

Don't Just Do IT! Re-Engineering Educational Technology for the Age of AI and Immersive Learning (2025 Edition)

Foreword: The Enduring Wisdom of 'Don't Just Do IT!' in an Accelerated Tech Landscape

The Timeless Relevance of Strategic Foundation-Building

The core message of the 2015 manual, "Don't Just Do IT! Build the Foundations for Pedagogical Innovation Using the 12 Step EdTech Roadmap," resonates with even greater urgency in the current educational technology milieu.¹ The central thesis—that technology integration devoid of a robust pedagogical and strategic underpinning inevitably leads to "toolishness" and the creation of "very expensive pencils"—finds amplified relevance amidst the proliferation of sophisticated Artificial Intelligence (AI) and eXtended Reality (XR) technologies.¹ The seductive power of these advanced tools presents a heightened risk: the temptation to "just do AI" or "just implement XR" without a profound understanding of their pedagogical implications or without establishing the necessary organizational "Implementation Ability".¹ Such an approach courts superficial adoption and squandered potential.

The Japanese proverb, "Vision without action is a daydream. Action without vision is a nightmare," prominently featured in the original work, remains a guiding principle for this updated edition.¹ As educational institutions stand on the cusp of transformative technological possibilities in 2025 and beyond, this revised manual endeavors to provide a concrete "action" framework—an updated 12-Step EdTech Roadmap—to realize the "vision" of truly innovative and impactful education. The original manual's emphasis on understanding an organization's "Implementation Ability" is now more critical than ever.¹ In 2015, this concept might have primarily addressed the infrastructure for 1:1 device programs or the adoption of basic educational software. By 2025, "Implementation Ability" encompasses a far more complex array of institutional capacities. These include fostering comprehensive AI literacy among staff, establishing ethical review boards to govern the use of AI tools, implementing robust data privacy protocols compliant with evolving regulations, and developing the capacity to manage and interpret AI-driven personalized learning pathways. The absence of these expanded capabilities doesn't just lead to ineffective technology use; it heightens the risk of ethical missteps and the exacerbation of inequities.

Bridging 2015 Principles to 2025+ Realities

Since the initial publication of "Don't Just Do IT!" in 2015, the technological landscape has undergone a seismic transformation. The intervening decade has witnessed the

meteoric rise of accessible and powerful AI, particularly generative AI capable of creating human-like text, images, and code, and agentic AI systems that can perform tasks autonomously. Concurrently, immersive XR technologies have matured, offering new dimensions for learning, and a new generation of creative and analytical tools has entered the educational sphere.

This rewritten manual aims to bridge the enduring principles of the 2015 edition with the dynamic realities of 2025 and beyond. Its purpose is to equip educational leaders, technology directors, curriculum developers, and teacher educators with updated strategies and deeper insights. The goal is to enable them to harness the profound potential of these new technologies—AI, XR, advanced data analytics, and decentralized systems—while steadfastly upholding the human-centered, ethical, and pedagogically sound foundations advocated in the original work.

A Note on Navigating Rapid Change

The pace of technological evolution is undeniably accelerating. Specific tools and platforms mentioned within these pages will inevitably be superseded by newer, perhaps even more powerful, iterations. However, the foundational strategies for thoughtful evaluation, ethical integration, effective professional development, and the cultivation of an innovative school culture are designed to be enduring. This manual, therefore, focuses on building an adaptable capacity within educational organizations—a resilient framework that allows them to navigate continuous change, make informed decisions about emerging technologies, and consistently prioritize meaningful learning outcomes over fleeting technological trends. The challenge is not merely to keep up with technology, but to lead with pedagogical vision and ethical responsibility.

Introduction: Charting the Course for 2025 and Beyond – A Renewed 12-Step EdTech Roadmap

The Unchanged Core: Revisiting the Foundational Philosophy of 'Don't Just Do IT!'

The foundational philosophy of "Don't Just Do IT!" remains the bedrock of this 2025 edition. The "Story of Joe," the student whose passion for filmmaking was ignited when a teacher said "YES" despite the lack of institutional resources or established curriculum, continues to serve as a powerful exemplar of student-driven innovation.¹ The core objective of a forward-thinking educational institution should be to create systemic conditions where many more "Joes" (and "Janes") can flourish, now empowered by an unprecedented array of creative and analytical tools. Imagine students like Joe, in 2025, having access to AI-powered video generation tools like

Google's Veo 3 to bring their cinematic visions to life ², or utilizing "Vibe Coding" platforms that translate natural language into functional applications, allowing them to develop solutions without deep programming expertise.⁴

A central tenet of the original manual was the imperative for educators to understand and connect with "Industry and Student Tech Culture".¹ This involves actively discerning what technologies and digital practices are currently engaging students and shaping various industries. In 2015, this might have pointed towards social media trends or the nascent stages of mobile app development. Today, this understanding must encompass the widespread student use of generative AI for tasks like homework assistance ⁶, the emergence of AI-first hardware designed for seamless human-AI interaction ⁸, and the growing appeal of immersive XR experiences for learning and entertainment.¹⁰ The concept of a "Flexible Curriculum," advocated for in the original manual, must now evolve to become even more dynamic and adaptable.¹ It needs to accommodate AI-driven inquiry, where students leverage AI tools for research and problem-solving, and support student-created AI solutions, fostering a new generation of innovators.

The New Frontier: Navigating AI, XR, and Convergent Technologies in Education

The educational technology landscape of 2025 is characterized by a confluence of powerful and rapidly evolving technologies. Understanding their individual capabilities and, more importantly, their potential for convergence is crucial for strategic planning.

Key technological shifts include:

- **Generative AI:** Platforms such as OpenAI's ChatGPT, Google's Gemini ¹³, and Anthropic's Claude ¹⁵ have democratized access to sophisticated content creation, ideation, and interactive learning. Research indicates that students are already extensively using these tools for academic purposes, often with and sometimes without explicit teacher permission.⁶ These tools can act as writing assistants, research aids, and even Socratic dialogue partners, fundamentally altering how students approach learning tasks.
- **Agentic AI & Coding:** Beyond content generation, agentic AI systems are emerging that can proactively assist users and even perform complex tasks like coding.¹⁷ The advent of "Vibe Coding" platforms represents a significant leap, enabling users to create software applications using natural language prompts, thereby lowering the traditional barriers to entry in software development.⁴
- **AI Teaching Platforms:** A new generation of AI-powered educational platforms like Magic School AI ¹⁹, SchoolAI ²³, and Flint Learning AI ²⁶ are offering tools for personalized tutoring, automated lesson planning assistance, differentiated

content delivery, and diverse interactive learning activities. These platforms aim to support teachers by automating routine tasks and providing students with tailored learning experiences.

- **Mixed Reality (XR):** Immersive technologies, encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), are becoming more accessible and sophisticated. Devices like Apple Vision Pro ²⁸ and platforms like Android XR ¹⁰ promise to deliver highly engaging and contextualized learning experiences, from virtual science labs to historical simulations. Furthermore, the development of AI-first hardware, potentially spearheaded by collaborations like Jony Ive and OpenAI, hints at future devices designed for seamless integration of AI into physical environments.⁸
- **Advanced Creative Tools:** AI is also revolutionizing content creation beyond text. Google's Veo 3, for example, is an AI model capable of generating high-quality video from textual prompts, opening new avenues for student projects and teacher-created instructional materials.²
- **Standardization and Interoperability:** The Model Context Protocol (MCP) is an emerging open standard designed to facilitate communication between AI models and external data sources or tools.⁴¹ MCP aims to create a more cohesive ecosystem where different AI applications can securely and efficiently access and utilize diverse information and functionalities.
- **Decentralized Technologies:** Web3 concepts and blockchain technology are gaining traction for their potential in education, particularly for creating secure and verifiable academic credentials, managing student data with enhanced privacy and user control, and facilitating transparent funding mechanisms.⁵²

The true transformative potential lies not just in these individual technologies, but in their convergence. Consider, for instance, an AI-powered tutoring system like Flint ²⁶ operating within an immersive XR environment such as that offered by Apple Vision Pro.³⁰ This system could leverage the Model Context Protocol ⁴¹ to access personalized learning resources tailored to a student, whose learning history and achievements are securely verified on a blockchain.⁵² Such a scenario presents far more complex and potentially powerful pedagogical opportunities—and challenges—than using an AI tutor on a conventional laptop. This necessitates that a school's "Implementation Ability" ¹ must now account for interoperability between disparate systems, secure data flow, and the heightened ethical considerations inherent in such deeply integrated technological ecosystems. This manual aims to prepare educational institutions for this convergent future, moving beyond a focus on discrete tools to a more holistic understanding of interconnected intelligent learning

environments.

Synergizing with Vision: Aligning with the 'CI Educational Technology Roadmap - 2023-2027'

This rewritten manual is designed to directly support and operationalize the strategic goals articulated in the 'CI Educational Technology Roadmap - 2023-2027'.¹ The Roadmap's emphasis on critical areas such as streamlining the introduction and approval of new initiatives, leveraging data analysis for informed decision-making, and systematically addressing WASC and IB recommendations provides a clear institutional context for the updated 12-Step model.¹

A cornerstone of the CI EdTech Roadmap is the development of a "Shared Vision" for technology in learning.¹ This aligns seamlessly with the core philosophy of "Don't Just Do IT!" which posits that a clear, collective purpose must precede any significant technology deployment. The Roadmap states, "Without a clear vision for learning, schools and districts risk purchasing technology, materials and building infrastructure without a plan for how they will use it or a set of criteria for measuring success".¹ This principle will be a recurring theme throughout the updated manual. Furthermore, the ISTE Essential Conditions survey results detailed in the Roadmap provide a valuable baseline, highlighting institutional strengths and areas requiring focused attention.¹ For instance, if survey data indicates that "Shared Vision" or "Prepared Educators" are areas for growth, the modernized 12 steps will offer concrete, actionable strategies to bolster these foundational elements, ensuring that technological advancements are purposefully and effectively integrated to enhance teaching and learning across the institution.

Part 1: Re-Engineering the 12 Steps for an AI-Infused Future

The original 12-Step EdTech Roadmap provided a robust framework for schools aiming to move beyond superficial technology use towards genuine pedagogical innovation. As we look towards 2025 and beyond, this framework remains fundamentally sound, but each step requires re-engineering to address the profound impact of Artificial Intelligence, Mixed Reality, and other convergent technologies. The following table offers a high-level comparison of the core focus of each step as envisioned in 2015 versus its modernized imperative for the current technological landscape.

Table 1: The Evolving 12-Step EdTech Roadmap: 2015 Core vs. 2025+ Imperatives

Step	Original Step Title & Core Focus (2015)	2025+ Imperative & Key Technologies
1	Why Toolishness is Foolishness (p. 11-12) More tools ≠ more integration; focus on purpose, vision, leadership, PD, culture.	Strategic AI & XR Adoption: Purpose Over Platform Prowess Key Tech: Generative AI, AI Tutors, XR, Advanced Creative Tools (e.g., Veo 3).
2	Understand Your Implementation Ability (p. 13-14) Assess organizational capacity to avoid technostress and high costs.	Assessing AI/XR Readiness: Gauging Your School's "Innovation Quotient" Key Tech: AI Platforms, XR Devices, Data Governance Systems.
3	Adopt Standards (ISTE Essential Conditions - Pillars of Strength) (p. 15-17) Use established standards for guidance and gap analysis.	Fortifying Pillars for AI & XR: ISTE Standards as Navigational Beacons Key Frameworks: ISTE Standards (Students, Educators, Leaders), UNESCO AI Competencies.
4	Consider CBAM for large scale implementation (p. 18-20) Address attitudes and usage levels during change.	Navigating AI/XR Adoption Waves with CBAM: Addressing Human Factors in Transformative Change Key Focus: Educator concerns about AI ethics, job roles.
5	Combine Steps 3 & 4 with Implementation Bridge Model (p. 21-22) Holistic model moving from current to new practices.	Building the AI/XR Implementation Superhighway: A Fortified Bridge to Future-Ready Education Key Focus: Systemic transformation for AI/XR integration.
6	Adopt an Integration Model (SAMR) (p. 23-25) Guide	SAMR Reimagined: Propelling Learning with AI

	teachers to deeper tech integration (S-A-M-R).	& XR from Substitution to Societal Redefinition Key Tech: GenAI, AI Tutors, XR, Vibe Coding, Veo 3.
7	Invest in People! Teach them R&D (p. 26-27) Crucial roles (EdTech Director, Coaches, IT), R&D processes, workflows.	Cultivating AI-Fluent Human Capital: Investing in Agile, Ethical, and Collaborative R&D Teams Key Focus: AI Pedagogy Coaches, Data Scientists, Ethical AI R&D.
8	Customize Learning Standards/Models to your culture (p. 28-30) Adapt global standards to local context; deeper learning.	Weaving AI/XR into Your School's Learning Culture: Hyper-Personalization with Global Standards Key Focus: AI Literacy, XR Literacies, Ethical AI use.
9	Flip your I.T. Department (p. 31-32) Out-of-the-box thinking for IT functions (BYOD, EBYO, 24/7 support).	Transforming IT into an AI/XR Innovation & Ethics Hub: From Support Center to Strategic Enabler Key Focus: AI Platform Management, XR Support, Data Governance.
10	Understand Change Facilitator Styles & ignite Change Agents (p. 33-34) Leadership impact; empower teacher innovators.	Leading AI/XR Transformation: Cultivating Visionary Initiators and Empowering AI-Fluent Change Agents Key Focus: Ethical AI Leadership, Responsible Innovation.
11	Strengthen Your One to World Program (p. 35-36) From labs to 1:1/BYOD; focus on equitable device access.	From One-to-World to AI-for-All: Ensuring Equitable Access and Agency in Intelligent Environments Key Tech: AI-first hardware, XR devices, AI platforms.

12	5 R's - Reflect, Research, Re-Plan, React, Redevelop (p. 37-38) Continuous improvement cycle for EdTech roadmap.	The AI-Driven Iteration Cycle: Continuously Refining Strategy in a Hyper-Evolving Landscape Key Focus: Agile adaptation to AI/XR evolution, AI-powered analytics.
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Step 1: Why Toolishness is Foolishness – Core Principles Revisited

2015 Core Principles:

The inaugural step of the original 12-Step EdTech Roadmap, "Why Toolishness is Foolishness," established a critical foundation: the mere accumulation of technological tools does not equate to enhanced educational practices or improved learning outcomes.¹ Introducing technology without a clear purpose, robust planning, and adequate support often leads to increased technostress among staff, ineffective or superficial use of devices (rendering them "very expensive pencils"), and a failure to progress beyond the basic Substitution level of the SAMR model. The 2015 manual identified key barriers to effective technology integration not as a deficit of tools, but rather a lack of shared vision, insufficient leadership, underdeveloped teacher proficiency in integrating technology with pedagogy, inadequate professional development, and the absence of an innovative school culture.¹

Modernizing Step 1 for 2025+: Strategic AI & XR Adoption – Purpose Over Platform Prowess

The core tenets of Step 1 are profoundly amplified in the context of 2025's advanced technological landscape. The allure of sophisticated Artificial Intelligence—encompassing generative AI platforms like Google's Gemini¹³ and Anthropic's Claude¹⁵, alongside specialized AI teaching platforms such as Magic School AI¹⁹, SchoolAI²³, and Flint Learning AI²⁶—and the immersive potential of eXtended Reality (XR) devices like Apple Vision Pro³⁰ and systems like Android XR¹², can easily lead to an even more detrimental form of "toolishness" if these technologies are adopted without a clear, pedagogically-driven purpose. The financial investment, the complexity of integration, and the ethical considerations associated with these advanced tools mean that the cost of their misuse or underutilization is significantly higher than with previous generations of educational technology. The "expensive pencil" analogy from 2015¹ evolves into "the underutilized AI-powered personalized learning system subscription" or "the XR headset fleet gathering dust in a storeroom." While the potential for transformative learning experiences is immense, so too is the potential for expensive, superficial, and even ethically problematic implementations if strategic foresight is lacking. The original manual warned against purchasing tools without a plan; this caution is magnified when considering AI and XR

tools, which often involve substantial ongoing subscription costs or significant upfront hardware investments (e.g., Apple Vision Pro reported at \$3,500 ¹⁰). Adoption without a clear vision, as emphasized in the CI Educational Technology Roadmap ¹, and without ensuring teacher preparedness ¹, will lead to greater financial and pedagogical waste than the "iPads in a closet" scenario described previously.¹

This modernized understanding of Step 1 directly connects with the 'CI Educational Technology Roadmap - 2023-2027'.¹ The Roadmap's "Shared Vision" section unequivocally states, "Without a clear vision for learning, schools and districts risk purchasing technology, materials and building infrastructure without a plan for how they will use it or a set of criteria for measuring success".¹ This sentiment is a direct echo of Step 1's core message. Furthermore, the WASC recommendation highlighted in the CI Roadmap, calling for "a clearer and more manageable process for introducing and approving new initiatives" ¹, is a critical mechanism for preventing AI toolishness and ensuring that any new technology adoption is purposeful and aligned with strategic goals.

The ISTE Standards and Essential Conditions provide a robust framework for navigating these challenges. The **ISTE Essential Condition of Shared Vision** is paramount ⁵⁵; before any AI or XR tool is considered, the "why" – its specific contribution to teaching and learning – must be collaboratively established and clearly articulated. This aligns with the **ISTE Standards for Education Leaders**, which call for leaders to "Inspire a culture of innovation and collaboration that allows time and space to explore and experiment with digital tools" (Standard 2c), thereby fostering an environment where purpose, not pressure, drives technology adoption.

Applying the SAMR model in the age of AI requires careful consideration. Many initial uses of AI tools, such as employing ChatGPT for a first draft of an essay instead of relying solely on a traditional search engine, might still reside at the Substitution or Augmentation levels. While these uses can offer efficiencies, the strategic goal must be to leverage AI to push towards Modification and Redefinition.¹ Modification could involve AI tools providing adaptive feedback that fundamentally changes the writing or problem-solving process for students. Redefinition might see students collaborating with AI to devise novel solutions to complex, real-world problems, and then potentially using emerging AI-powered tools like Google's Veo 3 ² to create compelling multimedia presentations of their solutions for authentic, global audiences.⁵⁶

Actionable Recommendations for 2025+ for Step 1:

To avoid the pitfalls of AI and XR toolishness and ensure strategic adoption, educational

institutions should:

1. Develop a clear, comprehensive "AI & Emerging Technologies Vision" that is explicitly aligned with the overall school mission, pedagogical philosophy, and the strategic objectives outlined in documents such as the CI EdTech Roadmap.¹
2. Establish a rigorous, multi-stakeholder vetting process for all new AI and XR tools. This process must prioritize pedagogical value, demonstrable alignment with specific learning goals, and thorough ethical review (addressing potential bias, data privacy implications, and equity concerns) over mere technological features or novelty. This directly addresses the CI Roadmap's WASC recommendation for a more manageable initiative approval process.¹
3. Prioritize and invest in sustained professional development focused on the *pedagogical integration* of AI and XR, rather than isolated technical training on specific tools. This professional learning, as emphasized in the CI Roadmap ¹, should occur *before* any widespread rollout of new AI or XR technologies, ensuring educators are equipped to use them effectively and ethically to enhance learning.

Step 2: Understand Your Implementation Ability[®]MP – Core Principles Revisited

2015 Core Principles:

Step 2 of the original roadmap, "Understand Your Implementation Ability," underscored the critical relationship between an organization's capacity to effectively implement technology and the resulting levels of staff technostress and overall costs.¹ A low Implementation Ability was generally correlated with higher technostress when new tools were introduced and increased costs over time due to underutilization or misuse. Conversely, a high Implementation Ability fostered lower technostress and more cost-effective, impactful technology integration. The process of understanding this ability—through methods like staff interviews, assessing user frustration levels, and evaluating the adequacy of technical support and professional development—was deemed essential before embarking on any large-scale technology implementation. The "melting crayons" analogy vividly depicted this concept: foundational elements must be solidly in place first, allowing innovation (the melted wax) to flow continuously and effortlessly once a "boiling point" is reached.¹

Modernizing Step 2 for 2025+: Assessing AI/XR Readiness – Gauging Your School's "Innovation Quotient"

The concept of Implementation Ability takes on new dimensions and heightened importance in the era of AI and XR. Assessing readiness for these transformative technologies requires a more comprehensive evaluation of an institution's "Innovation Quotient."

Expanded Dimensions of Implementation Ability for AI/XR:

- **Technical Infrastructure and Cybersecurity:** Beyond basic bandwidth and device access, AI and XR demand robust data security architectures, comprehensive privacy frameworks to protect sensitive student data utilized by AI systems⁵⁷, and potentially on-premises or edge computing capabilities to support demanding XR applications. Cybersecurity measures must be specifically adapted to address AI-related threats, such as data poisoning or adversarial attacks on AI models.
- **Educator AI Literacy and Pedagogical Skills:** Teachers require a new suite of competencies. This includes functional skills like prompt engineering for generative AI, the ability to critically evaluate AI-generated content for accuracy and bias, a deep understanding of AI ethics (including issues of plagiarism, bias propagation, and fairness⁶), and the pedagogical skills to design and facilitate AI-assisted learning experiences. This is a core theme in the CI EdTech Roadmap, particularly under the "Prepared Educators" ISTE Essential Condition.¹
- **Student AI Literacy and Digital Citizenship:** Students, too, must develop AI literacy. This involves learning to use AI tools responsibly and ethically, critically evaluating AI-generated information, understanding the implications of data privacy in AI systems⁶, and recognizing potential algorithmic biases. UNESCO's AI Competency Framework for Students offers valuable guidance in this area.⁶⁵
- **Ethical Governance Frameworks and Policies:** Educational institutions need to proactively develop and implement clear policies and robust review processes for the adoption and use of AI tools. These frameworks must address critical ethical considerations such as algorithmic bias, fairness in AI-driven assessments, transparency in AI decision-making, and accountability for AI outcomes.⁵⁹ Guidelines from organizations like IEEE and UNESCO can serve as vital resources.⁶⁵
- **Data Management and Analytical Capacity:** The effective use of AI-powered learning analytics platforms requires the ability to manage, analyze, interpret, and ethically act upon student data.⁷¹ This may necessitate new skill sets within the institution or dedicated data analysis roles.

The CI EdTech Roadmap¹ provides direct indicators of an institution's current Implementation Ability through its ISTE Essential Conditions survey results.¹ For example, if the survey reveals that "Prepared Educators" or "Skilled and Sufficient Technical Support" are rated at the "Initiates" or "Approaches" level, this signals a lower Implementation Ability for undertaking complex AI or XR projects, suggesting that foundational work is needed in these areas. Furthermore, the WASC recommendation for a "dedicated staff member to oversee data analysis and inform decision-making"¹ directly addresses a key component of Implementation Ability

required for leveraging AI-driven learning analytics effectively.

A low Implementation Ability in the context of AI and XR carries implications far beyond increased technostress or financial inefficiency. It signifies a heightened risk of serious ethical breaches, such as the deployment of biased AI systems that could negatively impact student grading, learning pathways, or opportunities. It also means a potential failure to achieve equitable outcomes, where some students benefit from AI advancements while others are left behind or even harmed. The "cost" of inadequate Implementation Ability is therefore not merely financial; it encompasses social, ethical, and reputational dimensions. The original manual's linkage of low Implementation Ability to higher costs and technostress¹ is thus amplified. If educators are not adequately trained (a low score in "Prepared Educators" in the CI Roadmap survey¹), they may misuse AI assessment tools, leading to unfair evaluations. If data privacy protocols are not robust (a critical aspect of modern technical infrastructure), student data could be compromised by AI platforms. If clear ethical guidelines and oversight are absent, biased AI tools⁵⁷ could be adopted, inadvertently perpetuating or even amplifying existing inequities. Consequently, a thorough assessment of Implementation Ability for AI and XR serves as an essential risk mitigation strategy.

Actionable Recommendations for 2025+ for Step 2:

To accurately gauge and strategically enhance AI/XR readiness, institutions should:

1. Conduct a comprehensive "AI/XR Readiness Assessment." This should build upon the interview questions suggested in the original manual¹ but expand to incorporate the new dimensions of Implementation Ability outlined above (technical infrastructure for AI/XR, educator and student AI literacy, ethical governance frameworks, and data management capacity).
2. Utilize the ISTE Essential Conditions Diagnostic Tool, as referenced in the original manual¹ and employed in the CI EdTech Roadmap¹, to specifically probe AI and XR preparedness across all essential conditions. The existing survey data from the CI Roadmap can serve as a valuable baseline for tracking progress.
3. Develop a clearly defined, phased approach to AI and XR adoption that is directly informed by the readiness assessment. This approach should prioritize building foundational capacities—such as comprehensive AI literacy programs for educators and students, and the development of robust ethical policies and data governance structures—before any large-scale deployment of AI or XR tools. This aligns with the "melting crayons" philosophy of building a solid base before expecting innovation to flow.¹

Step 3: Adopt Standards such as the ISTE Essential Conditions Rubric (Pillars of

Strength[®]MP) – Core Principles Revisited

2015 Core Principles:

Step 3 of the original EdTech Roadmap emphasized the strategic value of adopting established, research-backed standards, highlighting the International Society for Technology in Education (ISTE) standards as a prime example.¹ By aligning with such standards, schools gain access to a wealth of research, curated resources, professional development opportunities, and diagnostic tools like the ISTE Essential Conditions Rubric (referred to as the "Pillars of Strength"). This adoption process enables institutions to systematically identify their strengths and weaknesses, pinpoint gaps in their technology integration efforts, and lay the groundwork for building a formal, whole-school EdTech Roadmap.

Modernizing Step 3 for 2025+: Fortifying Pillars for AI & XR – ISTE Standards as Navigational Beacons

In the rapidly evolving landscape of AI and XR, the ISTE Standards and Essential Conditions become even more indispensable as navigational beacons, guiding ethical and effective integration.

Relevance of ISTE Essential Conditions in the AI/XR Era:

The seven ISTE Essential Conditions—Shared Vision, Implementation Planning, Equitable Access, Prepared Educators, Skilled & Sufficient Technical Support, High-Quality Learning & Content, and Ongoing Evaluation—provide a comprehensive framework for the complex undertaking of AI and XR integration.¹

- **Shared Vision:** This pillar must now explicitly encompass the ethical, equitable, and pedagogical use of AI and XR technologies. It requires a collective understanding of how these tools will enhance learning for all students.
- **Implementation Planning:** Planning for AI/XR necessitates addressing AI-specific infrastructure requirements (e.g., computational power, data storage), robust data governance policies, specialized professional development for AI literacy, and sustainable funding models for AI tools and platforms.
- **Equitable Access:** This is a critical consideration to ensure that AI tools and XR experiences do not widen the existing digital divide or create new forms of inequity.⁵⁹ It involves access not only to devices but also to high-quality AI-powered personalized tutors, AI-first hardware⁸, and immersive XR devices.
- **Prepared Educators:** As highlighted in the CI EdTech Roadmap¹, educators require substantial training in AI literacy, ethical AI use, data privacy, and AI-augmented pedagogical strategies.⁷³ UNESCO's AI Competency Framework for Teachers provides a valuable resource for this.⁶⁶
- **Skilled & Sufficient Technical Support:** The technical support team needs specialized expertise in managing AI platforms, supporting diverse XR devices, ensuring cybersecurity for AI systems, and potentially implementing

interoperability protocols like MCP.⁴¹ The CI EdTech Roadmap's survey data indicates this is an area for continued growth and investment.¹

- **High-Quality Learning & Content:** This involves the careful curation, development, and evaluation of AI-powered learning experiences and XR content to ensure they are effective, engaging, culturally responsive, and free from bias.
- **Ongoing Evaluation:** Given the rapid pace of AI and XR development, continuous evaluation of their impact on learning, ethical implications, and alignment with the shared vision is essential.

Integrating ISTE Standards for Students, Educators, and Leaders with AI & XR:

The ISTE Standards for Students, Educators, and Education Leaders offer specific competencies that are directly relevant to navigating the AI and XR landscape:

- **ISTE Standards for Students**⁷⁴: These standards guide how AI and XR tools can empower students. For example, as **Empowered Learners**, students might use AI tutors for personalized learning. As **Digital Citizens**, they must understand AI ethics, data privacy, and the implications of algorithmic bias. As **Knowledge Constructors**, they learn to use AI for research while critically evaluating AI-generated sources. As **Innovative Designers**, they might use Vibe Coding platforms⁴ or AI video tools like Veo 3² to create novel solutions. As **Computational Thinkers**, they gain an understanding of how AI algorithms work. The "AI Skills Official Findings Report May 2025"⁷⁴ explicitly links AI skill development to these standards.
- **ISTE Standards for Educators**⁷³: These standards define the evolving roles of educators. As **Learners**, educators must continuously update their own AI literacy. As **Leaders**, they advocate for ethical AI use. As **Designers**, they create AI-powered learning activities. As **Facilitators**, they guide students in AI-assisted inquiry. As **Analysts**, they use AI learning analytics ethically and effectively.⁷¹ ISTE Standard 2.1.a, which emphasizes educators setting their own professional learning goals, is particularly pertinent for navigating the complexities of AI.⁷³ The AI-TPACK framework further elaborates on the specific knowledge domains educators need for effective AI integration.⁷⁷
- **ISTE Standards for Education Leaders**⁷⁹: These standards guide leaders in creating systemic conditions for successful AI integration. Leaders act as **Equity and Citizenship Advocates**, ensuring AI benefits all students. As **Visionary Planners**, they develop strategic plans for AI adoption. As **Empowering Leaders**, they foster a culture of responsible AI innovation. As **Systems Designers**, they ensure the necessary infrastructure and policies are in place. As **Connected Learners**, they stay abreast of AI trends and ethical considerations. ISTE's "AI in Education Leadership Catalyst" program supports leaders in these roles.⁸⁰

The CI EdTech Roadmap ¹ explicitly adopts the ISTE Essential Conditions as its guiding framework. The survey results from August and November 2023 included in the Roadmap demonstrate both progress and areas requiring ongoing focus, such as continued development of a Shared Vision and robust Implementation Planning.¹ This existing data provides a concrete and institutionally relevant starting point for applying the modernized Step 3.

Without a strong foundation built on established standards, schools risk adopting AI and XR tools based on fleeting trends or vendor promises, thereby violating the core principle of Step 1 ("Why Toolishness is Foolishness"). The ISTE Standards—encompassing students, educators, and leaders—along with the Essential Conditions, collectively form the "Pillars of Strength" described in the original manual.¹ These pillars provide a multi-layered defense against uncritical technology adoption, ensuring that pedagogical objectives, equity considerations, and robust digital citizenship remain at the forefront of any AI or XR initiative. For example, the ISTE Student Standard focusing on "Digital Citizen" ⁷⁴ directly addresses the imperative for students to learn about the ethical use of AI. Similarly, the ISTE Educator Standard encouraging teachers to be "Designers" ⁷³ pushes them beyond passive use of AI tools towards the thoughtful creation of AI-enhanced learning environments. The CI EdTech Roadmap's ¹ explicit adoption of these conditions underscores their practical utility and relevance for the institution as it navigates the complexities of emerging technologies.

Actionable Recommendations for 2025+ for Step 3:

To ensure that AI and XR integration is guided by sound principles, institutions should:

1. Conduct regular (annual or biennial) assessments using the ISTE Essential Conditions framework. These assessments should include questions specifically tailored to gauge AI and XR integration readiness and to monitor progress over time, using the CI EdTech Roadmap's survey data ¹ as an initial benchmark.
2. Explicitly map all new AI and XR initiatives, professional development programs, and curriculum revisions to the specific ISTE Standards for Students, Educators, and Education Leaders. This ensures alignment with internationally recognized best practices and a holistic approach to technology integration.
3. Utilize the ISTE Standards, in conjunction with guidelines from organizations like UNESCO ⁶⁵, as a foundational basis for developing comprehensive ethical guidelines, acceptable use policies, and data governance protocols for AI and XR technologies within the school environment.

Step 4: Consider the Concerns Based Approach Model (CBAM) for large scale

implementation – Core Principles Revisited

2015 Core Principles:

The Concerns Based Adoption Model (CBAM) was introduced in Step 4 of the original manual as a valuable framework for managing any large-scale organizational change, extending beyond mere technology implementation.¹ CBAM provides tools to measure two key dimensions: the Stages of Concern (SoC), which capture the attitudes, feelings, and perceptions of individuals towards an innovation, and the Levels of Use (LoU), which describe how individuals are actually interacting with the innovation. The original manual highlighted that low SoC and LoU scores often indicate that users are aware of an initiative but have little personal involvement or commitment, a situation that, if left unaddressed, could lead to the initiative gaining a negative reputation and ultimately failing. Investing in gathering data through ISTE assessments and CBAM was positioned as a valuable upfront investment to guide successful implementation.

Modernizing Step 4 for 2025+: Navigating AI/XR Adoption Waves with CBAM – Addressing Human Factors in Transformative Change

The human factors involved in adopting AI and XR technologies are likely to be more pronounced and complex than with previous educational technologies, making CBAM an even more critical tool for leaders.

Heightened and Nuanced Concerns with AI/XR:

The introduction of AI—technologies capable of generating human-quality text, creating original art, writing functional code⁴, and potentially transforming professional roles—along with XR technologies that can alter an individual's perception of reality, can evoke a spectrum of deeper and more varied concerns among educators.

The Stages of Concern (SoC)¹ can be specifically contextualized for AI/XR adoption:

- **Stage 0 - Unconcerned:** This stage might be more prevalent than anticipated if educators are not fully aware of AI's rapidly advancing capabilities or its increasing integration into educational contexts.
- **Stage 1 - Informational:** Educators at this stage are actively seeking to understand the nature of generative AI⁶, agentic AI¹⁷, XR environments¹⁰, and how these technologies fundamentally operate.
- **Stage 2 - Personal:** This stage is likely to be particularly intense with AI/XR. Concerns may revolve around job security ("Will AI make teachers obsolete?"), the urgent need to acquire new skills (such as AI literacy, prompt engineering⁶³, and data interpretation), anxieties about student data privacy when using AI tools⁵⁷, and grappling with complex ethical dilemmas (e.g., AI-assisted plagiarism, algorithmic bias affecting student outcomes⁶).
- **Stage 3 - Management:** Practical concerns emerge about how to effectively manage AI tools within the classroom, develop new lesson plans that meaningfully incorporate AI and XR⁸¹, redesign assessment strategies for an AI-pervasive world

⁸³, ensure equitable access to these new technologies for all students, and manage the logistical aspects of XR device deployment.

- **Stage 4 - Consequence:** The focus shifts to the impact of AI and XR on student learning outcomes. Educators consider how these technologies affect critical thinking development ⁶³, creativity, collaborative skills, and students' overall preparedness for a future workforce shaped by AI.
- **Stage 5 - Collaboration:** Educators begin to explore how to collaborate with colleagues on developing effective AI integration strategies, sharing best practices for specific tools like Magic School AI ²¹ or SchoolAI ²⁵, and co-designing interdisciplinary AI/XR projects.
- **Stage 6 - Refocusing:** At this advanced stage, educators may look beyond current applications to explore entirely new pedagogical models and innovative educational approaches that are uniquely enabled by AI and XR, potentially challenging and reshaping existing educational system limitations.

Similarly, the Levels of Use (LoU) 1 will map the trajectory of AI/XR adoption:

Initial phases will likely see many educators at Non-use, Orientation, or Preparation.

Mechanical Use might involve basic, perhaps superficial, use of an AI tool without deep pedagogical integration (e.g., using an AI image generator for a presentation slide without further critical engagement). Routine use could manifest as the regular incorporation of an AI tutor into daily lessons. Refinement would be evident when educators begin to customize AI prompts for specific learning objectives or tailor XR experiences to particular student needs. Integration could involve combining AI capabilities with XR environments to create novel and powerful learning experiences. Renewal would signify educators or teams developing entirely new AI-driven pedagogical approaches or contributing to the broader understanding of effective AI use in education. Research applying CBAM to AI adoption in Early Childhood Education (ECE) confirms the model's utility, particularly its staircase representation for gauging educators' current positions and facilitating progression.⁸⁶

The CI EdTech Roadmap ¹ underscores the importance of "Prepared Educators." CBAM data, specifically SoC and LoU metrics, can directly inform the design and focus of professional development initiatives aimed at enhancing AI readiness. If data reveals high personal concerns (SoC Stage 2) about AI ethics or low levels of use (LoU) for new AI platforms, PD can be tailored to address these specific anxieties and skill gaps. This aligns with WASC/IB recommendations within the Roadmap that call for monitoring the impact of PD and consolidating professional learning efforts.¹

For AI and XR technologies, the "Personal" stage of concern (SoC Level 2) is likely to be significantly more intense and multifaceted than with previous technologies. This is due to the existential questions these technologies raise about professional identity, the nature of human intelligence, the future of work, and profound ethical considerations. Addressing these deeper anxieties is paramount for successful

adoption and requires more than just technical skills training. It necessitates ongoing dialogue, the establishment of clear ethical frameworks, visible leadership that acknowledges and validates these concerns, and support systems that help educators navigate this complex emotional and intellectual terrain. The original CBAM framework outlines SoC Level 2 as encompassing uncertainty about the demands of an innovation and one's adequacy to meet them.¹ With AI, this uncertainty is amplified because the technology can perform tasks previously considered uniquely human, such as sophisticated writing, artistic creation, and complex coding. This can trigger profound anxieties about job relevance⁷ and the very definition of teaching and learning in an AI-suffused world. The CI EdTech Roadmap's call for "planning for professional development to support the successful implementation of new initiatives"¹ must therefore be interpreted broadly. PD for AI must extend beyond technical operational skills to address these deep-seated personal and ethical concerns if educators are to be supported in moving effectively through the Stages of Concern.

Actionable Recommendations for 2025+ for Step 4:

To effectively manage the human side of AI and XR integration, institutions should:

1. Administer Stages of Concern (SoC) questionnaires and conduct Levels of Use (LoU) interviews specifically focused on AI and XR technologies. This should be done prior to and during any large-scale rollouts to establish baseline data and monitor shifts in concerns and usage patterns over time.
2. Utilize the collected CBAM data to design differentiated and targeted professional development programs for AI and XR. For example, educators primarily at the Personal or Management SoC stages might benefit from workshops on AI ethics, data privacy, and practical classroom management strategies for AI tools. Those at the Consequence or Collaboration stages might be ready for advanced pedagogical integration strategies or opportunities to lead peer coaching initiatives.
3. Establish accessible and ongoing forums for open, honest discussion about the personal, professional, and ethical implications of AI in education. These forums can help address SoC Level 2 concerns proactively, build a sense of community, and foster shared understanding.
4. Integrate CBAM findings into the "Ongoing Evaluation" process (ISTE Essential Condition 7), as outlined in the CI EdTech Roadmap.¹ This ensures that data on educator concerns and usage levels continuously informs the refinement of AI and XR implementation strategies.

Step 5: Combine step 3 and 4 along with The Implementation Bridge Model - Dr. Gene Hall, 2010 – Core Principles Revisited

2015 Core Principles:

Step 5 of the original manual proposed a powerful synthesis: combining the insights from the ISTE Essential Conditions (Step 3's "Pillars of Strength") and CBAM data (Step 4's "Beams of Support") with Dr. Gene Hall's Implementation Bridge model.¹ This integrated approach was presented as a comprehensive visual and conceptual tool for guiding an organization's transition from its current practices to new, innovative practices. The manual posited that if a school were to fully adopt and implement this model, its Implementation Ability would significantly increase, leading to lower technostress for staff and more cost-effective technology integration over time, ultimately enabling a culture where innovation could flourish.

Modernizing Step 5 for 2025+: Building the AI/XR Implementation Superhighway – A Fortified Bridge to Future-Ready Education

The Implementation Bridge model, when applied to the complex and rapidly evolving landscape of AI and XR, provides an even more critical framework for strategic planning and execution.

Strengthening the Pillars and Beams for AI/XR:

- **The Pillars (ISTE Essential Conditions):** As detailed in the modernized Step 3, these foundational elements must be robustly interpreted and implemented in the context of AI and XR. For example, "Equitable Access" now extends to ensuring all students can benefit from AI-powered personalized tutors⁶ and have opportunities to engage with XR hardware. "Prepared Educators" necessitates comprehensive AI literacy, including ethical understanding and pedagogical skills for AI-augmented teaching.⁶⁰ Weakness in any of these pillars compromises the stability of the entire implementation effort.
- **The Beams (CBAM Data – SoC, LoU, Innovation Configurations):** Data from CBAM assessments provide critical insights into how educators, students, and other stakeholders are *experiencing* the transition to AI and XR. High "Personal" concerns (SoC Stage 2) regarding AI ethics⁵⁹ or low "Levels of Use" (LoU) of newly introduced AI teaching platforms (e.g., Magic School AI²¹) indicate weak "beams" in the implementation bridge. These weaknesses signal a need for targeted interventions, such as specialized professional development, enhanced support systems, or clearer communication, to strengthen these supportive elements.

The Implementation Bridge in an AI/XR Context:

Dr. Gene Hall's model visualizes the journey from "Current Practices" to "New Practices" as crossing a bridge, supported by the aforementioned pillars and beams.

- **Current Practices:** This side of the bridge represents the existing state: traditional teaching methodologies, current technology infrastructure, prevailing

curriculum structures, and established school policies and culture.

- **New Practices:** This destination encompasses the desired future state, characterized by AI-augmented pedagogy, XR-enhanced immersive learning environments, AI-driven personalized learning pathways, students utilizing Vibe Coding for creative application development ⁴, the ethical use of AI for innovative assessment strategies ⁸³, and students leveraging tools like Veo 3 for sophisticated project creation.² The "gap" between current and new practices is arguably wider, deeper, and more complex with the introduction of AI and XR than with any previous wave of educational technology. This makes the careful construction and continuous reinforcement of the Implementation Bridge exceptionally critical.

The CI EdTech Roadmap ¹ serves as an institution-specific blueprint for constructing this very bridge. Its delineated focus areas—Shared Vision, Implementation Planning, Equitable Access, Prepared Educators, Skilled and Sufficient Technical Support, High-Quality Learning and Content, and Ongoing Evaluation—represent the macro-components or segments of this strategic bridge. The WASC and IB recommendations integrated into the Roadmap ¹ highlight specific areas where the "bridge" requires particular attention or strengthening, such as establishing "a system to monitor the impact of professional development" or the need to "prioritize school initiatives and data analysis."

When applied to AI and XR, the Implementation Bridge model powerfully underscores that achieving transformative "New Practices" is not merely a matter of adopting new tools. Instead, it demands a systemic, multi-year commitment to transforming institutional culture, developing new skills and literacies, upgrading infrastructure, evolving pedagogical approaches, and establishing robust ethical frameworks. This transformation must be deeply informed by an ongoing understanding of how stakeholders are experiencing the change (via CBAM) and a continuous assessment of whether the foundational elements (ISTE Conditions) are sufficiently strong to support the journey. The original manual presented the Implementation Bridge as a potent theoretical construct.¹ The CI EdTech Roadmap ¹ translates this theory into a practical, actionable plan for a specific institution. The inherent challenge with AI and XR is that the "New Practices" side of the bridge is itself a moving target, evolving at an unprecedented pace. This dynamism implies that the Implementation Bridge cannot be a static structure; it must be designed for adaptability, continuous monitoring, and ongoing reinforcement. For instance, if the "Prepared Educators" pillar (an ISTE Essential Condition) is identified as weak based on the CI Roadmap's survey data ¹, and concurrent CBAM data reveals high levels of anxiety (SoC) and low

levels of use (LoU) regarding a new AI tool, it signals a critical instability in the bridge. In such a scenario, the institution must prioritize targeted professional development and robust support systems, as advocated in the CI Roadmap under the "Prepared Educators" section, to strengthen that particular beam and pillar, ensuring the overall integrity of the implementation effort.

Actionable Recommendations for 2025+ for Step 5:

To strategically build and maintain the Implementation Bridge for AI/XR:

1. Visually map the school's current AI and XR initiatives onto the Implementation Bridge model. Use ISTE Essential Conditions survey data (drawing from the CI EdTech Roadmap ¹ where available) to assess the current strength of the "Pillars." Simultaneously, use CBAM data (SoC, LoU, and potentially Innovation Configuration maps for specific AI/XR tools) to evaluate the integrity of the "Beams."
2. Employ this visual and data-informed map to identify critical weaknesses or stress points in the "bridge." For example, if "Equitable Access" to AI-powered tools is identified as a weak pillar, and "Personal" concerns (SoC Stage 2) about algorithmic bias in AI are found to be a prevalent and weak beam, these areas become urgent priorities for intervention and resource allocation.
3. Integrate the Implementation Bridge concept into the "Ongoing Evaluation" process (ISTE Essential Condition 7), as outlined in the CI EdTech Roadmap.¹ This involves regularly reassessing the bridge's structural integrity as new AI and XR technologies emerge, as stakeholder concerns evolve, and as the vision for "New Practices" continues to develop. This makes the bridge a dynamic, living framework for managing sustained innovation.

Step 6: Adopt an Integration Model such as SAMR (Dr. Ruben Puentedura) – Core Principles Revisited

2015 Core Principles:

Step 6 of the original manual advocated for the adoption of a technology integration model, with Dr. Ruben Puentedura's SAMR model (Substitution, Augmentation, Modification, Redefinition) presented as a prime example.¹ SAMR serves as an accessible framework for educators to conceptualize and guide their efforts towards deeper and more meaningful levels of technology integration. The ultimate aim is to move beyond the lower levels of Substitution (tech as a direct tool replacement with no functional change) and Augmentation (tech as a direct tool substitute with functional improvement) towards Modification (tech allows for significant task redesign) and, ideally, Redefinition (tech allows for the creation of new tasks, previously inconceivable). The manual stressed that achieving significant positive impact on student outcomes typically requires reaching these higher M and R levels, emphasizing that effective technology integration is fundamentally about pedagogy, not just

the technology itself.

Modernizing Step 6 for 2025+: SAMR Reimagined – Propelling Learning with AI and XR from Substitution to Societal Redefinition

The SAMR model remains a valuable lens through which to evaluate and plan for the integration of AI and XR technologies. Its application can help ensure that these powerful tools are used not just to replicate existing practices but to genuinely transform teaching and learning.

SAMR with Generative AI (e.g., Gemini, Claude, ChatGPT):

- **Substitution:** A student uses a generative AI tool like ChatGPT to draft an email to a teacher instead of writing it manually from scratch. The fundamental task (composing an email) remains unchanged.
- **Augmentation:** A student uses an AI tool to refine the grammar, check the tone, or translate a drafted email into another language. Google's Gemini, for instance, can assist in fine-tuning written text.¹⁴ The core task is enhanced by AI's functional improvements.
- **Modification:** Students engage with an AI tool, such as Claude in its "Learning Mode" ¹⁵, as a Socratic partner to explore complex historical events or scientific concepts. The AI poses guiding questions and prompts deeper inquiry, significantly redesigning the traditional research and learning process. The task is no longer simple information retrieval but a co-constructive exploration of knowledge.
- **Redefinition:** Students collaborate with generative AI tools to co-create novel and complex solutions to authentic, real-world problems (e.g., designing a sustainable urban development plan or proposing a solution to a local environmental issue). They might then leverage AI-powered video generation tools like Google's Veo 3 ² to produce a professional-quality documentary or persuasive presentation about their solution, sharing it with a global audience to advocate for change—a task previously inconceivable for most students due to technical and resource limitations.⁵⁶

SAMR with AI Tutors (e.g., Magic School AI, SchoolAI, Flint, Khanmigo):

- **Substitution:** An AI tutor platform replaces a traditional paper-based worksheet for practicing math problems.
- **Augmentation:** The AI tutor provides immediate feedback, hints, and step-by-step solutions for the practice problems, offering functional improvements over a static worksheet.⁸⁸ Magic School AI, for example, offers personalized feedback capabilities.²⁰

- **Modification:** The AI tutor dynamically adapts learning pathways in real-time based on individual student performance, providing targeted support and challenging extensions as needed.¹⁷ This significantly redesigns the process of differentiation, making it more granular and responsive. Flint Learning AI allows teachers to design personalized AI tutors for such purposes.²⁶
- **Redefinition:** Students use AI tutors to achieve deep mastery of concepts at their own pace. They then leverage this profound understanding and the AI platform's tools to create peer-tutoring resources, contribute to open educational resource (OER) repositories, or even design learning modules for younger students, facilitated and perhaps even co-moderated by the AI tutor platform.

SAMR with XR (Apple Vision Pro, Android XR):

- **Substitution:** Students view a 3D model of the human brain on an XR device instead of looking at a 2D diagram in a textbook.
- **Augmentation:** Students interact with the 3D brain model in the XR environment, rotating it, zooming in on specific structures, and perhaps triggering informational pop-ups. Apple Vision Pro, for example, can bring 3D objects to life for close examination.²⁸
- **Modification:** Students collaboratively design, build, and explore complex virtual environments or interactive simulations within an XR platform (e.g., reconstructing an ancient Roman city, conducting a simulated physics experiment that would be dangerous or impossible in a real lab, or role-playing complex social interactions). This significantly redesigns traditional project-based learning, as seen in initiatives like Plainfield Public Schools' use of Apple Vision Pro for Career & Technical Education.³⁰
- **Redefinition:** Students use XR technologies to create and globally share immersive, empathy-building experiences focused on pressing global issues (e.g., simulating the impacts of climate change on a specific ecosystem, creating a virtual experience of a refugee's journey, or designing an interactive museum exhibit on cultural heritage). This fosters global collaboration, promotes social action, and allows students to communicate complex ideas in profoundly new ways, previously impossible within the confines of a traditional classroom.

SAMR with Vibe Coding & App Creation:

- **Substitution:** Students use a Vibe Coding platform ⁴ to generate the code for a simple "Hello World" application by typing a natural language prompt, instead of manually writing the code in a traditional programming language.
- **Augmentation:** Students use the Vibe Coding platform's AI assistant to help debug their generated application or to add simple new features through further

natural language instructions.

- **Modification:** Students utilize Vibe Coding to rapidly prototype, test, and iterate on a mobile application designed to solve a specific problem within their local school or community. This significantly redesigns the traditional software development cycle, making it more accessible and agile.
- **Redefinition:** Students from diverse academic backgrounds, including those with no prior formal coding experience, use Vibe Coding platforms to develop and deploy functional applications that address real-world local or even global challenges. They might publish these apps to a wide audience, collaborate with international student teams, or even launch social impact ventures based on their creations. This redefines who can be a "developer" and expands the potential for student-led technological innovation and impact.

The CI EdTech Roadmap's ¹ strategic goal of ensuring "High Quality Learning and Content" is directly supported by a conscious effort to move AI and XR integration towards the Modification and Redefinition levels of the SAMR model. These higher levels are where technology transcends mere efficiency gains and begins to enable fundamentally new and more powerful learning experiences.

With the advent of sophisticated AI and immersive XR, the "Redefinition" level of SAMR holds the potential to extend beyond individual classroom tasks to foster projects with tangible societal impact. Students are no longer limited to creating for their teacher or peers; they can become creators of globally relevant AI-driven solutions, data visualizations, immersive narratives, or functional applications. This fundamentally changes the scope and potential impact of "student work." The original SAMR model focused on transforming "teaching and learning" within the educational context.¹ Examples of Redefinition often involved novel student products or new forms of collaboration.⁵⁶ With generative AI, AI-powered video tools like Veo 3 ², and ubiquitous global connectivity, students can now create and disseminate highly sophisticated content or functional solutions to authentic global audiences. This elevates "Redefinition" from primarily a classroom pedagogical goal to a potential avenue for real-world problem-solving and student agency on a much larger scale, aligning powerfully with ISTE Student Standards such as "Global Collaborator" and "Innovative Designer".⁷⁴

Actionable Recommendations for 2025+ for Step 6:

To effectively leverage SAMR for AI and XR integration:

1. Provide targeted professional development that focuses on applying the SAMR model specifically to AI and XR technologies. This PD should include concrete examples of what Substitution, Augmentation, Modification, and Redefinition look

like with various tools (e.g., Magic School AI, Apple Vision Pro, Google Veo 3, Vibe Coding platforms).

2. Encourage and support educators in designing at least one learning experience per semester or academic year that intentionally aims for the Modification or Redefinition level using AI and/or XR tools.
3. Establish platforms and opportunities (e.g., school innovation fairs, digital portfolios, online showcases) to highlight and celebrate exemplary student projects that demonstrate Redefinition using AI and XR. This can inspire further innovation and demonstrate the transformative potential of these technologies when integrated thoughtfully.
4. Incorporate SAMR reflections into lesson planning templates and peer observation protocols to foster ongoing dialogue about the depth and impact of technology integration.

Step 7: Invest in People! Teach them how to Research and Develop – Core Principles Revisited

2015 Core Principles:

Step 7 of the original roadmap, "Invest in People! Teach them how to Research and Develop," underscored that human capital is the most critical investment for successful technology integration.¹ It advocated for a well-structured EdTech team, including a Director of Educational Technology to drive the overall vision, EdTech Coaches to provide pedagogical support, and skilled IT Support staff. A suggested ratio was one EdTech Coach and one IT support person per 300 students. Collaboration between the EdTech Director and the IT Deputy Director was emphasized to ensure alignment between educational goals and technical execution. A key function of this team was to learn how to conduct Research and Development (R&D), operate a Proof of Concept (PoC) flowchart for evaluating new technology requests, and design effective workflows for technology use.

Modernizing Step 7 for 2025+: Cultivating AI-Fluent Human Capital – Investing in Agile, Ethical, and Collaborative R&D Teams

The imperative to "Invest in People" is magnified exponentially in the age of AI and XR. The complexity, rapid evolution, and ethical dimensions of these technologies demand a significant upskilling and potential restructuring of educational technology and IT teams.

Evolving Roles and Ratios for the AI Era:

- **Director of Educational Technology & AI Strategy:** This pivotal leadership role expands significantly. Beyond general EdTech oversight, this individual must now champion the school's AI vision, lead the development and implementation of AI ethics policies and data governance frameworks, and spearhead AI-specific

professional development initiatives. They are the primary driver for realizing the vision articulated in the CI EdTech Roadmap.¹

- **AI-Pedagogy Coaches (Evolving from EdTech Coaches):** These coaches require deep pedagogical expertise combined with specialized knowledge of AI tools and platforms (e.g., Magic School AI ¹⁹, SchoolAI ²³, Flint Learning AI ²⁶). They must be adept at guiding teachers in AI ethics, designing AI-augmented instructional strategies, and applying frameworks like AI-TPACK.⁷⁷ The 1:300 coach-to-student ratio suggested in 2015 may need revision based on the depth of AI integration and the intensity of support required.
- **Data Scientists / Learning Analysts (Potential New Role):** The WASC recommendation in the CI EdTech Roadmap for a "dedicated staff member to oversee data analysis" ¹ becomes even more critical with AI. This role would be responsible for managing, interpreting, and ethically leveraging data from AI learning analytics platforms to inform instruction and improve student outcomes.⁷¹
- **IT Support Specialists (AI/XR Focused):** The IT team needs enhanced skills in deploying and managing AI platforms, supporting diverse XR hardware (Apple Vision Pro ³⁰, Android XR devices ¹²), implementing advanced cybersecurity measures tailored for AI systems, and potentially managing interoperability solutions like the Model Context Protocol (MCP).⁴¹

R&D and PoC for AI/XR – A More Complex and Critical Landscape:

The R&D function becomes central to navigating the AI/XR frontier.

- **Complex PoCs:** Requests for new technologies will increasingly involve complex AI systems rather than standalone apps. Proof of Concept evaluations must now routinely include rigorous ethical reviews (assessing for algorithmic bias, ensuring fairness, addressing data privacy concerns ⁵⁷), comprehensive data security assessments, and thorough interoperability checks (e.g., compatibility with existing systems via MCP ⁴¹).
- **Continuous Horizon Scanning:** The R&D team must actively monitor the rapidly evolving AI landscape, including trends in generative AI ⁶, agentic AI ¹⁷, emerging AI-first hardware ⁸, advancements in AI ethics research and guidelines (from organizations like UNESCO ⁶⁵ and IEEE ⁶⁹), and the capabilities of new creative and coding tools like Google's Veo 3 ² or Vibe Coding platforms.⁴

Workflow Design for Human-AI Collaboration:

Developing effective workflows is no longer just about system-to-system connections but about designing optimal human-AI interaction pathways. This includes establishing protocols for how teachers and students engage with AI tools for various purposes: for instance, workflows for using AI in formative assessment, for leveraging AI to generate personalized learning plans, or for guiding students in using AI ethically for research, content creation, and

problem-solving.

The CI EdTech Roadmap ¹ directly supports this modernized Step 7 through its emphasis on "Prepared Educators" and "Skilled and Sufficient Technical Support." The ISTE Essential Conditions survey data presented in the Roadmap ¹ indicates that these are areas requiring ongoing attention and investment. The WASC recommendation for a "dedicated staff member to oversee data analysis" ¹ is a clear call to invest in a new human role that is indispensable for effective AI integration.

Investing in people in the context of AI and XR transcends the mere acquisition of technical skills. It is fundamentally about cultivating *adaptive expertise*, fostering *ethical leadership*, and nurturing a culture of *continuous learning*. The unprecedented pace of AI development means that knowledge of specific tools or platforms will quickly become outdated. The truly crucial investment lies in developing individuals who can learn continuously, think critically and ethically about new AI capabilities, lead nuanced discussions about responsible AI use, and guide pedagogical innovation in an increasingly uncertain and complex future. The original manual's emphasis on R&D and PoC processes ¹ remains valid, but the nature of these processes shifts. For AI, the "Research" component becomes a continuous, mission-critical activity due to the technology's rapid evolution. The "Development" aspect is less about creating bespoke tools in-house and more about developing innovative *pedagogies*, robust *ethical frameworks*, and effective *support structures* for leveraging external AI tools and platforms. The "People" who drive Step 7 must themselves be dedicated lifelong learners, modeling the adaptability and intellectual humility required to navigate the AI world. This aligns powerfully with the ISTE Educator Standard of "Learner" ⁷³ and the ISTE Education Leader Standard of "Connected Learner".⁷⁹ The CI EdTech Roadmap's ¹ strategic focus on professional development and the potential for new data analysis roles directly supports this imperative for enhanced human capabilities in an AI-driven educational environment.

Actionable Recommendations for 2025+ for Step 7:

To cultivate the necessary human capital for the AI/XR era, institutions should:

1. Redefine existing EdTech and IT roles and potentially create new positions to explicitly include expertise in AI strategy, AI ethics, AI pedagogy, data science, and XR technologies. Consider roles such as "AI Integration Specialist," "Educational Data Scientist," or "XR Learning Experience Designer."
2. Invest significantly in continuous, advanced, and differentiated professional development for all EdTech, IT, and instructional leadership staff. This PD should cover emerging AI trends, AI ethics and governance ⁵⁹, AI-augmented pedagogy (including frameworks like AI-TPACK ⁷⁷), and practical experience with specific AI platforms (e.g., Magic School AI, SchoolAI) and XR devices.

3. Establish a multi-stakeholder "AI Ethics and Innovation Council" comprising educators, administrators, IT staff, students, and potentially parents and community members. This council would guide R&D efforts, oversee PoC evaluations, and lead the development of policies for new AI and XR tools.
4. Develop and implement clear Proof of Concept (PoC) workflows for all proposed AI tools. These workflows must include mandatory ethical reviews, data privacy impact assessments (DPIAs), and evaluations of potential algorithmic bias before any tool is approved for wider use.

Step 8: Customize Learning Standards/Models to match your culture – Core Principles Revisited

2015 Core Principles:

Step 8 of the original manual emphasized that while international standards and models (such as ISTE Standards, SAMR, and Common Sense Media for Digital Citizenship) provide essential guidance, schools must thoughtfully adapt and customize these frameworks to align with their unique institutional culture, which is shaped by factors like geography, curriculum (e.g., IB), economic context, and community values.¹ The manual also highlighted the importance of embracing global trends in education, such as the shift towards deeper learning approaches like Project-Based Learning (PBL) and inquiry-based learning. The example of the "One to World iPad Programme" illustrated how a school could synthesize various models—Bloom's Taxonomy, the Learning Pyramid, SAMR, and ISTE Standards—into a cohesive pedagogical framework tailored to its specific context and goals.

Modernizing Step 8 for 2025+: Weaving AI/XR into the Fabric of Your School's Learning Culture – Hyper-Personalization with Global Standards

The need to customize learning standards and models becomes even more pronounced with the integration of AI and XR, as these technologies introduce new literacies, ethical considerations, and pedagogical possibilities that must be contextualized within the school's specific values and learning objectives.

Adapting Standards for an AI-Augmented and XR-Enhanced Culture:

- **ISTE Standards:** The existing ISTE Standards for Students ⁷⁴, Educators ⁷³, and Education Leaders ⁷⁹ provide a robust foundation. Customization involves defining how these standards are enacted when students are co-creating with AI, learning within immersive XR environments, or managing their digital identity in AI-driven platforms. For instance, the "Digital Citizen" standard for students now explicitly includes understanding AI ethics, data agency, and the ability to critically evaluate AI-generated content.
- **SAMR Model:** The school's culture should actively encourage and support educators in moving beyond using AI for mere Substitution (e.g., AI as a slightly

more advanced search engine) towards Modification and Redefinition (e.g., AI enabling novel, student-led global projects that address authentic problems).⁵⁶ The customization lies in identifying culturally relevant projects and problems where AI can be a transformative tool.

- **Common Sense Media (or similar Digital Citizenship Frameworks):** Guidelines on digital citizenship and media literacy, referenced in the original manual¹, require significant updates to address AI-specific issues. These include educating students about deepfakes, the critical evaluation of AI-generated content, understanding algorithmic bias in information feeds, and navigating data privacy in an AI context.⁶
- **UNESCO AI Competency Frameworks:** The AI Competency Frameworks for Students and Teachers developed by UNESCO offer an excellent, globally informed starting point for schools to customize AI-related competencies to their local context, curriculum, and cultural values.⁶⁵ These frameworks can be adapted to align with existing school standards and learner profiles.

AI and XR in Deeper Learning Approaches:

AI and XR tools can significantly amplify deeper learning methodologies:

- **Project-Based Learning (PBL) and Inquiry-Based Learning:** AI tools can supercharge these approaches. Students can use generative AI for initial research, brainstorming complex questions, and outlining project plans.⁸³ Agentic AI tools or Vibe Coding platforms can assist in developing technical components of projects.⁴ AI video generation tools like Veo 3 can be used to create compelling project presentations or documentaries.² XR can provide immersive environments for inquiry and exploration relevant to PBL.
- **Personalized AI Tutors:** Platforms like Flint²⁶, Khanmigo⁸⁸, and others can provide individualized scaffolding and support for students working on diverse, self-directed projects, adapting to their unique learning needs and paces.

XR for Immersive Cultural and Contextual Learning:

XR technologies, such as Apple Vision Pro 30 and Android XR platforms 12, offer unparalleled opportunities for deeply contextualized and culturally relevant learning experiences. These can range from virtual field trips to historically significant sites around the world, to immersive simulations of scientific phenomena, to interactive cultural exchange programs with students in other countries. The customization involves selecting or creating XR content that aligns with the school's curriculum, local heritage, and specific learning objectives.

The CI EdTech Roadmap¹ provides a clear example of this customization process in action. The "K-12 Digital Literacy Standards - Dion Norman" and the "Updated Standards (2024)" mentioned in the Roadmap¹ represent the institution's current efforts to tailor standards to its needs. These existing standards will require careful

review and updating to explicitly incorporate AI literacy (including understanding concepts like prompt engineering and algorithmic bias), XR literacies (navigating and creating in immersive environments), and guidelines for the ethical use of these emerging technologies. Crucially, the "Pedagogical Foundations" of the school—its Mission, Philosophy, Core Values, and the IB Learner Profile, as cited in the Roadmap¹—must serve as the guiding principles that shape how AI and XR standards are customized and integrated into the learning culture.

Customizing standards in the AI era is a more profound task than simply adding a list of "AI objectives" to existing curricula. It necessitates a fundamental re-evaluation of which competencies—such as critical thinking, ethical reasoning, creativity, collaboration, and adaptability—become most vital when AI can automate many routine cognitive tasks. The challenge and opportunity lie in how the school's unique culture, values, and pedagogical approaches can foster these higher-order human skills in an environment increasingly rich with AI and immersive technologies. The original manual emphasized adapting standards to the local culture.¹ The CI EdTech Roadmap¹ demonstrates this with its bespoke "K-12 Digital Literacy Standards." The advent of powerful AI that can generate sophisticated text, code, art, and analyses⁶ fundamentally challenges traditional notions of literacy and skill. Therefore, "customizing standards" in 2025 means deeply considering what it means to be literate, to think critically, and to create innovatively *in collaboration with AI*. It is less about teaching students *about* specific AI tools (which will rapidly change) and more about cultivating enduring human skills that AI can complement but not replace. This entire process must be grounded in the school's specific cultural values and educational philosophy, such as the attributes of the IB Learner Profile (e.g., "Thinkers," "Inquirers," "Reflective") mentioned in the CI EdTech Roadmap.¹

Actionable Recommendations for 2025+ for Step 8:

To effectively weave AI and XR into the fabric of the school's learning culture:

1. Form a diverse and representative committee—including teachers from various disciplines and grade levels, students, parents, administrators, and technology leaders—to review and update the school's existing Digital Literacy Standards (referencing the CI EdTech Roadmap¹ as a starting point). This revision process should explicitly incorporate AI competencies (drawing from frameworks like ISTE Standards and UNESCO's AI Competency Frameworks⁶⁶), XR literacy skills, and clear ethical guidelines for the use of emerging technologies.
2. Develop and showcase exemplar AI-infused and XR-enhanced units and projects that are aligned with the school's customized standards, promote deeper learning approaches (such as PBL and inquiry-based learning), and resonate with the school's unique cultural context and values.

3. Ensure that the process of customizing standards and models is iterative and dynamic, reflecting ongoing dialogue with the entire school community about the evolving role of AI and XR in teaching and learning. This connects directly to the principles of Step 12 (The 5 R's).
4. Integrate training on these customized standards and AI-augmented pedagogical models into ongoing professional development programs for all educators.

Step 9: Flip your I.T. Department – Core Principles Revisited

2015 Core Principles:

Step 9 of the original "Don't Just Do IT!" manual, "Flip your I.T. Department," called for a paradigm shift in how IT functions within an educational institution.¹ It encouraged "out of the box" thinking regarding the traditional roles of IT support, applications management, and network operations. Key ideas floated included a stronger emphasis on Research and Development (R&D) within IT, the necessity of supportive and strategic budgets for technology, the exploration of Bring Your Own Device (BYOD) programs for students, the provocative idea of BYOD for staff (termed EBYO - Everybody Bring Your Own), and the potential for 24/7 IT support models, possibly through shared service centers. The underlying message was to transform IT from a reactive service provider to a proactive enabler of innovation.

Modernizing Step 9 for 2025+: Transforming IT into an AI/XR Innovation & Ethics Hub – From Support Center to Strategic Enabler

The advent of AI and XR places entirely new and significantly more complex demands on school IT departments, necessitating a profound transformation of their roles, skills, and strategic orientation.

New Demands on IT from AI/XR:

- **AI Platform Management and Governance:** IT departments will be responsible for deploying, managing, securing, and ensuring the ethical operation of a diverse array of AI teaching platforms (e.g., Magic School AI ¹⁹, SchoolAI ²³), various AI models, and AI development tools (such as Vibe Coding platforms ⁴). This includes managing licenses, updates, and user access.
- **XR Infrastructure, Content Delivery, and Device Management:** Supporting immersive learning requires IT to manage sophisticated XR devices (e.g., Apple Vision Pro ³⁰, Android XR devices ¹²), develop strategies for efficient XR content delivery (which can be bandwidth-intensive), and ensure the network infrastructure can handle the demands of high-fidelity immersive experiences.
- **Advanced Data Governance & Security for AI:** This is a paramount concern. IT must implement and enforce robust data privacy measures for all student data used by AI systems ⁵⁷, ensuring strict compliance with regulations like FERPA,

COPPA, and GDPR. They will also be responsible for managing the data infrastructure required for AI learning analytics platforms and ensuring its ethical use.⁷¹ This represents a significant expansion of the traditional "Applications" team's responsibilities, requiring expertise in data lifecycle management and AI-specific security protocols.

- **Interoperability and Protocol Management (e.g., MCP):** As AI ecosystems become more complex, IT will need to support the integration of various AI tools with existing school systems (SIS, LMS, etc.). This may involve leveraging emerging standards like the Model Context Protocol (MCP) to ensure standardized and secure connections between AI agents and diverse data sources or services.⁴¹
- **Ethical AI Deployment and Oversight:** IT personnel must be actively involved in the ethical vetting of all new AI tools. This includes understanding potential algorithmic biases⁶⁷, ensuring transparency in how AI tools operate, and supporting the responsible and equitable deployment of AI across the institution.

Rethinking IT Department Structure & Skills (Connecting to Step 7):

This expanded mandate requires a fundamental shift in IT's operational model:

- **From Reactive Support to Proactive Innovation Enablement:** The IT department must evolve from primarily a break-fix and maintenance function to a strategic partner that proactively identifies, evaluates, and enables the adoption of innovative AI and XR solutions.
- **Specialized Skill Sets:** The IT team will require members with specialized skills in AI technologies, data science, advanced cybersecurity (particularly for AI systems), XR device management, and network optimization for immersive applications.
- **Enhanced Collaboration:** Far closer and more integrated collaboration will be necessary between the IT department, AI-Pedagogy Coaches (formerly EdTech Coaches), curriculum developers, and potentially new roles such as Educational Data Scientists, as suggested by the WASC recommendation in the CI EdTech Roadmap.¹

BYOD/EBYO in an AI/XR World:

The "EBYO" (Everybody Bring Your Own) concept for staff 1 becomes more nuanced. While staff might continue to bring personal laptops for general productivity, specialized AI software often requires specific licenses, and high-performance XR devices represent a significant cost that may necessitate institutional provision or substantial stipends. For students, BYOD policies face even greater challenges. Ensuring equitable access to devices capable of running demanding AI applications or delivering high-quality XR experiences is a major hurdle.⁵⁹ Minimum device specifications for AI and XR readiness will become critical, and

schools will need strategies to support students whose personal devices do not meet these standards.

24/7 Support for AI-Powered Learning Environments:

If AI tutors and AI-driven learning platforms are designed to be accessible to students 24/7, the traditional model of IT support (typically aligned with school hours) may need to evolve. This could involve exploring AI-powered helpdesk solutions for common issues, developing extensive self-help resources, or considering partnerships for after-hours support for critical systems.

The CI EdTech Roadmap¹ directly addresses the need for a modernized IT function through its ISTE Essential Condition of "Skilled and Sufficient Technical Support." The survey results presented in the Roadmap¹ indicate that this is an area recognized as needing improvement and investment. Furthermore, any WASC recommendation for a "Centralized Technology Team"¹ would logically become the organizational home for this transformed, strategically focused IT department.

"Flipping the IT department" in the age of AI and XR signifies a transformation far deeper than just adopting new support models or technologies. It requires IT professionals to become deeply embedded in pedagogical discussions, ethical deliberations, and strategic innovation planning, moving far beyond their traditional role of technical upkeep. They become co-designers of the AI-infused learning ecosystem and crucial guardians of digital safety, data integrity, and ethical technology use. Their role shifts from primarily infrastructure managers to indispensable strategic partners in the institution's educational mission. The original Step 9 focused on efficiency and forward-thinking support models.¹ With AI and XR, IT's responsibilities expand dramatically. They are no longer just "keeping the network healthy"¹; they are managing systems that directly shape student learning experiences (AI tutors), handle vast quantities of highly sensitive student data (AI learning analytics platforms⁷¹), and operate in an environment fraught with complex ethical questions (AI bias, data privacy⁶⁷). Therefore, IT leaders and staff must be integral participants in discussions about curriculum, pedagogy, and ethics, reflecting the collaborative team model envisioned in Step 7.¹ The CI EdTech Roadmap's¹ call for "Skilled and Sufficient Technical Support" must be interpreted through this expanded, more strategic, and ethically-aware lens.

Actionable Recommendations for 2025+ for Step 9:

To transform the IT department into an AI/XR innovation and ethics hub:

1. Invest strategically in upskilling and reskilling the IT team, focusing on AI platform management, data security and governance for AI systems, XR technologies, network optimization for immersive experiences, and foundational principles of ethical AI.

2. Formally integrate IT staff into curriculum development teams, pedagogical planning committees, and ethical review boards, especially when AI and XR tools are being considered for adoption.
3. Develop clear Service Level Agreements (SLAs) that define the support IT will provide for AI and XR tools, platforms, and user experiences, ensuring clarity for educators and students.
4. Proactively explore and pilot AI-powered tools for IT support automation (e.g., AI chatbots for common troubleshooting, predictive analytics for network maintenance) to free up human IT staff for more complex, strategic, and user-facing responsibilities.
5. Conduct a thorough re-evaluation of existing BYOD/EBYO policies in light of the specific technical demands of emerging AI and XR technologies and the overarching institutional commitment to equitable access for all learners.

Step 10: Understand Change Facilitator Styles and how to ignite your Change Agents – Core Principles Revisited

2015 Core Principles:

Step 10 of the original roadmap, "Understand Change Facilitator Styles and how to ignite your Change Agents," emphasized the profound impact of leadership on the success of technology integration initiatives.¹ Drawing on the work of Hall & Hord, it highlighted three main change facilitator styles—Initiators, Managers, and Responders—and stressed that an "Initiator" style is most conducive to successful implementation. A key message was the importance of leadership saying "YES" to teacher-led innovation, provided the school's Implementation Ability could support such endeavors. Teachers were identified as vital resources and catalysts for pushing innovation forward within the school.

Modernizing Step 10 for 2025+: Leading AI/XR Transformation – Cultivating Visionary Initiators and Empowering AI-Fluent Change Agents

The principles of change leadership and the empowerment of change agents are even more critical when navigating the transformative—and often disruptive—potential of AI and XR in education.

Leadership Styles in AI/XR Adoption:

The facilitator styles described by Hall & Hord remain highly relevant in the context of AI and XR adoption 1:

- **Initiators:** These leaders proactively champion a clear and compelling vision for how AI and XR can enhance teaching and learning. They secure necessary resources, create supportive policy environments, empower teachers to experiment ethically with new tools and pedagogies, and drive systemic change. Initiators understand the transformative potential of technologies like generative

AI ⁶, agentic coding ¹⁷, and immersive XR environments ¹⁰, and they work to build the organizational capacity to leverage them effectively.

- **Managers:** These leaders focus on the orderly and efficient implementation of AI and XR initiatives. They ensure that policies are developed and followed, training programs are delivered, resources are managed prudently, and compliance requirements are met. While essential for stability, a purely managerial approach might be more cautious and less inclined to embrace disruptive innovation.
- **Responders:** These leaders tend to address AI and XR issues as they arise, often reacting to requests from teachers or students, or dealing with problems (e.g., AI plagiarism, inappropriate use of XR) after they occur, rather than proactively planning for and shaping the integration of these technologies. For the profound shifts demanded by AI and XR, an "Initiator" leadership style, characterized by vision, proactivity, and empowerment, is crucial for navigating complexities and capitalizing on opportunities.

Identifying and Empowering AI/XR Change Agents:

Change agents are the catalysts who can drive innovation from the ground up. In the AI/XR era, these individuals may include:

- **Educators:** Teachers who are early adopters, curious experimenters, and thoughtful critics of new AI tools (such as Magic School AI ¹⁹, SchoolAI ²³, Vibe Coding platforms ⁴, or AI video creation tools like Google's Veo 3 ²). These are often the individuals who pilot new approaches and share their learning with colleagues.
- **Students:** Students are often at the forefront of adopting new technologies. Those already using generative AI for their learning ⁶, exploring creative coding, or engaging with immersive gaming can be powerful change agents. The "Story of Joe" ¹ could now be the "Story of Jia" who uses AI to design a novel assistive technology or "The Story of Kenji" who creates an educational XR experience. Providing these change agents with access to resources (tools, funding, expertise), dedicated time for exploration and development, and a supportive institutional environment (characterized by a high Implementation Ability) is critical to unleashing their potential.

"Saying YES" in the AI/XR Era:

The empowering act of leadership saying "YES" to innovative ideas from teachers and students takes on new dimensions with AI and XR. A "YES" must now be contingent not only on technical feasibility and alignment with vision but also on a thorough consideration of ethical implications, data privacy requirements, and equity impacts. For example, approving an AI-based project might require an ethical review by the council proposed in Step 7, or the development of a specific data protection plan. The "Flexible Curriculum" advocated in the

original manual 1 becomes even more vital to create the necessary space and time for students to pursue these AI-driven or XR-enhanced projects.

The CI EdTech Roadmap ¹ itself exemplifies an "Initiator" and collaborative leadership approach through its development process, which was "Led by Director of EDTECH in Coordination with EdSteering Team and whole EDTECH team with input from multiple stakeholders".¹ Furthermore, WASC and IB recommendations highlighted in the Roadmap, such as ensuring "continuity of leadership" and establishing "a system to monitor the impact of professional development" ¹, are key enablers for sustained and effective change leadership in the context of ongoing technological evolution.

Igniting and supporting change agents for AI and XR requires more than just permission and resources; it demands that leaders themselves model *ethical digital citizenship* and *critical AI literacy*. If educational leaders do not possess a nuanced understanding of AI ethics, the potential for algorithmic bias, or the importance of data privacy, they cannot effectively guide or empower their change agents to innovate responsibly. Leadership in the AI era is as much about ethical stewardship and fostering a culture of responsible innovation as it is about promoting technological advancement. The original Step 10 emphasized leadership's role in enabling teacher-driven innovation.¹ The introduction of AI and XR brings immensely powerful tools but also significant ethical risks, including bias, privacy violations, and challenges to academic integrity.⁵⁷ A leader who indiscriminately says "YES" to every AI-related idea without a robust framework for considering these risks is not acting as an effective "Initiator" but potentially as a catalyst for unintended negative consequences. Therefore, effective leadership in the age of AI requires a new dimension: proactive ethical guidance, the establishment of clear ethical guardrails, and the cultivation of a *responsible* innovation culture. This aligns directly with the ISTE Standards for Education Leaders, particularly the role of "Equity and Citizenship Advocate".⁷⁹ The overarching vision articulated in the CI EdTech Roadmap ¹ must inherently embed these critical ethical dimensions.

Actionable Recommendations for 2025+ for Step 10:

To cultivate visionary leadership and empower AI-fluent change agents:

1. Provide targeted leadership development programs focused on AI ethics, the pedagogical potential of AI and XR, change facilitation strategies for complex technological innovations, and the application of ISTE Education Leader Standards ⁷⁹ and UNESCO AI guidelines.⁶⁵
2. Establish clear, transparent, and supportive pathways for teachers and students to propose AI and XR-based innovations. These pathways should include mechanisms for ethical review, resource allocation, and mentorship (linking to the R&D processes in Step 7 and the visioning in Step 1).

3. Actively recognize, celebrate, and share successful and ethically sound AI and XR innovations led by teachers and students. This helps to build momentum, foster a culture of responsible experimentation, and provide tangible examples for others.
4. Ensure that change agents (both educators and students) are actively involved in the "Ongoing Evaluation" process (ISTE Essential Condition 7, as per the CI EdTech Roadmap ¹) of AI and XR initiatives, providing valuable feedback from the front lines of implementation.

Step 11: Strengthen Your One to World Program – Core Principles Revisited

2015 Core Principles:

Step 11, "Strengthen Your One to World Program," focused on the shift from centralized computer labs to ubiquitous device access for students, encapsulated by the phrase "One Device to a World of Resources".¹ It acknowledged that technology was becoming more user-friendly and "invisible" (e.g., smartphones and tablets becoming commonplace). Bring Your Own Device (BYOD) was identified as a significant emerging trend. Critically, the manual stressed that the success of any One to World or 1:1 program hinges on the foundational pillars—the ISTE Essential Conditions—being firmly in place. Without this foundation, simply providing devices would not lead to meaningful educational transformation.

Modernizing Step 11 for 2025+: From One-to-World to AI-for-All – Ensuring Equitable Access and Agency in Intelligent Environments

The concept of "One to World" evolves significantly in an era defined by AI, XR, and increasingly intelligent, diverse personal devices. The focus shifts from mere device provision to ensuring equitable access to intelligent experiences and fostering student agency within these new digital ecosystems.

The Evolution of "Device": AI-First Hardware, XR, and Intelligent Endpoints:

The very definition of a "device" in an educational context is expanding rapidly. It no longer refers primarily to laptops or tablets. The landscape now includes:

- **AI-First Hardware:** Visionary concepts, such as those emerging from collaborations like Jony Ive and OpenAI, point towards screenless, ambient computing devices designed for seamless human-AI interaction.⁸ These devices aim to integrate AI more naturally into daily life and learning.
- **XR Headsets and Smart Glasses:** Devices like Apple Vision Pro ³⁰, Android XR compatible headsets ¹², and smart glasses (such as Meta Ray-Ban type devices) offer immersive and augmented experiences. A "One to World" program in 2025 and beyond must therefore consider how to provide or support access to this diverse and potentially more expensive range of intelligent endpoints.

Equitable Access to AI and Intelligent Tools:

The core challenge shifts to ensuring that all students have equitable access not just to a

physical device, but to the powerful AI tools and intelligent environments that are reshaping learning and work. This includes access to:

- **Generative AI tools** for research, writing, and creation.
- **AI-powered tutors** like Khanmigo⁸⁸ or features embedded in platforms like Gemini¹⁴ and Claude.¹⁵
- **AI-driven learning platforms** that offer personalized pathways.
- The necessary **connectivity and bandwidth** to effectively use these often cloud-based and data-intensive tools. Failure to address this can significantly exacerbate the "digital divide," creating new disparities based on access to transformative AI and XR capabilities.⁵⁹

BYOD in the AI/XR Era:

Bring Your Own Device policies require careful re-evaluation. Key questions include:

- Can student-owned devices adequately run demanding AI applications or deliver high-quality XR experiences?
- What are the equity implications if a significant portion of students' personal devices lack the necessary processing power, memory, or features?⁵⁹
- How can schools establish and manage minimum device specifications for AI/XR readiness in a BYOD environment?

Student Agency and Data Ownership in AI-Driven Systems:

Beyond physical device access, a modernized "One to World" program must empower students with agency over their personal data within AI systems. As AI tools collect and analyze vast amounts of student data for personalization and analytics, it is crucial that students understand how their data is being used, have rights concerning their data, and develop the skills to manage their digital footprint responsibly. This connects directly to emerging Web3 concepts of data ownership and decentralized identity⁵² and is a critical component of digital citizenship in the AI age, as reflected in the ISTE Standards for Students.⁷⁴

The CI EdTech Roadmap¹ places strong emphasis on "Equitable Access" as one of the ISTE Essential Conditions. The Roadmap asserts, "Schools and districts that provide equitable access to devices, connectivity and capable teachers will find that their technology initiatives narrow the opportunity gaps among students".¹ This principle must now be explicitly extended to encompass equitable access to AI tools, XR experiences, and the new generation of intelligent devices. While the CI Roadmap's survey data¹ indicates that "Equitable Access" is perceived as relatively strong (largely in the "Meets" or "Exceeds" categories), this assessment likely reflects access to traditional devices and internet connectivity. A re-evaluation is necessary to determine equitable access in the context of more demanding and potentially costly AI and XR technologies.

Strengthening a "One to World" program in 2025 and beyond is fundamentally less about achieving device saturation with a single type of hardware and more about ensuring *equitable access to intelligent experiences* and fostering *student agency* within complex, AI-driven digital ecosystems. The physical "device" increasingly serves as a gateway to personalized AI tutors, collaborative XR environments, AI-powered creative suites, and vast networks of information and expertise. The strategic focus must therefore shift from merely providing hardware to ensuring that all students can equitably access and benefit from these intelligent software platforms and immersive experiences. The original Step 11 focused on device access as a means to reach a "World of Resources".¹ Now, those "resources" are themselves becoming intelligent and interactive (AI tutors, generative AI). The "device" is also diversifying, with XR headsets and AI-first hardware on the horizon.⁸ Consequently, "strengthening" the program means ensuring all students can engage with and benefit from these *intelligent experiences*, not just possess a piece of hardware. This raises significant equity concerns⁵⁹ if access to powerful AI assistants, personalized learning algorithms, and immersive XR environments is unevenly distributed. The CI EdTech Roadmap's¹ commitment to "Equitable Access" must be re-interpreted and re-energized to address this new landscape of intelligent tools and diverse technological endpoints.

Actionable Recommendations for 2025+ for Step 11:

To evolve the "One to World" program into an "AI-for-All" reality:

1. Conduct a comprehensive "Equitable AI/XR Access Audit" to identify current disparities in student access to capable devices, essential AI software and platforms, high-speed internet connectivity (both at school and home), and supportive learning environments for AI and XR.
2. Develop a multi-tiered device and access strategy. This strategy should ensure that all students have baseline access to essential AI tools and platforms, while also creating pathways and providing support for students to engage with more advanced AI applications and XR experiences as appropriate for their learning goals.
3. Integrate robust AI literacy and data agency education into the core of the "One to World" or 1:1 program. This curriculum should empower students to understand how AI systems use their data, manage their digital footprint effectively, and exercise their rights in an increasingly AI-driven world, drawing upon resources like UNESCO's AI Competency Framework for Students.⁶⁶
4. Actively explore and pursue partnerships, grants, and other funding opportunities to provide equitable access to emerging AI-first hardware and XR devices for all students, with a particular focus on supporting students from disadvantaged

backgrounds or those with special learning needs.

Step 12: 5 R's - Reflect, Research, Re-Plan, React, Redevelop – Core Principles Revisited

2015 Core Principles:

The final step of the original 12-Step EdTech Roadmap, "5 R's - Reflect, Research, Re-Plan, React, Redevelop," emphasized the inherently dynamic nature of educational technology and the necessity for continuous improvement.¹ It asserted that any EdTech Roadmap is not a static document but a living plan that requires refreshing every few years to incorporate new pedagogical approaches, emerging technologies, and data-informed insights. The manual highlighted that visionary leadership, coupled with the courage to stay connected with evolving Industry and Student Tech Culture, is paramount for sustaining an innovative environment. A key takeaway was that once an innovative culture is successfully established, it tends to be resilient and self-perpetuating. The step concluded with the enduring Japanese proverb: "Vision without action is a daydream. Action without vision is a nightmare," reinforcing the need for both foresight and iterative execution.

Modernizing Step 12 for 2025+: The AI-Driven Iteration Cycle – Continuously Refining Strategy in a Hyper-Evolving Landscape

The 5 R's cycle of continuous improvement becomes even more critical and must operate at an accelerated pace in the era of AI and XR, where technological advancements, pedagogical understanding, and ethical considerations are evolving with unprecedented speed.

The Accelerated Pace of AI/XR Evolution Demands Agile Iteration:

The landscape of AI and XR is characterized by constant flux. AI models like Google's Gemini 1.5 and Anthropic's Claude 3.5 are updated frequently with enhanced capabilities. New AI tools for specific educational or creative purposes, such as Google's Veo 3 for video generation² or Vibe Coding platforms for natural language programming⁴, emerge regularly. Concurrently, our understanding of the ethical implications of AI and best practices for its use in education is also rapidly developing. This hyper-evolution necessitates that the 5 R's cycle becomes more agile, responsive, and deeply embedded in the school's operational culture.

The 5 R's in an AI/XR Context:

- **Reflect (with AI-Powered Analytics and Ethical Scrutiny):**
 - Systematically use AI-powered learning analytics platforms⁵, where ethically appropriate and with robust data privacy safeguards, to gather quantitative and qualitative data on the effectiveness of AI and XR integrations. This includes impact on student engagement, learning outcomes across diverse student groups, and teacher workload.
 - Critically reflect on ethical challenges encountered during AI/XR implementation. This includes instances of algorithmic bias in AI tools^{6,7},

issues related to AI-assisted plagiarism or academic integrity ⁶¹, data privacy breaches or concerns ⁵⁷, and any unintended negative consequences on school culture or student well-being.

- **Research (AI-Assisted Horizon Scanning and Best Practice Curation):**
 - Establish a continuous process for researching emerging AI and XR technologies, innovative pedagogical applications, and evolving ethical best practices. AI tools themselves can be leveraged to assist in curating, summarizing, and synthesizing this vast and rapidly growing body of research.
 - Stay consistently updated on revised ISTE Standards ⁷³, UNESCO guidelines on AI in education ⁶⁵, and ethical frameworks from organizations like IEEE. ⁶⁹
- **Re-Plan (Adaptive and Dynamic AI/XR Strategy):**
 - Regularly update the school's overarching EdTech and AI strategy based on the insights gained from reflection and research. This includes revising acceptable use policies, data governance protocols, professional development plans, curriculum integration guidelines, and resource allocation priorities for AI and XR.
 - The CI EdTech Roadmap ¹, as a multi-year strategic document, is itself subject to this iterative redevelopment process. Its goals and initiatives should be reviewed and adjusted in light of new technological possibilities and learned experiences.
- **React (Agile and Informed Responses to AI/XR Developments):**
 - Develop institutional agility to react promptly and thoughtfully to new opportunities presented by AI/XR (e.g., a breakthrough in AI-powered personalized assessment, a highly effective new XR learning environment) or to address new challenges as they emerge (e.g., a novel form of AI-driven academic misconduct, newly identified biases in widely used AI tools).
- **Redevelop (Iterative Improvement of AI/XR Practices and Resources):**
 - Continuously redevelop and refine AI-infused and XR-enhanced learning activities, assessment methods ⁸³, teacher support structures, and student guidance materials to optimize the educational benefits of these technologies while mitigating risks. This involves sharing best practices and lessons learned across the institution.

The CI EdTech Roadmap ¹ directly embodies the spirit of Step 12 through its ISTE Essential Condition of "Ongoing Evaluation." The Roadmap itself, with its 2023-2027 timeframe, implicitly acknowledges the need for a future redevelopment cycle. Furthermore, the WASC and IB recommendations integrated into the Roadmap, which call for systems to monitor the impact of initiatives and to prioritize future efforts based on data and evaluation ¹, feed directly into the reflective and re-planning

phases of the 5 R's cycle.

In the age of AI, the 5 R's cycle transcends a mere procedural review; it becomes a form of *organizational metacognition*. The educational institution must develop the capacity to continuously learn about its own learning and adaptation processes, particularly concerning these powerful, dynamic, and often unpredictable technologies. This requires not only strong and visionary leadership but also the cultivation of a pervasive culture of reflective practice, critical inquiry, and continuous improvement at all levels of the organization—from classroom teachers to district administrators. The original Step 12 emphasized the need for periodic review.¹ The sheer velocity of AI development⁶ demands a more continuous, almost real-time, reflective posture. A significant development is that AI tools themselves, such as sophisticated learning analytics platforms⁷¹, can *support and enhance* this reflective process by providing rich, timely data on what strategies are effective and where challenges lie. This creates a powerful meta-loop: leveraging AI to reflect upon and improve the use of AI in education. Consequently, the "Ongoing Evaluation" component of the CI EdTech Roadmap¹ should not be viewed as a periodic check-in but as an embedded, data-informed, continuous improvement cycle. This iterative approach is crucial for navigating the potential "nightmare" of unreflective action in the fast-changing and high-stakes AI landscape, ensuring that vision and action remain dynamically aligned.

Actionable Recommendations for 2025+ for Step 12:

To embed a robust cycle of continuous improvement for AI and XR integration:

1. Establish a dedicated "AI/XR Futures Council" or integrate this function into the R&D team proposed in Step 7. This group would be responsible for leading the 5 R's cycle specifically for emerging technologies, conducting horizon scanning, and advising leadership on strategic adjustments.
2. Implement comprehensive systems for collecting, analyzing, and reporting data on AI and XR use, student impact, and ethical considerations. This should leverage AI-powered learning analytics where appropriate and ethical, always prioritizing data privacy and security.
3. Schedule regular, at least annual, comprehensive reviews and updates of the school's AI/XR strategy and the broader EdTech Roadmap. These reviews should explicitly use the 5 R's framework (Reflect, Research, Re-Plan, React, Redevelop) to guide the process.
4. Actively foster a school-wide culture of reflective practice regarding all technology use, with a particular emphasis on AI and XR. Create channels and opportunities for teachers, students, and staff to share their insights, experiences, challenges, and successes with these tools, feeding this valuable

qualitative data into the formal review process.

5. Ensure that the "React" component includes mechanisms for rapid ethical review and response to unforeseen issues arising from AI/XR use, such as new forms of academic dishonesty or emergent biases in AI tools.

Part 2: Strategic Imperatives for Innovative Educational Ecosystems

The Evolving Landscape of Educational Technology and School Innovation

The trajectory of educational technology is shifting from the adoption of discrete tools towards the cultivation of interconnected and intelligent learning ecosystems.

Innovation in 2025 and beyond will increasingly be characterized not by isolated technological interventions, but by the synergistic integration of multiple advanced systems. Consider, for example, AI-powered tutoring systems seamlessly integrated with Learning Management Systems (LMS) via protocols like the Model Context Protocol (MCP), enabling fluid data exchange and personalized content delivery.⁴¹

Imagine XR experiences that draw upon real-time data from various sources to create highly contextualized and adaptive simulations. This move towards integrated ecosystems demands a more holistic and systemic approach to technology planning and implementation.

AI, in particular, is emerging as a powerful "innovation catalyst" within education. Its capabilities can accelerate research and development in pedagogy and curriculum design, enable the delivery of personalized learning experiences at an unprecedented scale⁸⁸, and automate a wide range of administrative and instructional tasks. This automation can, in turn, free up valuable human capacity—teacher time and cognitive energy—for more complex, creative, and relational aspects of education, such as deeper student interaction, mentoring, and innovative instructional design.¹⁹

The concept of the "Flexible Curriculum," a cornerstone of the original "Don't Just Do IT!" manual¹, must become even more profoundly adaptable in an AI-suffused world. Curricula need to be designed with the flexibility to allow students to pursue AI-driven inquiries, where they leverage AI tools for research, analysis, and problem-solving. They must also create space for students to become creators with new-generation tools, such as developing applications using Vibe Coding platforms⁴ or producing sophisticated multimedia content with AI video generators like Google's Veo 3.²

True innovation in the educational landscape of 2025 and beyond will arise from the *synergistic* application of AI, XR, data analytics, and other emerging technologies to create fundamentally new types of learning experiences and opportunities. This

represents a significant departure from merely digitizing existing practices or using technology as a more efficient substitute for traditional methods. It requires a fundamental shift in mindset from "EdTech tool integration" to "learning ecosystem design." The original manual highlighted how innovation often arises when the right conditions are in place, as illustrated by the "Story of Joe".¹ The CI EdTech Roadmap¹ is an institutional effort to create these enabling conditions. The new generation of technologies, especially AI, are not just passive tools to be integrated; they can be active *engines* of innovation themselves, for example, by assisting educators in designing novel learning experiences or by empowering students to create solutions previously beyond their reach. This implies that schools need to think systemically about how these tools interact, how data flows between them ethically and effectively, and how they can cultivate a culture where both students and teachers are empowered to leverage these combined capabilities for novel and impactful purposes. This is a conceptual leap beyond simply "adopting an integration model" like SAMR (Step 6 of the Roadmap); it is about actively architecting an innovative, adaptive, and intelligent educational ecosystem.

Cultivating Future-Ready Skills: AI Literacy, Prompt Engineering, Critical Thinking, and Data Literacy

As AI and automation reshape industries and daily life, the portfolio of essential skills for students is evolving. Educational institutions must prioritize cultivating competencies that enable learners to thrive in an AI-suffused world.

- **AI Literacy as a Foundational Skill:** This encompasses a fundamental understanding of what AI is, its core concepts (such as machine learning and large language models), its diverse capabilities, and, crucially, its inherent limitations and potential pitfalls.⁶³ Students need to grasp how AI algorithms are trained, how they can reflect and amplify biases, and the societal implications of widespread AI adoption. UNESCO's AI Competency Frameworks for Students and Teachers provide excellent guidance for developing AI literacy curricula.⁶⁵
- **Prompt Engineering:** As generative AI tools become ubiquitous, the ability to craft effective prompts to elicit desired, accurate, and nuanced outputs is emerging as a critical new literacy. This skill involves understanding how to communicate clearly and strategically with AI models to guide their responses and creative outputs.
- **Critical Thinking in the Age of AI:** The ease with which AI can generate information necessitates an even stronger emphasis on critical thinking. Students must learn to rigorously evaluate AI-generated content for accuracy, bias, relevance, and potential manipulation.⁶⁷ They need to develop the discernment to

know when to trust AI outputs, when to question them, and when to seek human expertise or alternative sources of information.⁶³ A significant challenge to address is the risk of "cognitive offloading," where over-reliance on AI diminishes students' own analytical and problem-solving abilities.⁶⁴

- **Data Literacy:** In an AI-driven world, understanding data is paramount. Students need to comprehend how AI systems collect, process, and utilize data. This includes interpreting data visualizations from AI learning analytics platforms⁷¹, understanding the ethical implications of data collection and usage (privacy, consent, security⁵⁷), and recognizing how data quality and biases can influence AI outcomes.
- **Vibe Coding and Low-Code/No-Code Skills:** The emergence of platforms like Replit and other "Vibe Coding" environments is democratizing software development.⁴ Teaching students to use these tools empowers them to create their own applications, automations, and digital solutions, transforming them from passive consumers of technology into active producers and innovators.

The "Basic Use Skills" mentioned in the 2015 manual, which enabled the housekeeper to learn pierogi-making from YouTube¹, have profoundly evolved. In 2025, effectively interacting with AI systems (which includes skilled prompt engineering), critically evaluating the veracity and potential bias of their outputs, and understanding the ethical implications of AI's data usage *are* the new foundational literacies. Without these competencies, students and educators alike cannot effectively, ethically, or safely leverage the power of AI tools. This shift necessitates a corresponding evolution in curriculum design and pedagogical approaches, moving beyond teaching *about* technology to cultivating deep, transferable skills for navigating and shaping an AI-integrated future.

The Teacher as Learning Architect and AI Collaborator

The integration of AI into education does not diminish the role of the teacher; rather, it profoundly transforms it, demanding new skills, perspectives, and pedagogical approaches.⁸⁷ Teachers are moving from being primary transmitters of information to becoming architects of rich learning experiences and skilled collaborators with AI.

- **Designer of AI-Augmented Learning Experiences:** Teachers will increasingly design learning environments and activities that strategically leverage AI tools to support diverse student needs and learning goals. This involves selecting appropriate AI resources, structuring tasks that encourage human-AI collaboration, and creating opportunities for students to apply AI in meaningful contexts.
- **Curator of AI Resources and Validator of AI-Generated Content:** Given the

vast and often variable quality of AI-generated information, teachers play a crucial role in curating reliable AI tools and resources. They must also guide students in developing the critical evaluation skills necessary to assess the accuracy, bias, and relevance of information produced by AI systems.

- **Ethical Guide and Digital Citizenship Mentor:** Teachers are central to fostering discussions about AI ethics, including issues of algorithmic bias, data privacy, intellectual property, and the responsible use of AI tools.⁶⁰ They model and teach the principles of digital citizenship in an AI-suffused world.
- **Collaborator with AI Tools:** Teachers themselves will increasingly use AI assistants, such as those provided by Magic School AI¹⁹ or SchoolAI²³, for a variety of professional tasks. These can include lesson planning, generating differentiated instructional materials, creating assessments, analyzing student work, and streamlining administrative duties. This collaboration aims to free up teacher time and cognitive resources for more direct student interaction, personalized support, and creative teaching.
- **Embracing the AI-TPACK Framework:** The AI-TPACK (Artificial Intelligence Technological Pedagogical Content Knowledge) framework⁷⁷ provides a valuable model for understanding the new knowledge domains required by teachers. It extends the traditional TPACK model by specifically integrating AI technological knowledge with existing pedagogical and content knowledge, highlighting the interconnectedness of these domains for effective AI integration.

Research and expert consensus suggest that AI is a complementary tool, not a replacement for educators.⁷ The teacher's role evolves from being the primary repository and dispenser of knowledge to that of a sophisticated learning designer, a facilitator of inquiry, a critical thinking coach, and an ethical guide. They create the conditions under which students can effectively and responsibly use AI, critically analyze its outputs, and engage in higher-order cognitive processes. This transformed role aligns with and amplifies ISTE Educator Standards such as "Designer," "Facilitator," and "Analyst".⁷³ Successfully navigating this role transformation requires significant, ongoing professional development and a willingness among educators to embrace new pedagogical paradigms.

Innovative Assessment in the Age of Generative AI: Beyond Traditional Metrics

The rise of powerful generative AI tools presents both profound challenges and significant opportunities for educational assessment.⁸³ Traditional assessment methods, particularly those relying on tasks that AI can now perform (e.g., writing standard essays, solving routine problems, generating basic code), are increasingly vulnerable to issues of academic integrity.⁸³ It is widely acknowledged that AI detection tools are often unreliable and can produce false positives, particularly for certain student demographics, making them an

inadequate solution.⁶

This necessitates a shift towards more innovative and robust assessment strategies:

- **Focus on Process Over Product:** Emphasize the assessment of the learning journey, not just the final artifact. This can involve evaluating drafts, reflections, annotated bibliographies, research journals, and evidence of iterative development.⁸³
- **Prioritize Higher-Order Thinking Skills:** Design assessments that require critical analysis, nuanced evaluation, creative problem-solving, ethical reasoning, and the synthesis of complex ideas—skills that AI currently struggles to replicate authentically.⁸³
- **Authentic and Contextualized Assessments:** Employ more in-class, proctored assessments, oral examinations, presentations, debates, and performance-based tasks that require students to apply their knowledge and skills in real-time or simulated real-world scenarios.
- **Assessments Requiring Personal Connection and Reflection:** Incorporate tasks that demand personal reflection, connection to lived experiences, or hands-on engagement with the physical world, which are inherently difficult for AI to generate genuinely.
- **Transparent and Ethical Incorporation of AI into Assessment:**
 - Design assessments where students are explicitly asked to use AI tools as part of the process.
 - Require students to critique, improve, or extend AI-generated content, demonstrating their ability to evaluate and refine AI outputs.
 - Ask students to document and reflect on their use of AI tools, explaining how AI assisted their process and what they learned from the interaction.⁸³
- **AI for Formative Assessment and Feedback:** Leverage AI tutors and intelligent learning platforms to provide students with real-time, personalized formative feedback, helping them identify areas for improvement as they learn.⁷¹ AI can also assist teachers in generating a variety of formative assessment items and analyzing student responses to inform instruction.¹⁹
- **Developing Assessments for New Literacies:** Create valid and reliable methods for assessing emerging skills such as AI literacy, prompt engineering proficiency, data literacy, and the ability to critically evaluate AI-generated information.

The challenge posed by generative AI to traditional assessment methods can be viewed as a catalyst for positive change. It compels educators to move away from assessments that primarily measure recall or easily automated tasks, and towards those that evaluate deeper conceptual understanding, critical and creative thinking, ethical reasoning, and the complex skills required for success in the 21st century. If AI

can readily "complete" a traditional assessment, it is a strong indicator that the assessment itself may not be measuring the most important or enduring learning outcomes. This realization pushes educators to design assessments that require students to demonstrate their understanding and capabilities in ways that AI cannot authentically replicate, such as through authentic, performance-based tasks, personal reflections that connect learning to individual experiences, and critical evaluations of AI-generated output itself. This shift aligns powerfully with the broader educational goal of fostering future-ready, 21st-century skills.

AI and the Democratization of Knowledge Generation

Artificial intelligence is poised to significantly democratize the processes of knowledge generation and dissemination, empowering a wider range of individuals to participate as creators and contributors.

- **AI as a Research Assistant:** Students and educators can leverage AI tools for sophisticated research tasks, including conducting literature reviews, analyzing large datasets, identifying emerging research trends, and summarizing complex information.⁷ Platforms like Google's NotebookLM are specifically designed to help users conduct research and extract insights from a defined set of source materials.¹⁴
- **AI for Enhanced Content Creation:** The capabilities of generative AI extend beyond text. Tools like Google's Veo 3 enable the relatively easy creation of high-quality video content from textual prompts, opening new possibilities for student projects, teacher-created instructional materials, and multimedia storytelling.² Generative AI can also assist in drafting articles, scripts, lesson plans, and diverse forms of educational materials.
- **Democratizing Development with Vibe Coding and Low-Code/No-Code Platforms:** The rise of "Vibe Coding"⁴ and other low-code/no-code development environments significantly lowers the barrier to entry for creating digital tools, applications, and automations. This empowers students and educators, even those without traditional programming backgrounds, to move from being passive consumers of technology to active producers and innovators, designing solutions to meet specific needs.
- **Critical Challenges in Democratized Knowledge:** This democratization is not without its challenges. Ensuring the quality, accuracy, and reliability of AI-generated knowledge is paramount. Addressing algorithmic bias embedded in AI models and the information sources they are trained on is crucial to prevent the spread of misinformation or skewed perspectives.⁶⁷ Consequently, teaching students and educators to critically evaluate all AI-generated outputs, verify

information, and understand the limitations of these tools becomes an essential responsibility.

AI has the potential to empower a much broader and more diverse group of individuals to participate actively in the creation and dissemination of knowledge. Traditionally, many forms of knowledge generation were the domain of experts or those possessing specialized technical skills, such as coding, advanced statistical analysis, or professional video production. Tools like Vibe Coding platforms⁴ and AI video generators like Veo 3² significantly lower these barriers, enabling more people to translate their ideas into tangible forms and share them widely. This is a powerful democratizing force. However, this democratization carries inherent risks. If the AI tools themselves are built on biased data or are prone to generating inaccurate information ("hallucinations"), then the "democratized" knowledge they help produce can be flawed, misleading, or even harmful. Therefore, the cultivation of critical evaluation skills, as emphasized in Step 8 (Customizing Standards) and throughout this report's discussion of future-ready skills, becomes even more vital in an era of AI-assisted knowledge generation.

Personalized Learning at Scale: AI-Powered Analytics and Adaptive Tutoring Systems

One of the most compelling promises of AI in education is its potential to deliver truly personalized learning experiences at scale, catering to the unique needs, paces, and preferences of individual students.

- **AI-Powered Tutoring Systems:** A growing number of AI tutors and intelligent learning platforms are becoming available. Examples include dedicated platforms like Magic School AI¹⁹, SchoolAI², and Flint Learning AI²⁶, as well as AI-powered tutoring features integrated into broader systems like Khan Academy's Khanmigo⁸⁸, Google's Gemini (with LearnLM capabilities)¹⁴, and Anthropic's Claude (with its Learning Mode).¹⁵ These systems offer capabilities such as personalized instruction, adaptive learning pathways, immediate feedback, and targeted support. Research indicates that such tools can have a positive impact on student engagement, motivation, and learning outcomes.⁷²
- **AI Learning Analytics:** AI algorithms can analyze vast amounts of student data—from performance on assessments and interaction patterns with digital content to engagement levels in online discussions—to identify individual learning patterns, predict students who may be at risk of falling behind, and provide actionable insights for teachers.⁵ These analytics can empower educators to differentiate instruction more effectively, tailor interventions, and make data-informed decisions to improve curriculum and pedagogical approaches.

- **Agentic AI for Dynamic Personalization:** Emerging agentic AI systems hold the promise of even more sophisticated personalization, with AI agents capable of proactively adjusting content, strategies, and support based on a deep, ongoing understanding of each student's evolving needs and learning trajectory.¹⁷
- **Cognitive Science Principles in AI Tutor Design:** The effectiveness of AI tutors is significantly enhanced when their design is grounded in established principles of cognitive science. These include providing scaffolded learning support, incorporating active recall and spaced repetition techniques to strengthen memory, using interleaving to promote deeper conceptual understanding, and facilitating error correction and reflection to support metacognition.⁹⁴
- **Critical Ethical Considerations:** The power of AI in personalization brings with it significant ethical responsibilities. Robust data privacy and security measures are non-negotiable to protect sensitive student information.⁵⁷ Algorithmic bias in personalization engines must be actively identified and mitigated to prevent AI systems from inadvertently disadvantaging certain student groups.⁶⁷ Continuous human oversight and the ability for educators to intervene and override AI-driven recommendations are crucial. Furthermore, equity issues can arise if high-quality AI tutors and personalized learning platforms are not equally accessible or effective for all students, potentially widening achievement gaps.⁵⁹

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