally launched to deepen interdisciplinary thinking through STEM projects, many schools now incorporate AI-themed design challenges, robotics with vision or voice AI, and basic machine learning toolkits. These ALPs function as contextualized entry points for cultivating AI awareness and responsible use, without requiring formal curriculum overhauls.

In a recent development, the Ministry of Education announced that from 2026, *Computing* will become an elective subject for Secondary 3 (9th grade) students, replacing the former *Computer Applications* subject. This curriculum shift aims to raise students'

awareness of emerging technologies including AI, with differentiated depth across learning tracks. For instance, students will be introduced to cloud computing and AI as part of their digital and computational literacy education.

Beyond student-facing programmes, teacher capacity-building plays an important indirect role in supporting AI literacy. Some schools have initiated bespoke AI workshops for teachers, often inviting experts from universities such as National Institute of Education, Nanyang Technological University (NIE, NTU) to introduce current AI trends, tools, and pedagogical implications. These one-off sessions raise awareness of how AI can be responsibly introduced into school learning environments. At a more structured level, the "Leadership in Artificial Intelligence for Education" module within NIE's *Management and Leadership in Schools (MLS)* programme prepares middle leaders to conceptualize school-wide AI action plans. The module includes: (1) Foundations of AI and generative AI; (2) Adaptive/personalised learning systems; (3) Ethical issues in AI (bias, transparency, privacy); (4) AI-supported lesson planning and use-case design; (5) Strategic planning for school-level AI integration.

Singapore's decentralized yet coordinated efforts reflect an ongoing negotiation between local school-level initiatives and broader national ambitions. Rather than imposing a standardised curriculum, the hub-and-spoke model allows schools to explore AI literacy within existing STEM or coding-related programmes. This approach aligns with broader regional thinking that "the relentless progress in educational technologies… prompts us to reconsider the dynamics of AI-empowered learning" (Wong & Looi, 2024, p.1).

2.5 AI Literacy in Thailand (Weena NAOWAPRATEEP)

Thailand recognizes artificial intelligence as a critical component for national innovation and economic growth, particularly in preparing students for an AI-driven future. However, significant gaps exist in K-12 AI literacy, with over 50% of teachers having never used AI or operating only at basic levels according to recent surveys (OBEC, 2025).

A comprehensive three-tier approach has been adopted for AI literacy development that aligns with international best practices. The first tier, *learning with AI*, focuses on applying AI tools to improve teaching, learning, and school management. The second tier, *learning about AI*, builds students' understanding of AI fundamentals, capabilities, limitations, and ethical considerations. The third tier, *building AI*, emphasizes hands-on creation where students design and develop AI solutions to foster innovation. This framework is consistent with the OECD and European Commission's *AI Literacy Framework for Primary and Secondary Education* (OECD, 2025), which similarly emphasizes engaging with AI, creating with AI, managing AI, and designing AI.

Multi-agency collaboration between the Office of Basic Education Commission (OBEC), the Institute for the Promotion of Teaching Science and Technology (IPST), and the National Science and Technology Development Agency (NSTDA) has produced a five-module AI curriculum. These modules cover AI basics, machine learning, natural language processing, generative AI, and ethics, spanning elementary to high school. This aligns with UNESCO's AI competency framework that highlights human-centered mindsets and ethical considerations (UNESCO, 2024). Pilot programs have already reached 47 schools and 2,134 students, with teacher reports showing that 70% of elementary learners could explain AI concepts taught in class. In addition, the "Learn to Earn" program has enrolled 33,664 students in AI creation activities, while the Adaptive Education Platform supports 45,000 students with personalized learning.

Despite this progress, several challenges persist. Rural schools face infrastructure gaps that limit equitable access. Teacher preparedness varies: although curriculum materials are available, many educators require more training to confidently integrate AI into teaching. Assessment frameworks also lag, with limited tools to measure AI literacy. Moreover, cultural adaptation of international frameworks to Thai contexts requires ongoing refinement to ensure local relevance while maintaining global standards.

2.6 AI Literacy in the US (Shuchi GROVER)

Over the past five years, U.S. K-12 AI literacy has advanced through NSF-funded initiatives such as AI4K12.org that articulated the "Five Big Ideas in AI" (Touretzky et al., 2019) that have guided resource development, curriculum design, and educator networking (Grover, 2024). Complementary programs have expanded access to free curricula, teacher professional learning, and student outreach. Recent federal executive orders have elevated AI literacy as a national priority, directing agencies to support AI-integrated curricula, teacher training, and public–private partnerships. One outcome is the launch of the National Academy for AI Instruction (AFT, 2025), a national effort backed by industry partners to provide large-scale professional development (PD) for teachers.

31 US states have official guidance or policy on the use of AI in K-12 education as of this writing (TeachAI, 2024). Guidance currently is mostly teacher-facing, and policies typically emphasize data privacy, ethical use, oversight, and integration into existing curricula rather than standalone AI courses. Concurrently, individual school districts, especially large ones, are publishing their own guidance documents and policies that clarify AI (especially Generative AI use). Somewhat related, some states (such as Ohio) are mandating that all K-12 school districts create local policies to govern the use of AI. Initiatives such as TeachAI.org have created resources to guide policymakers, district administrators, as well as educators.

At least five states are actively piloting classroom-based curricula focused on helping students develop foundational understanding of AI concepts and applications. For example, Connecticut's pilot program provides grade 7–12 students with opportunities for hands-on inquiry into how AI systems function and impact society, while Indiana is supporting teacher training and digital learning environments that integrate AI into tutoring and everyday coursework (ECS, 2025).

Meanwhile, the K-12 computing education community is reimagining their role in preparing children for a future not only with computing, generally, but AI, more specifically. The Computer Science Teachers' Association (CSTA) has published "AI Learning Priorities for All K-12 Students" to guide the revision of K-12 CS standards with a view to covering the general and technical aspects of AI literacy that are imperative for all students. These include learning goals under themes: Humans and AI, Representation and Reasoning, Machine Learning, Ethical AI System Design and Programming, and Societal Impacts of AI.

Despite this momentum, the highly decentralized U.S. education system poses significant challenges. State and district autonomy results in uneven adoption. Rural and under-resourced schools face infrastructure gaps compounding equity concerns.

3. Discussion and Conclusion

The six panel presentations reveal critical connections between policy decisions, local needs, teacher preparation, and curriculum implementation across diverse educational contexts. The perspectives from various countries also reveal a consistent theme, especially in Asia: the collaborative role being played by higher education institutions, researchers, and other partners in designing AI Literacy curricula and nationwide rollout efforts. Three themes will be explored in depth during the conference: the boundaries between technical skill development and curricula focused on AI awareness and use; the role of teacher PD as both catalyst and bottleneck for implementation; and the challenge of creating culturally responsive AI literacy that addresses local contexts while meeting global competency standards. The discussion will synthesize insights from varied national approaches to identify design principles and implementation strategies. The significance of these contributions lies in advancing contextualized frameworks for AI literacy that balance learning goals, informing policy and practice as countries worldwide navigate this emerging educational imperative.

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