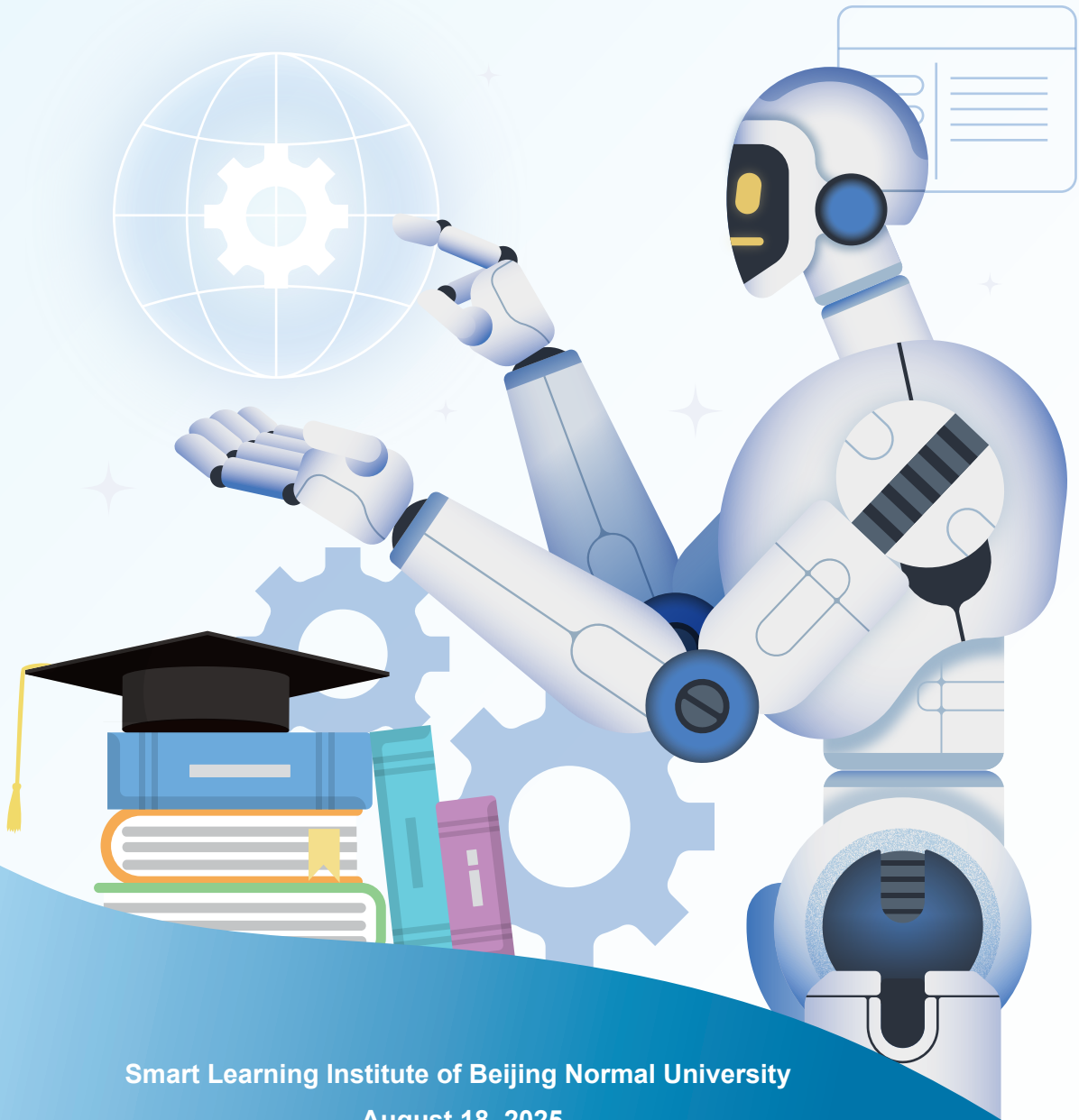
2025 GSENet Annual Report

Smart Education in the Age of AI



Smart Learning Institute of Beijing Normal University

August 18, 2025

Smart Education in the Age of AI

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We would like to thank all the BNU students and graduates who shared their firsthand experiences of learning and teaching. For the protection of their identities, we have kept their names anonymous.

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FOREWORD

Education stands at a defining moment. As the world faces widening inequalities, accelerating technological change, and the urgent imperative of achieving Sustainable Development Goal 4 (SDG 4), the concept of smart education has emerged as both an effective approach and a vision for the future of education. Reimagining smart education in the Age of AI responds to this moment with clarity and conviction—offering a roadmap for transforming learning systems through the ethical and equitable use of artificial intelligence and appropriate technologies.

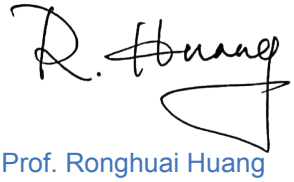
This report is not just a reflection of where we are, but a call to action. While the digital revolution has already begun to reshape education, its benefits remain unevenly distributed—especially across the Global South. This report highlights the need for innovation while demanding systemic, human-centered change to ensure no learner is left behind.

Developed through a collaboration led by Beijing Normal University and Hangzhou Normal University—with support of UNESCO IITE and the Global Smart Education Network (GSENet)—the report draws on decades of research and diverse case studies from countries of the Global South. It is clear that technology alone is not the solution. The future of education must combine the best in the human and the machine, in theory and practice, and in policy and action.

Three themes emerge from this report: i) Teachers are being called into new roles as facilitators, mentors, and co-designers of learning and empowering them is essential to any smart education strategy; ii) Smart education is not a one-size-fits-all approach but must be tailored to local needs, cultures, and infrastructures; iii) South-South cooperation, and cross-sector partnerships are vital to the successful implementation of smart education.

As we look ahead to 2030 and beyond, smart education challenges the education sector to move beyond pilot projects and isolated innovations, toward systemic change guided by principles of equity, ethics, and sustainability. Smart education is not merely a technological upgrade—it is a reimagining of learning itself, built for resilience, inclusivity, and the uncertain challenges of the future.

We extend our deepest appreciation to the researchers, educators, policymakers, and communities who contributed their insights to this endeavor. We hope this report will serve as a critical resource for those committed to transforming education for a fairer, smarter, and more just world.



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The collective efforts of numerous individuals and institutions contributed significantly to the successful completion of this report. We extend our sincere gratitude to all those whose dedication and unstinting support made this work possible.

We acknowledge the leadership of Prof. Ronghuai Huang and Prof. Asha Singh Kanwar,who guided the team of the Smart Learning Institute of Beijing Normal University (SLIBNU) in the development of this report. We are also grateful for the invaluable contributions of Prof. Junfeng Yang of Hangzhou Normal University and his brilliant team of researchers, whose contributions have made this report possible.

Our heartfelt appreciation is extended to each member of the Global Smart Education Network (GSENet), for their collaboration throughout this process. This is their report and would not have been possible without their contributions. Many experts, recognized in the “List of Contributors”, came forward to generously share their insights and resources for shaping this document.

We are especially thankful to the individuals who contributed to research, writing, and coordination. Their tireless efforts and meticulous attention to quality deserve sincere appreciation. In particular, we would like to acknowledge Yao Sun, Haotian Zhu, Yixuan Zhong, Zhanshan Yang, and Chenhui An of Hangzhou Normal University. We wish to thank Prof. Rongxia Zhuang, Dr. Ahmed Tlili, Usama Kalim, Qiang Wang, Mohamed Oubibi, Tingwen Chang, Lin Xu, Jingwen Pan, Mengyu Liu, and Zhisheng Li, the Smart Learning Institute (SLI) team, for their dedication and hard work. We also appreciate the valuable contributions of Michael Agyemang Adarkwah and Jiena Sha, who were always there to provide support.

Last but not least, we acknowledge the contributions of generative artificial intelligence (GenAI), especially ChatGPT and DeepSeek, which accompanied us on this journey with research, drafting, and editing support—a nice instance of human-machine collaboration.

SUMMARY

The rapid proliferation of artificial intelligence (AI) and generative AI (GenAI) agents is creating an unprecedented paradigm shift in global education. While the world continues to grapple with persistent challenges in achieving Sustainable Development Goal 4 (SDG 4)—including learning poverty, teacher shortages, and deep-seated inequities in access—this technological revolution presents both a profound opportunity and a complex set of new challenges. Navigating this new era requires a strategic and human-centered reimagining of what it means to learn, teach, and govern education systems. This working report of Global Smart Education Network (GSENet) aims to provide a comprehensive framework for policymakers, educators, and institutional leaders to navigate the complexities of AI integration, harnessing its potential to create more intelligent, inclusive, and effective learning ecosystems. By analyzing theoretical foundations, best practices, and empirical data, the report explores how smart education can be redefined to meet the demands of an AI-driven future.

The report begins by outlining the persistent global education crises, from access and equity gaps to learning poverty and teacher shortages, positioning smart education as a strategic solution.

In response to the challenges of smart education, the diverse perspectives of smart education were presented. The National Smart Education Framework, produced by the BNU-UNESCO joint project, was first introduced. A global consultation of experts was also conducted to gather insights on how education can thrive leveraging new and novel technologies as a “smart” solution to achieve its transformational potential to shape just and sustainable futures.

The third chapter offers an international outlook on the current state of GenAI adoption in higher education, based on a comprehensive survey of teachers across ten countries with varying income levels. Key findings reveal a burgeoning “intelligence divide” linked to infrastructure disparities, alongside widespread educator concerns about generating inaccurate outputs, ethical implications, and the lack of professional competencies. The data also uncovers nuanced differences in GenAI usage based on economic context, providing critical empirical evidence for targeted policymaking.

The fourth chapter examines the status of AI and ICT in education in Africa, including African Union’s AI strategy, Vision 2063, and the 2023 AI report, underscoring the need for strategic policies, investments, and distinctive approaches. This chapter also calls for beyond a one-size-fits-all approach and points out the potential for China-Africa cooperation to accelerate Africa’s AI development.

The fifth chapter focuses on national-level policies and practices of smart education in Mainland China. At the policy level, around key areas like national vision, planning and infrastructure development, China has built a multi-dimensional, coherent policy system with a series of documents forming institutional guarantees. At the practice level, based on analysis of more than 1000 relevant cases by the Ministry of Education in 2025, it provides empirical references for deepening smart education, serving as references for countries to advance balanced global smart education.

The sixth chapter aims to investigate the integration and application of AI across the Quacquarelli Symonds (QS) Top 100 Universities. The study focuses on three critical domains: Teaching and Learning, Research and Innovation, and University Administration, each of which represents a fundamental aspect of higher education. It aims to identify patterns, best practices, challenges, and emerging trends in AI integration within academia. Drawing on insights from the “100+EdTech Project” and best practices from QS Top 100 universities, several key findings have emerged regarding the transformative role of AI in higher education.

Finally, the report concludes by synthesizing these findings to reimagine the futures of smart education, highlighting the evolving role of AI agents in creating human-AI collaborative learning ecosystems. It culminates in a set of ten actionable recommendations for national governments, educational institutions, and international partners. These recommendations emphasize the need for: focusing on smart education in national strategic planning; investing in AI-ready infrastructure and AI literacy; advancing human-AI collaboration in pedagogy; ensuring ethical governance; and fostering a culture of continuous improvement through multi-sector partnerships.

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ABBREVIATIONS

Abbreviation	Full Form
AETP	Advanced Education Technology Program
AI	Artificial Intelligence
AIEOU	AI in Education at Oxford University
AR	Augmented Reality
AU	African Union
BCI	Brain-Computer Interface
EdTech	Educational Technology
GenAI	Generative AI
GER	Gross Enrolment Ratio
GLM	General Language Model
GSENet	Global Smart Education Network
ICT	Information and Communication Technology
IoT	Internet of Things
LMS	Learning Management System
OECD	Organization for Economic Co-operation and Development
OER	Open Educational Resources
OFDL	Open, Flexible, and Distance Learning
SDG 4	Sustainable Development Goal 4
SDGs	Sustainable Development Goals
UCL	University College London
UIS	UNESCO Institute for Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSW	The University of New South Wales
VR	Virtual Reality
XR	Extended Reality

Contents

1 Introduction

Junfeng Yang, Usama Kalim, Haotian Zhu, Tao Zhan

1.1 Global Education Challenges Entering the AI Era

In 2015, the global community adopted the 17 Sustainable Development Goals (SDGs) to foster peace and prosperity for the planet and the people. Sustainable Development Goal 4 (SDG 4), dedicated to ensuring "inclusive and equitable quality education and lifelong learning opportunities for all" by 2030, is off-track to achieve the expected targets, especially in the Global South (low- and middle-income countries). With the phenomenal developments in technology in recent times, can smart education support countries to accelerate progress towards achieving SDG 4?

Education is the core of human development. It is one of the most important factors of individual empowerment, social mobility, economic growth, and international peace. However, even after several decades of international efforts and policy commitments, millions of individuals are deprived of the right to quality education. In 2023, UNESCO estimated that more than 272 million children and adolescents around the world are out of school, highlighting the existing inequalities that persist. In many countries of the Global South, even when children attend school, they do not achieve proficiency in reading and basic mathematics. There is a learning crisis where 6 out of 10 children in low- and middle-income countries leave primary school without basic literacy or numeracy (UNESCO, 2025).

The crisis in learning is further exacerbated by the lack of qualified teachers. To achieve the targets of SDG 4 by 2030, UNESCO estimates that the world will require about 69 million additional teachers. However, recruitment alone will not suffice. There is an urgent need to enhance the quality of teachers, especially in digital pedagogy, personalized instruction, and inclusive practices (UNESCO, 2023).

In addition, there is a huge disparity in the Gross Enrolment Rates (GER) in tertiary education between the countries of the Global South and the Global North (predominantly high-income countries).

While globally, GER in tertiary education is nearly 40%, the average drops to a mere 10% in Sub-Saharan Africa. Simultaneously, adult illiteracy continues to remain alarming. Two-thirds of the 773 million illiterate adults globally are women, who find it hard to engage fully in society and find stable jobs or educate their own children (UIS, 2022).

While technology is growing at a phenomenal pace, the digital divide continues to persist with billions of individuals, especially in rural or underserved areas, with little or no access to electricity, affordable internet, and computing devices (OECD, 2023). In addition, the gender digital divide is alive and well in the Global South, indicating the existence of structural inequalities in access to digital technologies among men and women. Technology, to be effectively harnessed, needs to be placed in an appropriate political, economic and social context.

The UN Transforming Education Summit 2022 highlights the urgent need to overhaul global education systems, and address the deep crisis marked by inequality, outdated curricula, undertrained teachers, and the inability to equip learners with the skills needed for the 21st century. This requires rethinking the purpose of education to focus on lifelong, inclusive, and values-driven learning across four areas: learning to learn, to live together, to do, and to be. Transformative change will require collective leadership, and strong political will, supported by partnerships to ensure that education truly fulfills its role in shaping a just, sustainable, and peaceful future (United Nations, 2022).

The UN Summit of the Future 2024 emphasizes the key role of science, technology, and innovation to advance sustainable development. Recognizing persistent divides—particularly between developed and developing countries and across gender and marginalized groups—the Pact for the Future commits to international cooperation to ensure equitable access to technologies, promote ethical innovation, and strengthen capacities in the Global South. It underscores the need to invest in the social and economic development of youth through access to quality education and decent jobs, eliminating discrimination and addressing challenges like climate change (United Nations, 2024).

With the entry of the artificial intelligence (AI) era, the rapid evolution of artificial intelligence—particularly generative AI (GenAI)—has profoundly accelerated its integration into educational domains. The unprecedented pace of AI development offers promising opportunities to address the challenges mentioned above. However, alongside these potentials, the

integration of AI into educational practice also generates new and complex issues, including ethical considerations, equity concerns, and pedagogical disruptions. This dual nature underscores the necessity of examining how education systems can effectively and responsibly integrate AI.

In order to address these issues, smart education proposes a revolutionary vision by harnessing the potential of AI technologies and a human-centric approach. Smart education systems, informed by principles of equity, accessibility, and sustainability, have the potential to fast-track the realization of SDG 4.

1.2 Smart Education as the Guiding Vision and Mission

Within this context, smart education can potentially be an effective and efficient solution. Smart education is an approach based on technology and learner-centeredness that uses emerging technologies, including AI, the Internet of Things (IoT), Big Data analytics, Cloud Computing, and virtual/augmented reality (VR/AR) to revolutionize teaching, learning, and educational management. In contrast to traditional methods, smart education systems are flexible, inclusive, data-oriented, and scalable, providing the opportunity to overcome long-standing structural problems in the global education system.

First, smart education has the potential to widen access to learning by removing geographic, financial, and infrastructural obstacles. With the help of mobile learning platforms, open educational resources (OER), and virtual classrooms powered by AI, students in remote or underprivileged communities can access high-quality content and communicate with instructors, and interact with peers.

Second, it has the potential to increase equity and inclusion through multilingual support, individualized learning paths, and assistive technologies that support diverse learners, including students with disabilities.

Third, smart education enhances teaching capacity and quality. Teachers can be assisted with AI-powered tools to automate routine work, including grading, and help develop personalized lesson plans, diagnose learning gaps, to adapt and tailor instruction to suit individual needs. Smart education platforms can provide continuous professional development, as teachers improve their digital and pedagogical skills at scale.

Fourth, smart education is important in closing the digital divide. Although technological solutions are not a panacea

for infrastructural disparities, smart education systems support universal access to affordable digital tools and connectivity through inclusive policies and partnerships. The system focuses on digital literacy education of students and educators to equip them with the skills to work in the knowledge economy.

Finally, smart education can enhance the quality and relevance of education to meet the targets of SDG 4. Smart education prepares learners to become lifelong learners equipped for the future with skills in critical thinking, problem-solving, creativity, and digital fluency.

To sum up, the global education environment is currently experiencing several issues, including access and equity, teacher shortages, and digital exclusion. Technology, to be effectively harnessed, needs to be placed in an appropriate political, economic and social context. To solve these pressing issues, smart education proposes a revolutionary vision. Smart education systems, informed by principles of equity, accessibility, and sustainability, have the potential to fast-track the realization of SDG 4.

In this report, we will first focus on the development of smart education globally. We will first explore the diverse perspectives of smart education, including the international organizations, scholars, and the voices from teachers. Followed by Africa's status on AI and ICT in education, and the analysis of the top 100 universities' AI utilization in teaching and learning. Then, the policies and practices of smart education in mainland China will be presented. The Final section of the report will highlight the importance of smart education, its future directions, and make concrete recommendations that can be implemented to ensure that access to quality education and lifelong learning can become a reality for all.

2 Diverse Perspectives on Smart Education

Asha Singh Kanwar, Michael Agyemang Adarkwah, Usama Kalim, Lin Xu, Mengyu Liu, Zhisheng Li

In the previous chapter, we posed the critical question, “Can Smart Education support countries to accelerate progress towards achieving SDG 4?”. The question highlights the complex and multitudinous challenges facing education systems globally. Technology especially AI is seen as a panacea to these challenges. It is undeniable that many governments have increased investments in digital technologies to enhance the educational process (teaching, learning, research, administrative tasks, etc.). However, the effectiveness of digital technologies in education is still a valid concern and a topic of ongoing debate. The Global Education Monitoring Report 2023 revealed that while technology offers an educational lifeline for millions of students, it excludes many more. At the same time, the rapid pace of development of technologies such as AI/GenAI is putting a strain on education systems worldwide. This calls for consensus-building among key stakeholders, experts, and academics to chart a path forward for safeguarding and shaping the futures of education.

In response, Global Smart Education Network (GSENet) conducted a global consultation of experts to gather their insights on how education can leverage new technologies as a “smart” solution to transform itself for the future. Modern education systems cannot achieve their goal of solving societal issues when traditional education models, often ill-equipped to address the complex and multifaceted societal problems of the 21st century, are still being implemented. UNESCO (2022) proposed a new social contract for education to repair the injustices of the past while transforming the future. As such, smart education uses technologies as a transformative tool in education, grounded in human rights and based on principles of social justice, human dignity and cultural diversity.

2.1 National Smart Education Framework

Since 2020, BNU, in collaboration with international organizations such as UNESCO IITE, ISTE, COL, SEAMEO, and ALECSO, has initiated a joint project on “Rethinking and Redesigning National Smart Education Strategy” to conceptualize a common understanding of smart education. Over the past few

years, a series of annual reports have progressively refined the conceptual, strategic, and practical dimensions of smart education to shape a global consensus.

The 2021 report introduced the National Smart Education Framework (Yang et al., 2022), which consists of four core elements (see Figure 2-1): implementing forward-thinking policy, building smart digital learning environments, transforming teaching and learning, and overarching considerations.

Forward-thinking governance and policy initiatives:

A modernized digital learning ecosystem requires a strategic, long-term commitment from government leaders to develop a national vision and plan for the effective use of educational technology, as well as adequate investments required to ensure effective and sustainable implementation.

Digital learning environments conducive to smart education:

A modernized digital learning ecosystem requires an environment where both formal and non-formal education opportunities are provided by access to the necessary technology (UNESCO, 2020). These digital learning environments allow learning to occur anytime and anywhere, whether on campus or otherwise (Matthew & Halgali, 2019). In addition, leaders, educators, and students must be guided by a shared set of standards, rules, and guidelines around the ethical use of digital information.

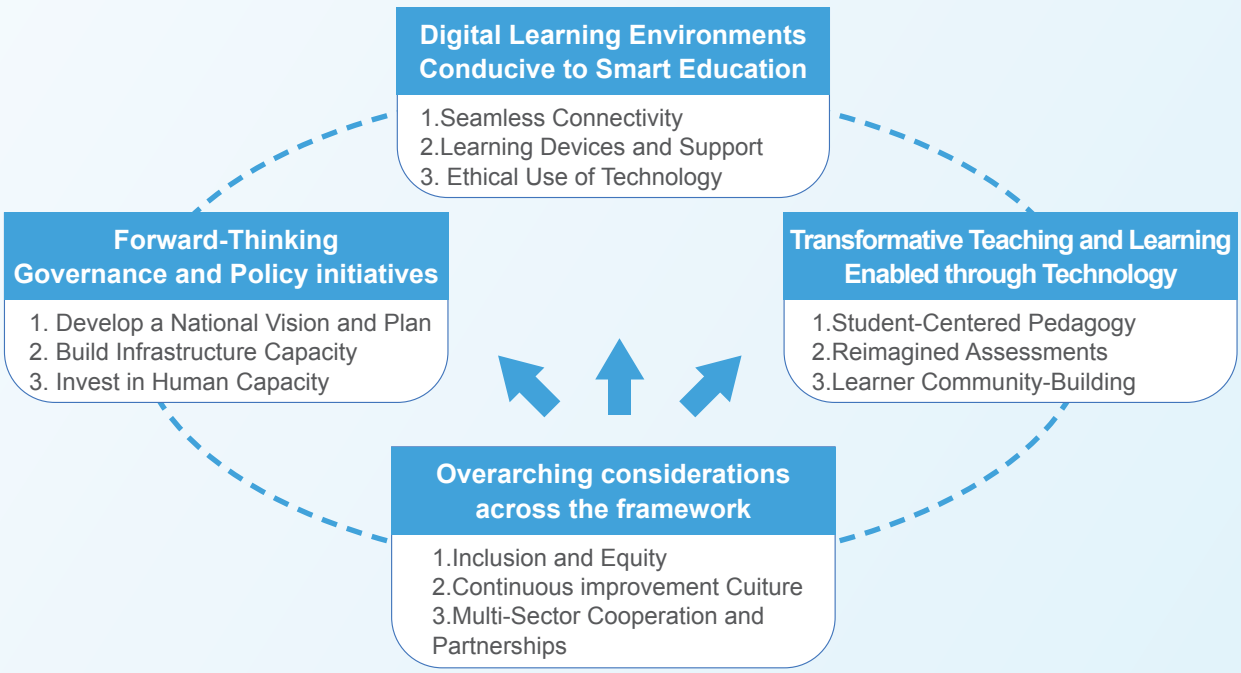

Figure 2-1 National Smart Education Framework

Source: UNESCO IITE, BNU, ISTE (2022) Report on National Smart Education Framework. https://iite.unesco.org/publications/report-on-national-smarteducation-framework/.

Transformative teaching and learning enabled through technology:

A modernized digital learning ecosystem requires a renewed, shared understanding among leaders and stakeholders around what an effective educational experience transformed through technology looks like (Tri et al., 2021). This fundamental shift necessitates an in-depth look at improving pedagogy, assessments, and learner communities.

Overarching considerations:

In implementing the three key leverage points in this framework, government leaders must prioritize several overarching considerations to ensure that the digital learning ecosystem is agile, sustainable, and meets the needs of all stakeholders. First, ensure inclusion and equity, especially paying attention to the needs of disadvantaged groups, such as students in rural areas. Second, a continuous improvement culture needs to be established through cooperation with stakeholders to constantly collect information, evaluate and enhance the educational experience. Thirdly, multi-sector cooperation and partnerships are also key to the effective implementation of smart education. The collaboration among the government, the private sector, social organizations, and higher education institutions can pool the strength and resources of all parties to jointly promote the development of smart education.

The 2022 report highlighted that the smart education system had three layers (see Figure 2-2), such as a smart learning environment, a new model of technology-enhanced learning and teaching, and

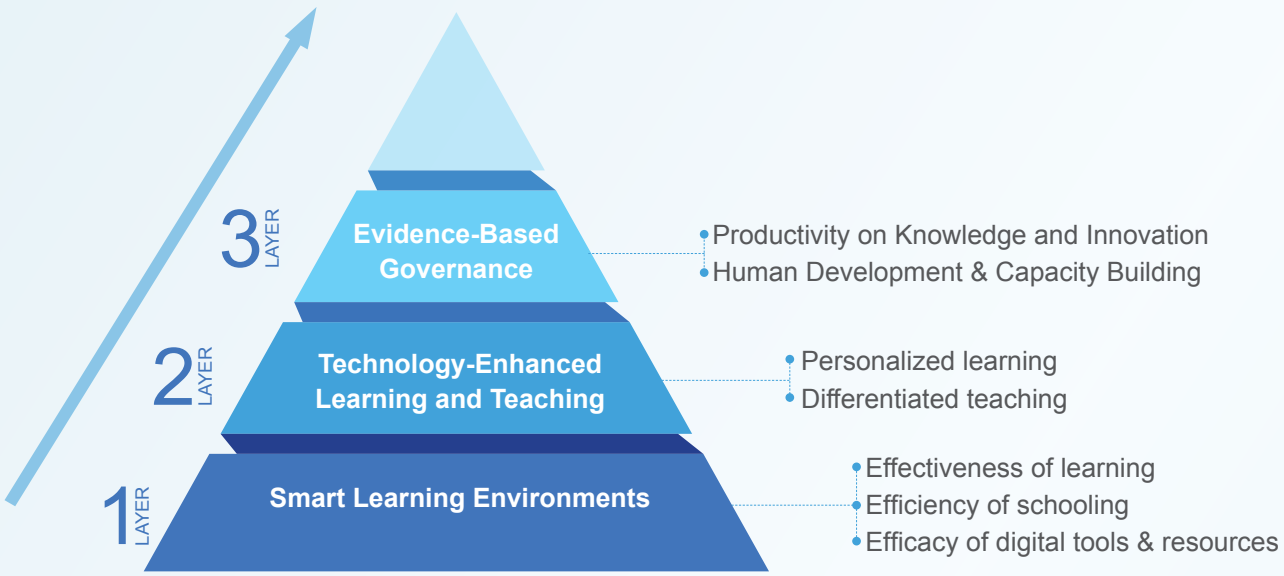

Figure 2-2 Three Layers of Smart Education

Source: GSENet. (2022). Rethinking and Redesigning National Smart Education Strategy.

evidence-based governance of education (GSENet, 2022). The framework emphasized that effective implementation of smart education can continuously improve productivity, efficiency, and impact.

According to the 2023 report, in the realm of education, it is essential to recognize the fundamental components of a smart education ecosystem (GSENet, 2023). This ecosystem includes evidence-based governance, technology-enhanced learning and teaching, and smart learning environments (see Figure 2-3). By understanding and integrating these key features, we can foster a more effective and efficient educational system that caters to the needs of diverse learners. By incorporating these key features into the smart education ecosystem, we can create an environment that promotes evidence-based decision-making, personalized learning experiences, and optimized learning environments. This holistic approach empowers both educators and learners, fostering a more effective, efficient, and inclusive educational system.

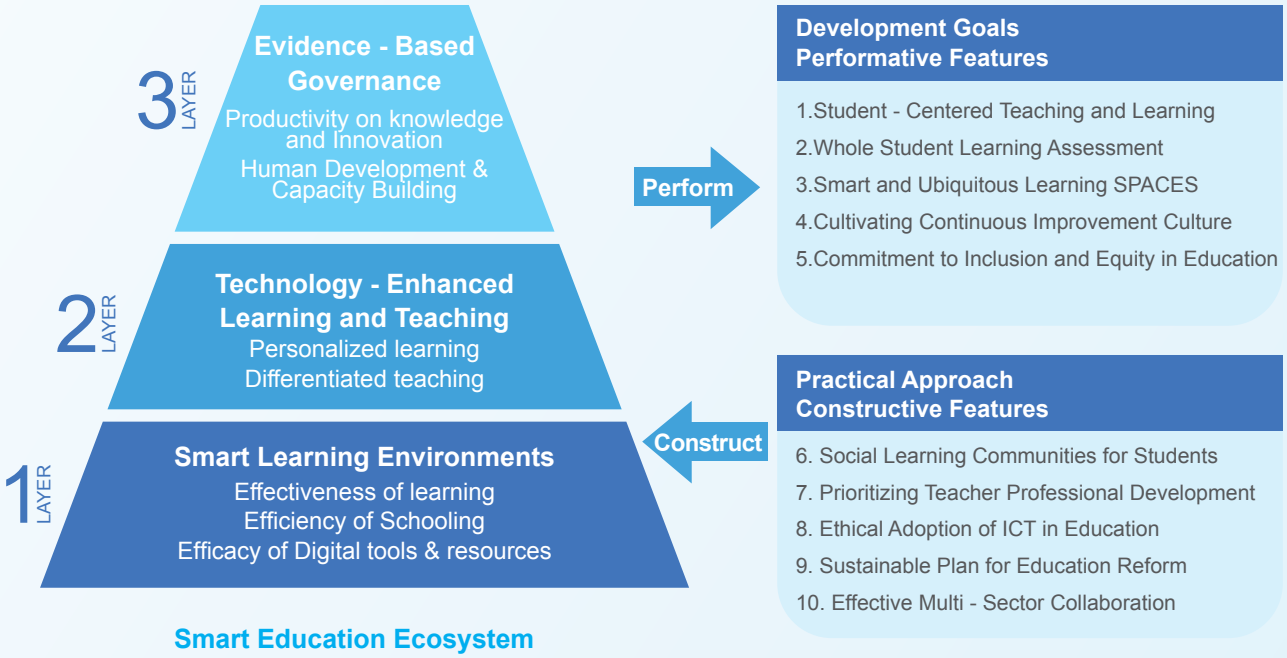

Figure 2-3 Recognizing the Key Features of Smart Education

Source: GSENet. (2023). Consolidating Smart Education Strategies for SDG4.

The 2024 report distilled insights from previous years to offer a consensus understanding of smart education. The report proposed that smart education, often perceived as an enhancement of current educational practices, is regarded as synonymous with both good education and future education (Huang et al., 2024). As a term, smart education is continuously evolving and reflecting the dynamic nature of educational advancements over the past decades. This term aligns with the United Nations' vision of the future of education.

Building on this global consensus, China has taken concrete steps to translate the vision of smart education into action. The White Paper on China's Smart Education was officially released at the 2025 World Digital Education Conference (Ministry of Education of China, 2025). Declaring 2025 as the "Inaugural Year of Smart Education", the paper calls for driving systemic change in education through four elements. First, cultivating future teachers with the capacity to take on new roles and missions. In the future, teachers can reduce workload, enhance instructional effectiveness, support professional growth, and focus on creativity and student-centered innovation through AI-assisted lesson preparation systems, AI-powered tutoring systems, and data-driven teaching research systems. Second, building future classrooms by exploring a new model featuring "teacher-student-machine" collaboration, integrating AI, big data, virtual simulation, and other technologies into the teaching process. The adoption of modular courses, agile learning, open assessments, and immersive learning environments can inspire and motivate teachers and students to participate in knowledge construction and innovation. Third, creating future schools will require the integration of intelligent technologies into all aspects of school operations, including administration, services, and decision-making to effectively modernize school governance. Through data-driven decision-making mechanisms and AI evaluation tools, schools can accurately match educational resources and conduct comprehensive assessments of student development. Fourth, future learning centers can be established with a student-centered approach. Intelligent, ubiquitous, and multimodal future learning centers can enhance students' core competitiveness in adapting to the future. By leveraging digital technologies and AI, the learning centers can reconstruct learning ecosystems and learning paradigms by bringing in high-quality resources to meet the personalized and diversified learning needs of different types of learners.

Over the years, the concept of smart education has evolved with the developments in technology and the needs of the education sector. Grounded in a global consensus and articulated through the 2025 White Paper, China's smart education

vision reimagines education in the digital age. By integrating intelligent technologies and prioritizing innovation, collaboration, and personalization, China aims to build a future-ready education system that empowers learners and educators to thrive in an increasingly uncertain, complex and interconnected world.

2.2 Next Generation Learning Environments

The GSENet held an in-person panel discussion on “Creating Smart Learning Environments that Energize and Inspire” at ISTE Live 2025, held in San Antonio, USA in June 2025. One of the largest Educational Technology (EdTech) conferences in the world, ISTE Live 2025, attracted more than 15,000 participants from 74 countries. The panel brought together a diverse group of global education leaders who provided invaluable insights and a comprehensive framework for creating joyful and motivating digital learning spaces.

The objective was to explore how to infuse smart learning environments with elements that spark genuine joy and motivation across diverse learning contexts. Moving beyond technological novelty, the panel examined the psychological, cultural, and pedagogical dimensions that transform digital learning spaces from merely efficient to truly inspiring. Practical strategies and examples were shared from different international contexts to explore how joyfulness manifests uniquely in various global educational settings. This session was a critical step in expanding the global visibility of GSENet, and its partners and to raise awareness about the benefits of adopting smart learning environments for institutional transformation.

The following questions were discussed in the forum:

- What are the ways in which smart learning environments can bring joy, engagement, and creativity?
- How can technology be designed to meet the well-being of learners and cultural relevance?
- What is the way to scale smart education models fairly in different regions?

Experts shared concrete examples of how smart learning environments were being implemented. The introduction of digital textbooks and AI-enhanced classrooms brought smart learning to even remote communities in China. In the US, there was an increasing emphasis on creating inclusive, joyful, and student-centered digital learning environments. It was also important to focus on the learning needs and preferences of younger learners such as Generation Alpha by developing curriculum-aligned video-based learning systems. Experts stressed the need to focus on responsible and ethical use of AI.

The panel discussion moved beyond the allure of technological novelty to examine the pedagogical and cultural dimensions that can transform digital learning spaces into truly inspiring educational environments. The panel offered essential guidance for educators seeking to redefine smart learning environments, foster genuine student engagement, ensure accessibility and inclusion, and cultivate collaborative ecosystems that address the diverse educational needs of learners across the globe.

The event accelerated the development of closer collaboration between GSENet, ISTE+ASCD, and UNESCO IESALC, and indicated the readiness of GSENet to promote human-centered, inclusive, and adaptive smart education systems. Being a platform that brings together the voices of research, policy, and practice, it showed how the world can collaborate to reimagine education in the age of AI.

The “Smart Education in a Global Context” webinar series and the regional forum at ISTE Live 2025 underscore a pivotal shift in the global education discourse: from viewing technology as a mere tool, to embracing smart education as a holistic, equity-centered transformation strategy. As AI and other emerging technologies continue to evolve, the path forward must be guided by inclusive dialogue, ethical governance, and a shared commitment to human-centered values. Smart education, when rooted in social justice and contextual relevance, holds immense potential to reimagine learning systems—making them more adaptive, personalized, and joyful. GSENet’s efforts demonstrate that through sustained collaboration and critical reflection, education systems worldwide can begin to close the digital divide, empower educators, and co-create learning environments that are not only “smart”, but “wise”.

2.3 Scholars Perspectives from Different Regions

“Smart Education in a Global Context” webinar series, held between April 2024 and August 2025, consisted of ten high-level international webinars. A detailed summary of the first seven webinars, conducted in 2024, was included in the GSENet 2024 report. These sessions featured four regional events under the theme “Bridging Smart Education around the World”, which gathered experts to share diverse perspectives, innovative practices, and strategic approaches for advancing Smart Education within the unique contexts of the Asia-Pacific, Europe, Africa, and the Americas. The other three webinars concentrated on the theme of inclusive education, addressing the specific needs of learners with disabilities, promoting gender equity, and supporting education for remote and marginalized groups.This report will

focus on the three webinars held since the beginning of 2025, which explored the transformation of Open, Flexible, and Distance Learning; the role of AI in transforming higher education; and the development of Smart Learning Environments in the age of AI.

The purpose of the series was to:

- Explore the possibility of AI as an intelligent means of changing higher education.
- Discuss how smart education is transforming Open, Flexible, and Distance Learning (OFDL).
- Discuss the best approaches to using AI technologies in establishing Smart Learning Environments for promoting personalized learning experiences.

Using a thematic analysis approach, the perspectives of the experts were grouped into broad themes. Although the discussions were based on informative ideas about the existing innovations and implementation strategies, they represented the subjective opinions of specialists. Additional empirical studies, particularly in low- and middle-income nations, are needed to confirm and build on these expert-based reflections. Nonetheless, the discussions highlighted key themes and insights that can guide the future of smart education globally.

The first webinar, “What Role can smart education play to transform Open, Flexible and Distance Learning?” explored how smart education frameworks can promote inclusive and lifelong learning by incorporating AI, equity-driven governance, and innovative pedagogy. The presentations focused on digital transformations in rural China, the Malaysian approach to micro-credentials and open universities, and the work of the ICDE to increase access in under-resourced areas.

The second webinar, titled “Is AI a Smart Solution to Transforming Higher Education?” discussed how generative AI is transforming curriculum design, instructional delivery, and evaluation. Case studies showed how AI could be used to monitor progress in real-time and enhance access to marginalized learners. Ethical issues like algorithmic bias and data privacy, the capacity building of teachers, and appropriate regulations for AI deployment were discussed.

The third webinar, “Smart Learning Environments in the Age of AI”, focused on innovations such as immersive VR, adaptive robots, and AI-powered learning analytics, as well as regional issues such as teacher preparedness, digital infrastructure, and equity. The webinar recommended sharing existing resources and adopting collaborative strategies to develop responsive, ethical, and learner-centered AI ecosystems in education.

Overall, the sessions highlighted the potential of AI to reinforce smart learning

environments, promote cross-regional cooperation, and find the best practices to incorporate emerging technologies in teaching and learning.

2.3.1 Redefining Smart Education

The concept of smart education is evolving beyond the mere use of digital tools and technologies. Experts emphasized that smart education represents a comprehensive model that blends learner-centered pedagogies, innovative practices, and adaptable technologies. This shift underscores the need to move away from a technology-centric approach and instead focus on how these technology tools can enhance the learning experience, promote inclusion, and foster educational transformation.

2.3.2 Leveraging AI for Personalized and Adaptive Learning

AI-powered technologies were highlighted as a key driver of innovation in smart education, enabling personalized learning pathways, real-time feedback, and adaptive content delivery. Experts shared examples of how AI can be integrated into open distance and flexible learning to create interactive, engaging, and scalable learning environments. This includes the use of AI-assisted tutoring, automated assessments, and data-driven analytics to optimize the learning experience for diverse learners.

2.3.3 Bridging the Digital Divide

A recurring theme across the webinars was the critical need to address persistent digital inequities and ensure equitable access to smart education, particularly in underserved and remote regions. Speakers highlighted innovative practices, such as remote teaching models, flexible learning arrangements, and data-driven personalization, that leverage appropriate and affordable technologies to bridge educational gaps and provide quality learning opportunities to all learners, regardless of their geographical location or socioeconomic background.

2.3.4 Transforming the Role of Educators

The integration of AI and other smart technologies in education was seen as an opportunity to redefine the role of educators. Experts emphasized that the focus should be on fostering human-machine collaboration, where technology augments and enhances the teaching and learning process, rather than replacing human interaction and empathy. This requires ongoing professional development to build educators' capacity in leveraging AI responsibly and effectively.

2.3.5 Ethical and Governance Considerations

Alongside the promise of smart education, the webinars highlighted the critical

importance of addressing ethical, privacy, and governance concerns. Speakers stressed the need for transparent, accountable, and inclusive frameworks to guide the design and deployment of AI-powered educational tools. This includes safeguarding data privacy, mitigating algorithmic bias, and ensuring that smart education initiatives promote equity, accessibility, and student well-being.

2.3.6 Collaborative Ecosystems and Multi-Stakeholder Engagement

The successful implementation of Smart Education was recognized as a collaborative endeavor, requiring the active engagement of diverse stakeholders, including policymakers, educational institutions, technology providers, and local communities. Speakers emphasized the importance of fostering multi-sector partnerships, sharing best practices, and aligning national strategies with global frameworks to create inclusive, scalable, and sustainable smart education ecosystems.

2.3.7 Future Research Directions

To better enhance educational practice in the future, the Speakers advocated for the need for more in-depth research and analysis to provide evidence and solutions for implementing smart education globally and in diverse local contexts. Additionally, there was a call for ongoing research into educator-informed frameworks for evaluating AI tools. Action research on topics such as AI ethics, assessment, and inclusion should be undertaken to build capacity across educational levels.

3 Teachers' Voices on Smart Education: GenAI in Teaching and Learning

Usama Kalim, Yao Sun, Yixuan Zhong, Lin Xu, Rongxia Zhuang, Jiena Sha

Teachers are the key stakeholders in the achievement of smart education, and it is important that their voices and experiences are taken into account. To gain a comprehensive understanding of how teachers are navigating the current global landscape, we conducted an international survey titled "Current Status and Practical Experiences of Global Smart Education Development". The survey focused on several key areas, including the extent to which teachers use GenAI, integrate GenAI into assessment practices, and how they perceive advantages and challenges.

The questionnaire survey was conducted using a convenience sampling approach across multiple countries. Valid responses were collected from 37 institutions in 10 countries: Brazil, China, Fiji, India, Kenya, Malaysia, Nigeria, Pakistan, Russia, and Rwanda. In the final analysis, 262 valid teacher questionnaires from institutions in the higher education sector were included.

Since the number of respondents varied significantly across institutions, and some institutions did not meet the minimum sample size required for statistical analysis, comparisons based on individual institutions or countries were deemed inappropriate. Therefore, regions were classified according to the World Bank's GNI per capita criteria (see Table 3-1).

As none of the participating countries belongs to the high-income group, the 11 countries were categorized into three groups: low-income, lower-middle-income, and upper-middle-income. Each group had a sample size greater than 30, meeting the basic requirements for statistical validity.

Table 3-1 World Bank GNI Per Capita

Income Group	GNI Per Capita (USD)
Low-income	$1,135 or less
Lower-middle-income	$1,136 – $4,465
Upper-middle-income	$4,466 – $13,845
High-income	$13,846 or more

Source: World Bank Country and Lending Groups FY2025

3.1 Most Used GenAI Features

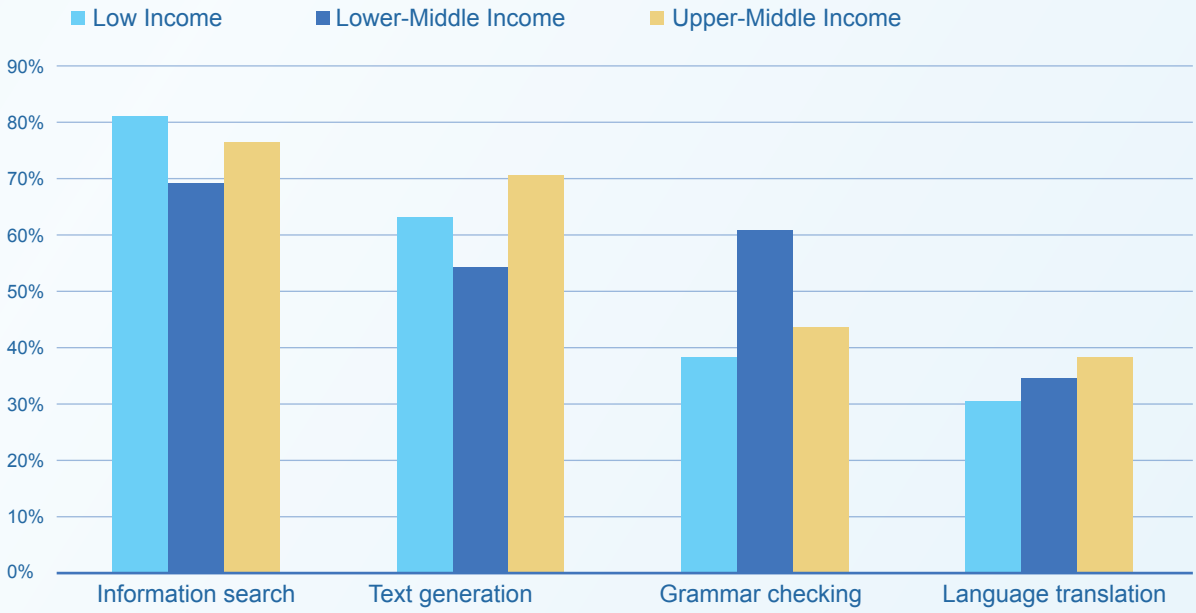

Figure 3-1 Statistics of the Most Used GenAI Features

Figure 3-1 illustrates the utilization of GenAI features by teachers in countries with different income levels. Overall, “information search” emerges as the most frequently employed feature, whereas “language translation” exhibits a relatively lower usage frequency. Specifically, low-income countries demonstrate an extremely high reliance on “information search”, with the proportion of usage for other features declining; similarly, in lower-middle-income countries, the proportions of using “information search” and “grammar checking” are relatively higher, and the utilization of features is more scattered; conversely, in upper-middle-income countries, the usage proportions of various features are more balanced and generally higher.

3.2 GenAI Application Scenarios

Figure 3-2 indicates the average scores of GenAI applicability across four major educational dimensions, namely, “Teaching”, “Research”, “Assessment”, and “Administration”. Upper-middle-income countries consistently report the highest GenAI usage across all four dimensions highlighting their stronger digital infrastructure and institutional support. “Research” stands out as the most widely adopted dimension across all income groups. Interestingly, low-income countries have a mean score of about 3.1, which is slightly above lower-middle-income countries with a mean score of about 3.0. This trend indicates that GenAI

is seen as a useful research instrument even in low-income environments, possibly due to the possibility of increasing academic productivity and access to information. The “Administration” dimension has the lowest scores in all four dimensions, particularly in the low-income countries, indicating that the administrative applications of GenAI, like scheduling, communication, or data management, are not yet widespread. The above results highlight the necessity of tackling the issue of digital inequality to make sure that every education system, regardless of its economic background, can enjoy the potential of transformative opportunities that GenAI can provide.

3.3 Ethical and Security Considerations

Figure 3-3 shows that “generating factually inaccurate output”, “ethical implications and fairness”, “data privacy and security issues” are the three dimensions that receive the highest levels of attention across countries. This widespread concern may be attributed to the broad and immediate impact of these issues, such as the tangible risks associated with data breaches or misinformation. In contrast, the relatively low level of concern regarding the “lack of transparency in GenAI processes” may stem from the technical complexity of these systems, which pose difficult problems to solve in the short term. Low-income countries report the highest level of concern regarding increased “dependence on GenAI technologies”. A possible explanation for this pattern is that while AI technologies are being rapidly

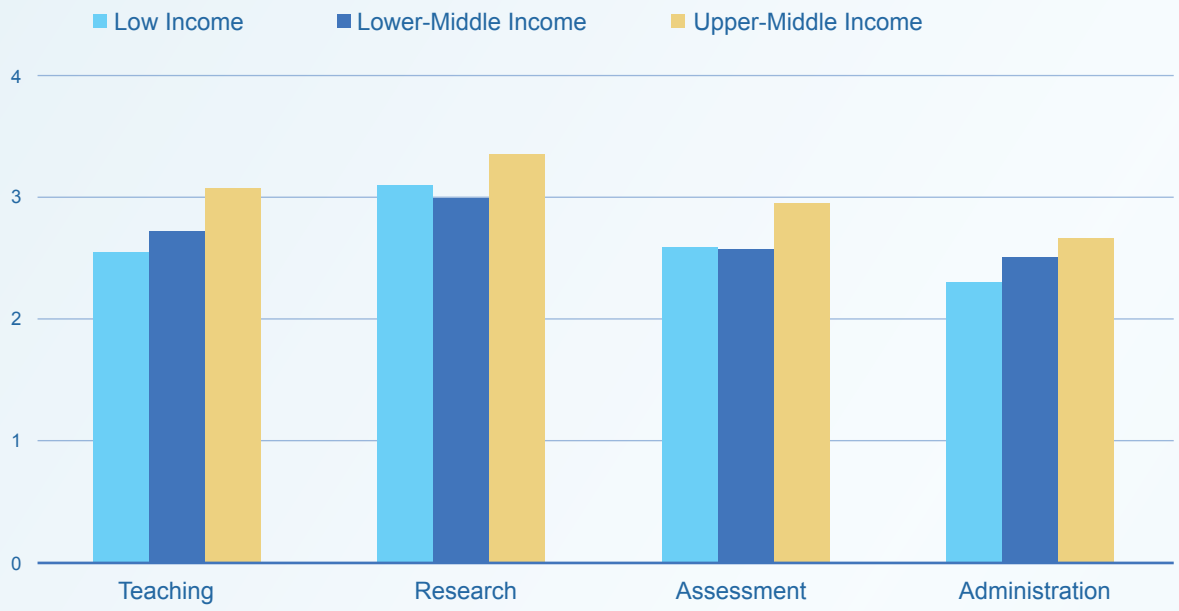

Figure 3-2 GenAI Application Scenarios

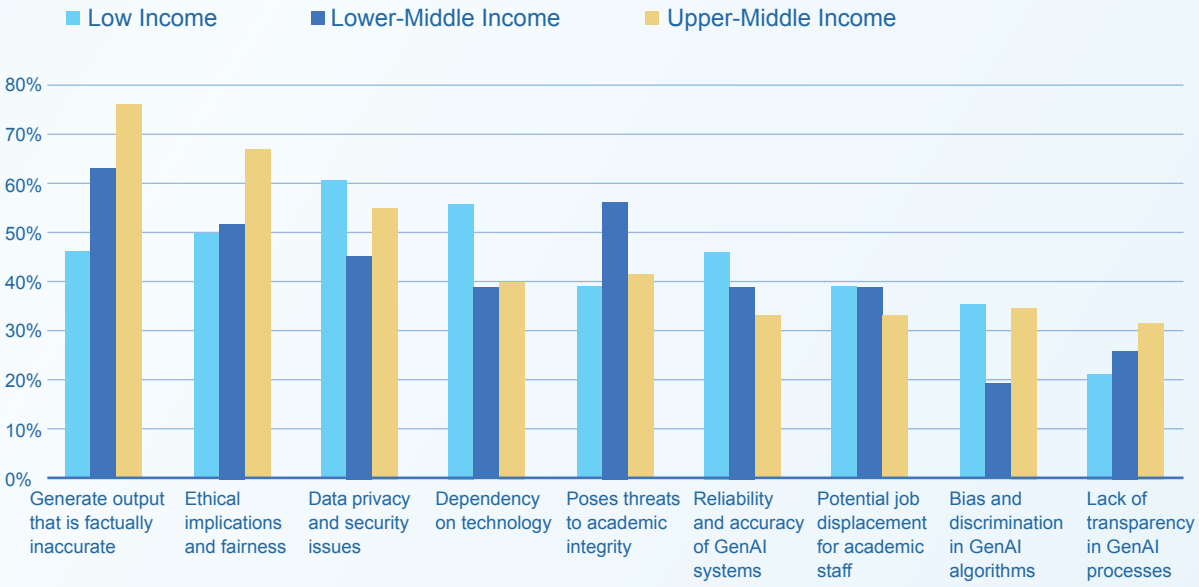

Figure 3-3 Teachers' Concerns about the Application of GenAI in Education

introduced in lower-income contexts, these countries often lack corresponding AI literacy initiatives and support systems. As a result, educators and students may be ill-equipped to use GenAI tools critically and effectively, thereby increasing the risk of overreliance.

3.4 Key Enablers for Quality of Education

The survey included three open-ended questions to understand teachers' perspectives about the impact of GenAI in enhancing the quality of education, its impact on their role as teachers and the most common ways these technologies have been applied in higher education settings.

The results indicate a focus on educational outcomes rather than inputs with six key enablers of quality that can be achieved through the use of GenAI.

Table 3-2 outlines the teachers' perceptions of how GenAI is influencing and enhancing the quality of education. Thematic patterns across these domains include personalization, teacher empowerment, equity, efficiency, and ethical responsibility. The opportunity versus risk is a common theme, particularly in ethical considerations and fair usage for all. Overall, AI is enhancing teachers' performance and the quality of education. An important point highlighted by some teachers is that more work is needed on the capacity-building of teachers to operate effectively in the changing world of AI.

3.5 Changing Roles of Teachers

This research question captures the evolving professional identity of teachers in the age of GenAI, emphasizing new responsibilities, emerging opportunities,

Table 3-2 Thematic Analysis of AI Key Enablers in Education

Themes	Sub-themes
Personalized Learning	Adaptive learning paths, AI tutoring, learner engagement
Teacher Empowerment	Automated lesson planning, grading, content generation
Access & Inclusion	Resource delivery, multilingual support, equity tools
Research & Knowledge	Literature access, interpretation aids, academic support
Efficiency	Time-saving automation, real-time info, flexibility
Cautions & Ethics	Responsible use, overreliance risks, equity in access

and critical challenges.

Table 3-3 shows six themes that redefine the teacher in an AI-enabled learning environment. Both fields indicate the change in expectations, practices, and professional identities. The themes of transformation, adaptability, responsibility, advocacy for equity, and capacity are revealed in the analysis. While the role of the teacher will change in the age of AI, it will continue to remain critical for the teaching-learning process and for social and emotional support.

3.6 Human–GenAI Collaboration

This responses to this research question have highlighted current and emerging roles of human–AI interaction in the educational landscape, especially in the resource-poor contexts of Asia and Africa.

Table 3-4 shows six themes in which human-AI collaboration is changing the practice of education and decreasing the workloads of teachers. Key themes of co-creation, efficiency, accessibility, and digital integration have been identified, and they demonstrate that AI is not replacing but complementing and augmenting teachers' roles.

This international teacher survey underscores the key role educators play in shaping the future of smart education, particularly in the age of GenAI. While disparities in infrastructure and usage remain stark across income groups, the potential of GenAI to enhance teaching, research, and personalized learning is evident even in resource-poor contexts. Teachers' insights reflect

Table 3-3 Thematic Analysis of the Changing Roles of Teachers

Themes	Description
1. Instructor → Facilitator	Teachers shift from delivering content to guiding inquiry, fostering creativity, and supporting critical thinking.
2. Task Automation	AI takes over routine work (e.g., grading, lesson planning), allowing teachers to focus on mentoring.
3. Content Curation & Ethics	Teachers help students evaluate AI outputs, combat bias, and foster responsible AI use.
4. Lifelong Digital Learning	Teachers adopt new tools, model adaptability, and become co-learners in fast-evolving digital spaces.
5. Advocacy for Equity	Teachers ensure inclusive GenAI integration and equitable student access to technology.
6. Navigating Challenges	Teachers face concerns over redundancy, need training, and must ensure academic integrity.

Table 3-4 Human-GenAI Interactions

Themes	Description
Lesson Planning & Content Generation	Teachers use GenAI for lesson drafts, quizzes, presentations
Student Support & Learning	Students receive writing help, feedback, and tutoring via AI
Language & Translation Support	Content translated into local languages; language learning support
Research & Academic Writing	GenAI supports research planning, summarization, paraphrasing
Assessment & Feedback	Teachers use AI to generate questions and grade student work
EdTech Integration & Platforms	Use of AI-embedded tools like Moodle, LMS, and digital games

a nuanced understanding of both the promise and the perils of AI, highlighting the need for ethical safeguards, inclusive access, and ongoing professional development. Most importantly, the data reveals that GenAI is not replacing educators but is transforming their roles—empowering them to become facilitators of deeper learning, curators of content, and champions of digital equity. Moving forward, a human-centered approach to AI integration—based on collaboration, and capacity-building—will be essential to ensure that smart education fulfills its potential to advance equitable, quality learning for all.

4 Digital Learning and Smart Education in Africa: UNESCO's Global Priority

Ahmed Tlili, Michael Agyemang Adarkwah, Xu Lin, Zhisheng Li, TingWen Chang

In light of the massive proliferation of AI technologies, there is an urgent call for countries worldwide to adopt these groundbreaking innovations to seize the opportunities of the digital age. However, many African nations are experiencing stagnation in the integration of advanced technologies, particularly in key sectors like education, when compared to their more developed counterparts. Most institutions in Africa are lagging behind in the digital transformation of their economies partly due to the reluctance to be early adopters of advanced technologies and limited internet connectivity. As the AI landscape develops, it is crucial for African governments to develop their AI sectors through strategic policy frameworks and investments in technological infrastructure. AI offers many benefits that the African continent can leverage to promote economic growth through the creation of employment, catalyzing innovation, and providing lifelong opportunities for all.

Recognizing the need for AI integration, the African Union (AU) has formulated a "Continental Artificial Intelligence Strategy" that aims to prioritize the development and adaptation of AI systems tailored to Africa's unique context. The report is part of the AU's inclusive development approach to achieve the SDGs and the Agenda 2063. This continental AI strategy is anchored on five main pillars involving harnessing AI's benefits, building AI capabilities, minimizing risks, stimulating investment and fostering cooperation. Many African nations have so far been inadequately prepared to implement AI effectively, which highlights the need for collective efforts to catch up in this critical area.

"The State of AI in Africa Report 2023" emphasizes that African countries are rapidly implementing AI in a manner unique to their context. The four key areas focused on in the report include AI and Data, AI and Innovation, AI Use and Impact in Health, Agriculture, Legal and Creative Fields, and Responsible AI. While the report recognizes that Africa is taking steps to harness the transformative potential of AI, there are significant gaps (in access to knowledge/information, data, education, training, and human resources) and situational challenges (ill-equipped policy frameworks, ethics, skills and capacity, and a need for a structured

data ecosystem) that negatively impact the effective adoption of AI. Hence, it is advocated that Africa strategically implement AI according to its unique needs instead of following the approach of the Global North. Collaboration with potential partners is key for successful AI sector development in the African region.

4.1 Geographical Distribution

The African continent is a vast and complex region characterized by immense geographical, cultural, and social diversity. Spanning approximately 30.37 million square kilometers, Africa is home to over 1.07 billion people distributed across 54 recognized countries, each with distinct historical and cultural contexts. The continent's landscape is equally varied, encompassing the arid expanses of the Sahara Desert in the north, the dense tropical rainforests of Central Africa, the sprawling savannas of the east, and the mountainous terrains of the south.

Linguistically, Africa is one of the most diverse regions in the world, with an estimated 2,000 languages spoken. However, English and French are among the most widely spoken languages. English is prevalent in nations such as Nigeria, Kenya, and South Africa, while French is common in West and Central African countries like Senegal, Côte d'Ivoire, and Cameroon. Arabic is the dominant language in North Africa, particularly in countries such as Egypt, Algeria, and Morocco, reflecting the region's historical and cultural ties to the Arab world. Additionally, Portuguese is spoken in several countries, including Mozambique and Angola. Swahili, a Bantu language with Arabic influences, serves as a lingua franca in East Africa.

Religious practices in Africa are equally diverse, with Islam and Christianity being the two most prominent religions. Islam predominates in North and West Africa, with significant Muslim populations in countries such as Egypt, Sudan, and Nigeria. Christianity, on the other hand, is more widespread in Sub-Saharan Africa, particularly in countries like South Africa, Kenya, and Uganda. Indigenous religions are still practiced in various regions, often coexisting with the major world religions. This rich tapestry of languages and religious practices reflects Africa's complex history and the various cultural influences that have shaped its development over centuries.

4.2 Status of AI and ICT in Education

Using a systematic approach, African countries have been identified based on their policies to adopt and implement AI and Information and Communication Technology (ICT). Table A1 (Appendix A) reveals that only 13 countries had launched AI policies in 2024, which

explains the reason why the African continent is still lagging behind in terms of adopting and implementing AI generally and AI in education particularly. Table A2 (Appendix A), on the other hand, reveals that 38 African countries have already started implementing ICT policies.

The availability of an AI or ICT policy document from a country represents the commitment to integrate AI or ICT across all sectors, especially education. The year the document was published demonstrates and helps assess the longevity and sustained commitment of the country. The achievements and challenges enshrined in each of the documents serves as evaluation criteria for knowing the accomplishments and struggles of each country with respect to AI or ICT application and implementation. Blogs, research publications, and press releases are ranked lower than official policy documents. Table A3 (Appendix A) presents the strategy used to categorize African countries based on their AI and ICT adoption.

Based on the ranking criteria within Table A3, Table A4 (Appendix A) demonstrates the categories of countries that have highly invested in AI technologies over the years by releasing a policy document or guideline to regulate its implementation and application across various sectors involving education. It can be observed that only 9 out of 13 countries have an official policy, 1 country (Morocco) has a document published by an international organization (UNESCO), one country (Cameroon) has a Ministry press release on utilizing AI, one country (Botswana) has a research publication assessing its readiness to embrace AI. Mauritius (#1) was one of the earliest countries to have a formalized an official policy document on AI, followed by Ethiopia (#2), Egypt (#3), Algeria (#4), and Ghana (#5). These countries have set clear measurable objectives for the implementation of AI. South Africa, Rwanda, Benin, and Mauritania all have official policy documents on AI that were recently released. Countries ranked medium or low are those that have an AI plan installed but have yet to release an official document from the government or ministry.

The AI policy documents in Table A4 (Appendix A) were then reviewed and analyzed. Figure 4-1 presents the overall focus of AI policies. It is evident that most of the countries are focusing on improving AI literacy (15%) and increasing AI research and development (15%). Additionally, 5% of the policies focus on improving the infrastructure to implement AI powered technologies.

Figure 4-2 presents the distribution of limitations according to the AI policy documents. It is seen that in most of the countries that the highest AI challenges are insufficient development (24%), insufficient

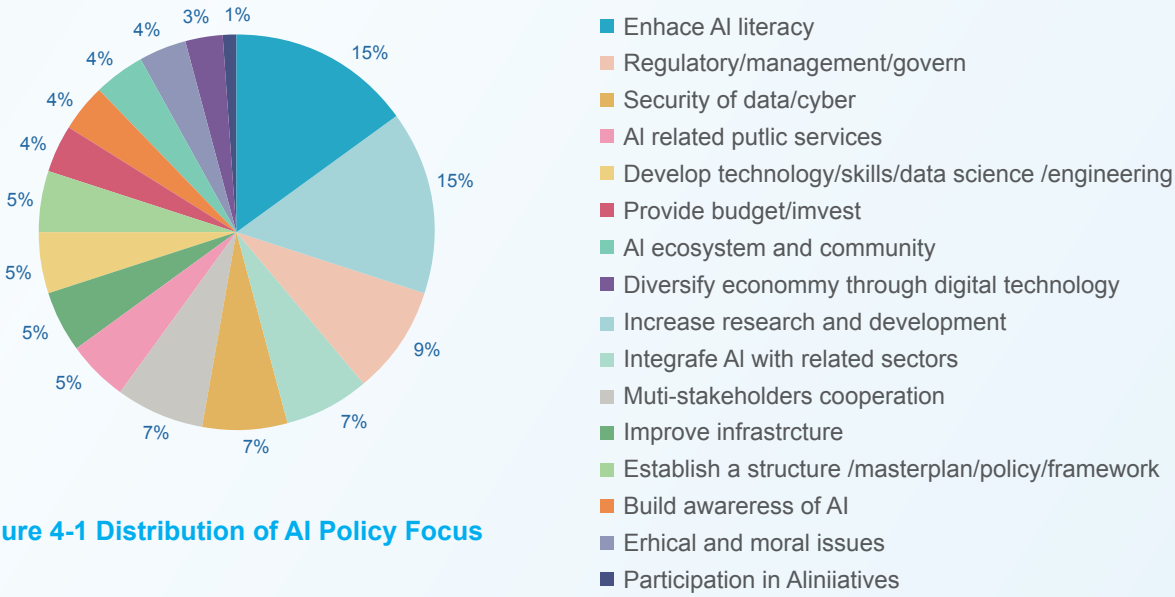

Figure 4-1 Distribution of AI Policy Focus

human resources (12%), and insufficient infrastructure (12%). Lack of funding (8%) and AI literacy (8%) are also issues highlighted by several African countries

Table A5 (Appendix A) depicts the list of African countries that have designed and implemented an ICT policy or are in the discussion phase to have a national ICT strategy. It can be seen from the Table A5 that 23 countries are ranked as high because of the availability of an official ICT policy document at the national level or from the ministries. About nine countries are ranked as medium because although there is an official document to gauge the progress of ICT development, these reports are not from the government but rather from international organizations such as UNESCO and OECD. Countries ranked as low are those that have ICT consultations and discussions but are yet to release an official policy document. In ranking the countries, the publication year and key milestones achieved, and contextual challenges were also

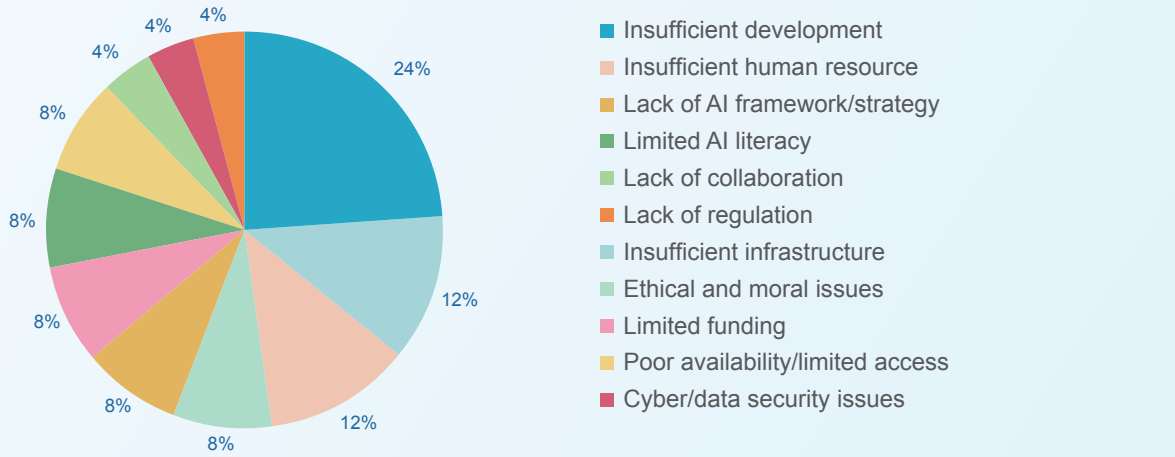

Figure 4-2 Distribution of Limitations according to the AI Policy Documents

considered. For example, Kenya sits at the top of the table because although the ICT masterplan has its own challenges, it has reaped positive results such as the training of 331,000 teachers on ICT integration, 218,253 on competency-based curriculum (CBC), with 93,009 teachers trained on the utilization of ICT devices. Kenya's ICT masterplan is also for the long-term extending to 2032. In contrast, South Sudan, Sao Tome and Principe, and Equatorial Guinea are ranked low because of the lack of an official policy document and significant challenges in these contexts curtailing the effective adoption of ICT.

Based on Table A5 (Appendix A), an analysis of ICT policies in African countries was conducted. Figure 4-3 illustrates the focus areas of these ICT policies. The data show that the majority of countries are committed to improving infrastructure (13%) and enhancing ICT literacy (12%). Additionally, ICT-related development and research (9%) and digital services and content (8%) are also significant areas of focus. Furthermore, 6% of the policies address connectivity and access.

Figure 4-4 presents the distribution of ICT limitations according to ICT policy documents. The most commonly identified limitations among the countries include inadequate development (17%), insufficient ICT frameworks/master plans/policies/ standards (13%), and insufficient ICT literacy (12%). Additionally, the lack of resources (10%) and inadequate infrastructure (10%) are also areas of concern.

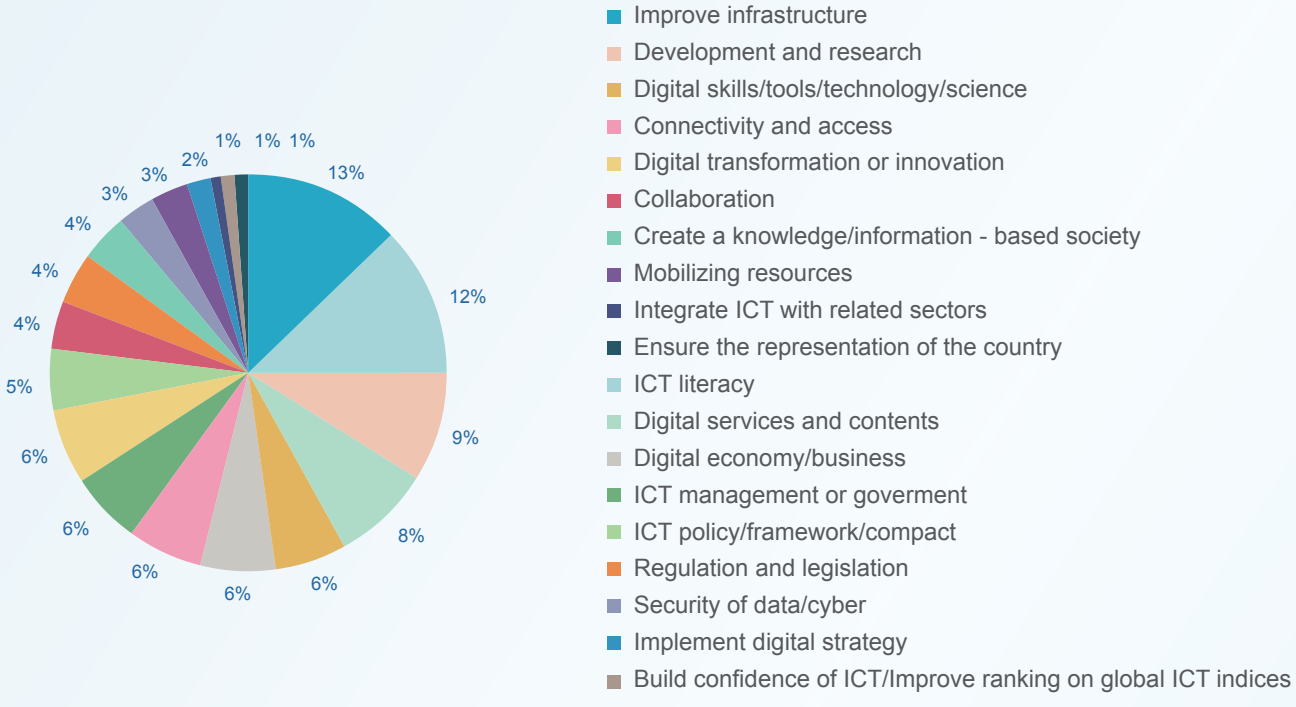

Figure 4-3 Distribution of ICT Policy Focus Documents

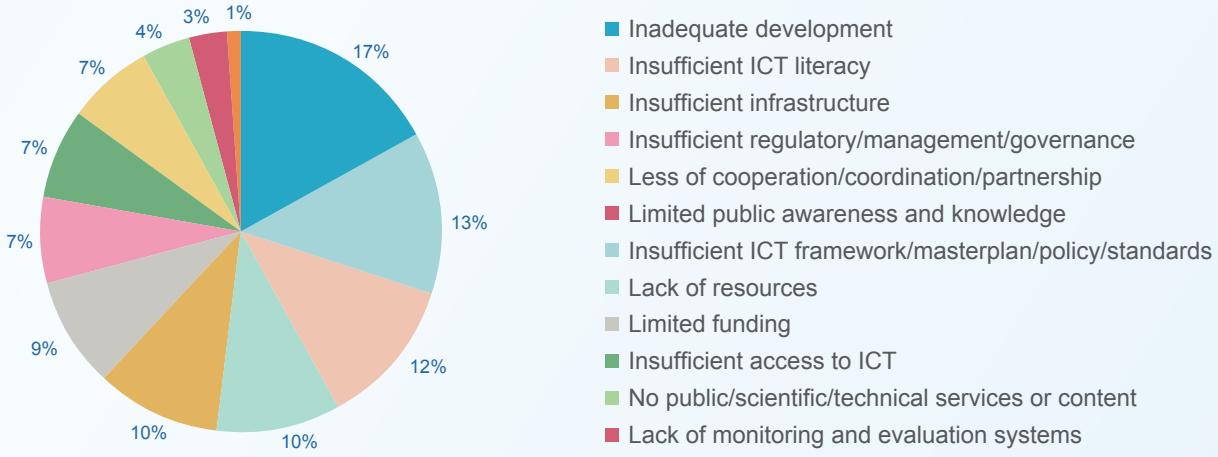

Figure 4-4 Distribution of Limitations according to the ICT Policy Documents

4.3 Beyond a One-Size-Fits-All Approach

The development and adoption of AI and ICT in Africa remain uneven, with remarkable progress in some countries but critical challenges in others across the continent. Despite the transformative potential of AI to drive economic growth, innovation, and inclusive development, only a few African nations have formalized AI policies, while ICT policies are more widespread but still vary in scope and impact. Key insights reveal that most African countries prioritize improving AI and ICT capacity, research and development, and infrastructure, yet face significant limitations including underdevelopment, lack of skilled human resources, poor infrastructure, and weak policy frameworks. Strategic implementation of AI and ICT—tailored to local contexts and backed by robust policy and international cooperation, especially with partners like China—is essential.

Moving forward, a unified and proactive approach is necessary for Africa to bridge the digital divide, capitalize on technological advancements, and achieve its development goals. Given Africa's diverse sociocultural and infrastructural realities, it must implement smart education that goes beyond a one-size-fits-all approach. Smart education needs to be contextually relevant, low-bandwidth compatible, multilingual, and inclusive to serve rural, underserved, and multilingual populations effectively.

5 Smart Education at Country Level: Policies and Practices in Mainland China

Jingwen Pan, Changshan Ren, Haijun Zeng, Chenhui An, Lin Xu

Declaring 2025 as the "Inaugural Year of Smart Education", China placing smart education at the core of its educational development strategy. A series of policies have been formulated to advance the comprehensive digital transformation of education. To implement these policies, under the framework of "Education Informatization 2.0", the first batch of 8 Smart Education Pilot Zones has been established to pilot and explore replicable experiences, accompanied by a dedicated secretariat to coordinate inter-departmental collaboration. Additionally, a large number of practical cases have been collected to provide empirical support. This chapter will delve into the relevant policy framework and implementation paths, and through case studies, present the practical achievements, challenges, and solutions of smart education at both national and local levels.

5.1 Strategic Policies

In analyzing China's policies on AI-enabled educational transformation, reference is made to the National Smart Education Framework (UNESCO IITE et al., 2022). This framework systematically outlines the core dimensions of digital education policies across nations, covering key aspects such as digital infrastructure, human resource development, technical governance, and innovation in teaching and learning. Drawing on this framework, the following sections examine China's practical approaches to advancing educational transformation through artificial intelligence from five dimensions: national vision and planning, infrastructure development, human resource development, technical standards and governance, and innovation in teaching and learning.

5.1.1 National Vision and Plan

China has formulated a series of policies and plans to define the development goals and direction for educational digitization, striving to advance the digital transformation of education and promote its high-quality development. In 2019, the Ministry of Education of the People's Republic of China (MOE) released China's Education Modernization 2035, which was the first major document to propose "accelerating educational transformation in the information age," providing strategic guidance for subsequent digital

transformation in education (Central Committee of the Communist Party of China & State Council, 2019). In 2025, the Ministry of Education (MOE) and eight other central government agencies, jointly issued the Guidelines on Accelerating Educational Digitization, comprehensively outlining the strategic layout for educational digitization (Central Committee of the Communist Party of China & State Council, 2025).

In January 2025, the Central Committee of the Communist Party of China and the State Council issued the 2024-2035 Master Plan on Building China into a Leading Country in Education, setting phased goals for educational digitization:

2024-2027: Complete the upgrade to National Smart Education Platform 3.0, establish the national education big data hub system, and achieve AI education application coverage in over 50% of schools.

2028-2032: Formulate a comprehensive smart education standards system, construct a digital ecosystem for lifelong learning, and elevate the level of digital education governance to rank among the world's top tier.

2033-2035: Fully establish a globally leading educational digitalization system, forming the core supporting capacity for building an education power.

5.1.2 Infrastructure Development

To support this transformation, China has significantly upgraded its digital education infrastructure. The 2021 Guiding Opinions on Promoting the Construction of New Educational Infrastructure and Building a High-quality Educational Support System jointly issued by six government agencies including the Ministry of Education (MOE), established the target of developing an optimized, efficient, and secure new educational infrastructure system by 2025 (Ministry of Education of China et al., 2021). The 2024-2035 Master Plan on Building China into a Leading Country in Education led to "1Gbps-to-school/classroom" upgrades, the establishment of ten regional education computing centers, the migration of 85% of education applications to the Cloud, and the deployment of 5G+AR/VR teaching terminals alongside 200 national virtual simulation experiment centers (Central Committee of the Communist Party of China & State Council, 2025).

5.1.3 Human Resource Development

China places human resource development at the core of its strategy. In 2022, the Plan for Strengthening Basic Education Teachers in the New Era explicitly proposed advancing information-based teacher development through establishing integrated management

systems for teacher candidates, practicing teachers, and teaching qualifications (Ministry of Education of China et al., 2022). The plan further emphasizes implementing AI-assisted teacher development pilot programs, exploring new approaches for optimizing teacher management, reforming teacher education, innovating teaching methodologies, and providing targeted educational support, with successful models to be scaled nationwide.

Complementing this effort, the Ministry of Education issued the industry standard Teacher Digital Literacy (JY/T 0646-2022), which defines a five-dimensional framework: digital awareness, technical knowledge, digital application, digital responsibility, and professional development. This standard provides the basis for teacher training and evaluation nationwide, facilitating education digitalization and quality improvement (Ministry of Education of China, 2023).

The 2024-2035 Master Plan on Building China into a Leading Country in Education promotes AI integration through “Dual-Teacher Tri-Dimensional” classrooms (human teachers, AI assistants, virtual environments), introduces a three-tier AI-teaching certification system, and builds intelligent teaching-research platforms. (Central Committee of the Communist Party of China & State Council, 2025).

5.1.4 Technical Standards and Governance

To ensure responsible AI use, China is strengthening ethical and governance frameworks. The 2023 Interim measures for the management of generative artificial intelligence services jointly issued by six agencies including the Cyberspace Administration promotes industry innovation while mandating lawful data sourcing, intellectual property protection, and regulated data labeling practices. Service providers must clarify accountability through published usage protocols, implement content identification systems, and establish complaint mechanisms. Multi-agency oversight enforces tiered regulation including security assessments for public opinion services (Cyberspace Administration of China et al., 2023).

The Measures for Scientific and Technological Ethics Review (for Trial Implementation) issued in the same year by the Ministry of Science and Technology requires comprehensive ethical risk evaluations for educational AI development, focusing particularly on student privacy protections and algorithmic fairness across diverse regional and socioeconomic groups. These measures establish clear legal boundaries for technology deployment.

5.1.5 Teaching and Learning Innovation

The 2023 Action Plan for Deepening Basic Education Curriculum and Teaching Reform emphasizes leveraging digital technologies to modernize education. It promotes AI and big data-enabled precision assessment to help teachers adjust instruction based on student progress, utilizing the National Smart Education Platform to enrich resources and support pedagogical innovation. Digital platforms expand learning opportunities beyond traditional classrooms, stimulating student engagement and self-directed learning.

The Guidelines on Artificial Intelligence General Education for Primary and Secondary Schools (2025 Edition) establishes a progressive curriculum aligned with cognitive development stages, employing diverse pedagogies (lecture, inquiry, project-based, experiential) enhanced by AI-driven interactivity. It integrates AI education with campus activities and implements quad-dimensional assessment (knowledge, skills, thinking, values) combining process and outcome evaluation.

5.2 Scenario-Driven Practices

In 2018, China's Ministry of Education launched the Education Informatization 2.0 Action Plan, designating "Smart Education Innovation Initiatives" as one of eight priority implementation measures. Through 2019-2020, the ministry established 18 Smart Education Pilot Zones and 2 pilot development regions. Commencing in 2022, the Secretariat of the MOE's Smart Education Pilot Zone Expert Panel has conducted four consecutive annual nationwide case studies. These efforts, undertaken in collaboration with MOE's Strategic Research Bases for Educational Informatization (Beijing, Central China, Northwest), involve rigorous expert evaluation to identify exemplary cases. This systematic documentation showcases the practical innovations of local education authorities, educational institutions, and EdTech enterprises. Recognized cases demonstrate significant annual growth: 2022: 123 cases; 2023: 324 cases; 2024: 540 cases; 2025: 1,008 cases.

China's smart education ecosystem now exhibits a decentralized innovation model, with multiple stakeholders (local education administrations, schools, and enterprises) generating regionally distinctive, replicable practices. Despite this bottom-up dynamism, comprehensive analysis of implementation patterns, developmental characteristics, and scalability remains underdeveloped. As technology-pedagogy integration drives systemic educational transformation, 2025—designated as the "Inaugural Year of Smart Education"—signifies a new evolutionary phase. Therefore, this study analyzes 1,008 exemplary cases (selected from 3,000+ submissions) categorized as: School-

level practices (837 cases); Regional development initiatives (101 cases); Research outcomes (40 cases); Technical solutions (30 cases).

Guided by the six strategic priorities established in the Action Plan (Figure 5-1)—digital literacy, deep integration, precision assessment, teaching service, resource provision, and governance level—our content analysis aims to identify core value orientations, dominant implementation models, and characteristic distribution patterns within China's smart education ecosystem. This provides empirical evidence for evaluating current developments and future trajectories.

Analysis reveals significant stratification across dimensions (Table 5-1): deep integration dominates (512 cases, 50.8%), followed by precision assessment (155, 15.4%), governance level (114, 11.3%), digital literacy (93, 9.2%), teaching services (69, 6.8%), and resource provision (65, 6.4%). This distribution demonstrates a distinct operational paradigm: school-level implementations prioritize pedagogical integration, while regional administrations emphasize governance enhancement. Subsequent analysis will examine representative cases across all six dimensions to elucidate implementation pathways, technological applications, and demonstrable outcomes.

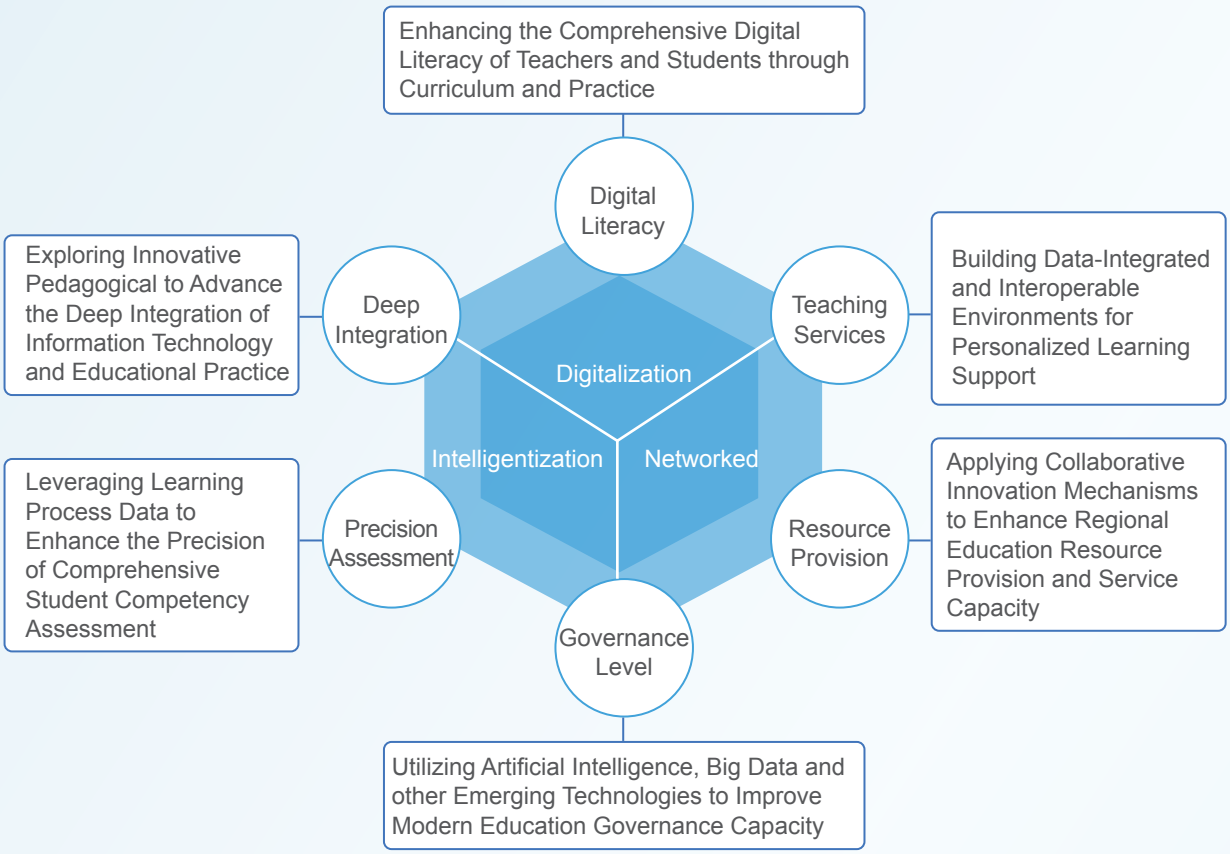

Figure 5-1 Six Strategic Priorities of "Smart Education Pilot Zones"

Table 5-1 Distribution of Case Themes by Category

Category	Information Literacy	Deep Integration	Precision Assessment	Teaching Services	Resource Provision	Governance Level	Total
School Practice	82	480	126	59	26	64	837
Regional Development	8	13	14	2	32	32	101
Solution	2	6	0	5	6	11	30
Research Outcome	1	13	15	3	1	7	40
Total	93	512	155	69	65	114	1008

5.2.1 Enhancing the Comprehensive Digital Literacy of Teachers and Students through Curriculum and Practice

Qingdao Xihai'an New Area Emeishan Road Primary School responded to students' limited cognitive foundation in artificial intelligence, scarce hands-on opportunities, and the latent safety and ethical risks in early-age education by designing a four-stage curriculum system—Perception–Application–Critique–Innovation—in accordance with relevant national plans and guidelines. Complementing this was a cognitive loop of Application–Questioning–Improvement. This approach significantly enhanced students' AI application skills and critical thinking capacity fostered appropriate technological ethics and core values and laid a solid foundation for basic AI literacy aligned with the demands of the intelligent era. Siming Primary School in Xiamen leveraged the National Smart Education Platform for Primary and Secondary Schools and the Intelligent Training Platform of the China Educational Technology Center to initiate the Four Commons, Three Forces school-based digital training model. Anchored in three core drivers—Driving Force, Research Capability, and Self-Growth Capacity—the model promoted a collaborative culture of Co-Learning, Co-Research, Co-Creation, and Co-Growth. It harnessed data-driven insights to shift school-based training from an "experience-led" approach to one combining "evidence-based + experience" and from "unidirectional transmission" to "multi-dimensional interaction."

5.2.2 Exploring Innovative Pedagogy to Advance the Deep Integration of Information Technology and Educational Practice

Huaxia School in Changsha has developed a “data-driven, precision teaching” model to address challenges in traditional classrooms, such as unclear student learning diagnostics, rigid instructional formats, and inefficient home–school collaboration. Its innovative “Three-Stage, Ten-Step” teaching paradigm integrates pre-class precision learning analysis, real-time interactive teaching, and post-class differentiated assignments in a closed-loop design. This approach has markedly improved student engagement and learning effectiveness. Yian District Experimental Primary School in Tongling, Anhui Province, introduced a virtual-experiment–based algorithm learning initiative, using a digital simulation of the Buffon’s Needle experiment to integrate algorithm design with mathematical computation. Through the Scratch programming platform, students engaged in a cross-disciplinary inquiry process—”Hands-on Practice–Algorithm Design–Data Verification”—which deepened their capacity to apply knowledge across domains. Jinjiang District Special Education School in Chengdu, Sichuan Province, in collaboration with Jinjiang District Foreign Language Primary School, developed AI-powered, multimodal instructional resources tailored for children with autism. Featuring cognitive scaffolding, immediate feedback, and guided prompts, these resources support individualized instruction that improves cognitive, emotional, and behavioral engagement among special-needs learners.

5.2.3 Leveraging Learning Process Data to Enhance the Precision of Comprehensive Student Competency Assessment

Yinchuan Xingqing District No. 25 Primary School in Ningxia has developed the Red Footprint Digital Holistic Education Evaluation System based on the National Smart Education Platform. This framework—structured around “Recording–Incentivizing–Showcasing–Feedback” —enables dynamic collection and tracking of students’ developmental process data to support multi-dimensional assessment. By embedding the platform into home–school communication channels, the school has established a data-driven decision-making mechanism, promoting a paradigm shift from score-based evaluation to competency-oriented assessment. San Jiaohu Primary School in Wuhan Economic and Technological Development Zone has created the Water Elf Five-Domain Comprehensive Evaluation System, integrating moral, intellectual, physical, aesthetic, and labor education dimensions. By combining

evaluation inputs from teachers, students, and parents and embedding big data analytics and real-time learning monitoring, the system supports targeted guidance. Incentive mechanisms—including an online point-redemption platform and self-service redemption stations—further stimulate intrinsic motivation for student development.

5.2.4 Building Data-Integrated and Interconnected Environments for Personalized Learning Support

Kaiyue Kindergarten in Xiaoshan District has restructured the early childhood education ecosystem through digital–intelligent technologies, creating a smart education system that spans governance, health, and pedagogy. By establishing a central data hub for refined management, it has designed blended physical–virtual learning environments that foster integrated development across the five key domains of moral, intellectual, physical, aesthetic, and labor education. The school's child-profile–based personalized growth support mechanism offers an innovative pathway for leveraging technology to promote holistic development in early childhood education. Tianyuan Foreign Language Experimental Primary School in Minhang District, Shanghai, has designed an intelligent learning space framework consisting of foundational, application, and goal-oriented layers. Developed across three dimensions—disciplinary integration, physical–virtual convergence, and resource consolidation—the system supports a personalized curriculum architecture. Through its "Intelligent Space Hub," the school enables seamless interaction between physical and virtual environments, harnessing data to explore context-aware learning, ubiquitous support, AI-based learning companions, and collaborative learning models. This student-centered ecosystem integrates technology, curriculum, environment, and assessment to promote personalized learning and self-directed growth.

5.2.5 Applying Collaborative Innovation Mechanisms to Enhance Regional Education Resource Provision and Service Capacity

Qingshan District in Wuhan has established a systemic model characterized by a "dual-track architecture – three connectivity mechanisms – four-dimensional support" framework. Implemented through a "district-level coordination, lead school demonstration, member school collaboration" pathway, this model forms a "1 (district hub) + 8 (lead schools) + N (member schools)" resource cluster. The approach effectively dismantles inter-school resource barriers, enabling full coverage of high-quality educational resources and providing a systemic mechanism for equitable resource allocation across the district. Zoucheng City has launched the UGEST Collaborative Innovation Action, creating a multi-stakeholder

partnership model involving government leadership, school-driven needs, higher education guidance, and enterprise participation. By accelerating the integration of education "cloud–network" infrastructure, it has developed a teacher training framework of "joint research in the cloud, online co-training," advanced the "Three Classrooms" initiative, and leveraged digital means to bridge rural–urban and inter-school gaps—ensuring rural education resource supply and contributing to rural revitalization.

5.2.6 Utilizing Artificial Intelligence, Big Data and other Emerging Technologies to Improve Modern Education Governance Capacity

Dadong District in Shenyang has developed an education digital infrastructure grounded in the principles of "data integration, intelligent enablement, and agile co-creation." Following a three-stage pathway—foundation capacity building → full-scale user adoption → continuous ecosystem evolution—the district has addressed challenges of data silos and innovation bottlenecks through comprehensive data governance, low-code platform deployment, and district–school collaboration mechanisms. This framework provides systematic data support for regional education policymaking, significantly improving governance responsiveness. Feicheng City has addressed persistent issues in county-level governance, such as pronounced urban–rural disparities, superficial application of technology, and difficulties in implementing formative assessment. It has adopted a three-phase strategy to build a governance model characterized by "smart connectivity, data-driven processes, and quality–equity balance." This has led to the establishment of a high-quality and equitable public education service system, offering a replicable model for collaborative county-level education governance.

6 Smart Education at the Institution Level: AI Transforming Top Universities Worldwide

Qiang Wang, Mohamed Oubibi, Junyi Wang

As a central initiative of the UNESCO Chair on Artificial Intelligence in Education (hereinafter referred to as "the Chair"), the Global Call for Best Practices is grounded in UNESCO's vision and aims to harness AI's potential while addressing its challenges in the higher education landscape. The Chair invites higher education institutions to share their pioneering AI applications in educational settings. The primary goal is to identify, showcase, and disseminate exemplary practices that demonstrate the transformative impact of ethical AI on higher education and interlink with digital transformation. By gathering diverse cases from various regions, the Chair aims to create a comprehensive repository of best practices that will serve as a valuable resource for educational leaders, policymakers, and practitioners worldwide. This initiative is intended to foster responsible and ethical AI integration to enhance educational quality, equity, and sustainability.

The primary objective of this research is to investigate the integration and application of AI across the Top 100 QS Universities. The study focuses on three critical domains: Teaching and Learning, Research and Innovation, and University Administration, each of which represents a fundamental aspect of higher education. In the domain of Teaching and Learning, the research explores AI-powered tutoring systems, automated assessments, and adaptive learning technologies, examining how they are reshaping the educational experience. In Research and Innovation, the research seeks to understand how AI is driving education sciences, fostering interdisciplinary collaboration, and advancing research initiatives. Lastly, within the realm of University Administration, the study investigates the use of AI for improving student recruitment, academic advising, campus operations, and institutional decision-making. By exploring these areas, the report aims to provide valuable insights into how AI is transforming key facets of higher education and to offer recommendations for further enhancing AI adoption in universities.

This research employs a qualitative, case-study-based research design to explore how AI is being adopted in higher education across globally recognized institutions. The data collection process was designed to be comprehensive, systematic, and triangulated to ensure the accuracy and reliability of the findings. A multi-source approach was adopted, utilizing both primary and secondary data sources to capture a broad range of information on how AI is being integrated across leading global universities. The key sources for data collection included university websites, academic

research papers and publications, official reports, media articles, and optional interviews or surveys. Another crucial source of data was academic research papers and scholarly articles on AI initiatives in higher education. These publications, sourced from databases such as Google Scholar, IEEE Xplore, Springer, and arXiv. Official reports issued by universities, academic organizations, or government entities were essential for obtaining in-depth information about AI's role in education.

By focusing on the top 100 universities as ranked by the QS World University Rankings, the research aims to identify patterns, best practices, challenges, and emerging trends in AI integration within academia. Drawing on insights from over 100 global EdTech initiatives and best practices from QS Top 100 universities, several key findings emerged regarding the transformative role of AI in higher education. These findings are organized across four major thematic dimensions.

6.1 Enhancing AI Competence for Deep Learning

In the evolving landscape of higher education, digital competence has become a critical skill for enabling students to engage meaningfully with AI-enhanced learning environments. Universities worldwide are embedding AI tools into curricula not merely to automate tasks, but to foster deeper, more interactive, and more personalized learning experiences. These initiatives often focus on developing students' abilities to think critically, collaborate effectively, and create content within AI-supported platforms. Notably, leading institutions are deploying intelligent agents, adaptive learning frameworks, and immersive digital environments to promote constructivist and autonomous learning. These approaches not only support self-directed exploration and real-time feedback but also empower learners to become co-creators of knowledge.

Developed by an interdisciplinary team at Tsinghua University, Massive AI Empowered Courses deploys AI agents that mimic a teacher, teaching assistants, and even fellow students. The system is powered by Tsinghua's own General Language Model (GLM) and automatically generates diverse virtual teachers and peer learners, enabling a personalized multi-agent learning environment.

The AI Education Lab of The University of Hong Kong aims to explore and implement AI technologies to enhance educational experiences, promote AI literacy, and support educators and students in effectively utilizing AI tools. Serving as a dynamic hub, the lab provides resources such as tutorials for using GenAI tools, and guidelines for incorporating generative AI in classrooms. It also offers frameworks for AI assessment and promotes ethical

awareness regarding AI usage. A significant contribution of the AI in Education Lab is the development of frameworks for foundational AI literacy.

Seoul National University established a dedicated AI Education Lecture Hall and a VR Education Lab on campus as testbeds for new teaching technologies. The Department of AI-Integrated Education and SNU's Research Center for AI-Based Teaching jointly ran a "Summer School for AI-Integrated Education". During this intensive program, students engaged in workshops and coding labs covering Python programming, big data analytics, and current AI research trends. They also learned to use AI-powered educational tools and platforms.

6.2 Promoting Evidence-Based Teaching with Quality Digital Resources

As AI becomes increasingly integrated into university ecosystems, its role in supporting data-informed teaching practices has grown substantially. Leading institutions are leveraging AI to curate high-quality digital content, optimize instructional design, and provide real-time feedback that informs both pedagogy and learning outcomes. By embedding analytics and intelligent recommendation systems, AI enables a shift from intuition-based to insight-driven decision-making in teaching. This not only improves the efficiency and precision of instruction but also enhances the credibility and impact of digital learning environments.

To meet the diverse learning needs of students in online and hybrid settings, the University of Michigan offers adaptive learning opportunities through initiatives such as the Advanced Education Technology Program (AETP) and accessibility-focused course design. The AETP is a certificate program offered by the School of Education which aligns with the internationally recognized ISTE Standards for Educators. The program prepares educators and workplace leaders to apply educational technology in transformative ways.

University of Oxford is exploring AI-powered tutoring systems to provide personalized learning support. In 2024, it launched the AI in Education at Oxford University (AIEOU) hub, a research initiative aimed at developing intelligent tutoring and adaptive learning tools for students. AI-powered tutoring systems can deliver immediate feedback, provide clear explanations and guidance, identifying specific areas where students encounter difficulties and offer targeted support to enhance their learning outcomes. Oxford's AIEOU hub brings together experts in computer science, education, and psychology to design such systems, with the goal of "more personalized, effective, and accessible learning environments".

6.3 Facilitating Human-AI Collaboration in Teaching

The most impactful applications of AI in higher education do not seek to replace

educators but rather to collaborate with them, amplifying their roles through intelligent assistance. Effective integration depends on creating synergy between human judgment and machine efficiency, ensuring that AI tools support rather than overshadow pedagogical goals. Institutions pioneering in this area are establishing models where AI augments the teacher's ability to deliver personalized instruction, manage large-scale classrooms, and provide high-quality feedback. These collaborations preserve the educator's critical role in mentoring and ethics while allowing AI to handle repetitive, data-intensive tasks. As the following examples illustrate, universities are designing innovative systems where AI empowers teaching through dual-track instruction, feedback automation, and faculty training support, maintaining a human-centered approach in the age of intelligent technologies

The Artificial Intelligence Centre at University College London (UCL) conducts foundational research aimed at developing innovative AI technologies and providing guidance on the implementation of AI across scientific, industrial, and social domains. The Centre brings together researchers focused on core areas such as Machine Vision, Machine Learning, Natural Language Processing, Machine Action, as well as Knowledge Representation and Interpretation. Through these efforts, the Centre seeks to address the evolving demands of an increasingly automated society and lay important groundwork for technological advancements across various fields.

In a collaboration under the strategic partnership between Ludwig-Maximilians-Universität München and the University of Cambridge, education researchers and computer scientists developed an AI-driven system to train pre-service teachers in diagnostic skills. The project aimed to improve how trainee teachers learn to identify pupils' learning difficulties. The team built an artificial neural network using natural language processing to provide adaptive feedback on teachers' case analyses.

6.4 Building Resilient Smart Learning Ecosystems

Universities are rethinking the design of their learning environments to ensure they are adaptable, transparent, and sustainable in the age of AI. This includes embedding principles of openness, modularity, data privacy, and AI ethics directly into their digital platforms and curricula. Leading institutions are adopting hybrid ecosystems that blend self-paced learning, interdisciplinary modules, and governance frameworks to ensure both educational quality and technological accountability. These ecosystems support not only academic continuity and scalability but also institutional integrity in the face of rapid technological change. The following

examples illustrate how top universities are building resilient digital architectures that prioritize ethical use, learner empowerment, and sustainable innovation.

The University of New South Wales (UNSW) has established a robust AI governance and policy framework centered on ethical, responsible, and collaborative innovation. Guided by its AI Leadership Group, the university coordinates strategic decision-making across education, research, and technology through a structured ecosystem that integrates expertise from diverse working groups. Core principles emphasize transparency, societal benefit, and adherence to legal and ethical standards, supported by resources such as compliance guidelines and a commitment to ethical AI innovation. The AI Capability Framework equips teaching staff with knowledge from defining AI mechanisms and prompt engineering to evaluating outputs, while addressing data security, and privacy risks. This governance model ensures alignment with UNSW's mission to harness AI for societal good while mitigating risks like bias and copyright infringement.

The AI Center of The University of Tokyo prioritizes three core domains: Dynamic Real-World Intelligence, focusing on adaptable systems for unpredictable environments; Human Artificial Intelligence, which combines neuroscience, ethics, and social sciences to build AI that aligns with human values; and Intelligent Society Design, addressing AI's societal impacts and proposing frameworks for future governance. By fostering industry-academia alliances and startups, the Center accelerates technology transfer, while its interdisciplinary education programs cultivate leaders skilled in both technical innovation and ethical responsibility.

Top 100 QS Universities are leveraging AI to drive transformative changes in higher education, making significant contributions to the advancement of smart education. Through AI-powered personalized learning, adaptive assessment, and intelligent tutoring systems, they are achieving unprecedented levels of learner engagement and differentiated instruction. Human–AI collaborative teaching models, AI-assisted research environments, and data-informed governance frameworks are reshaping how universities deliver, evaluate, and manage education. These practices not only enhance academic efficiency and inclusivity but also set new benchmarks for quality, scalability, and innovation in learning ecosystems. Looking ahead, smart education will increasingly feature AI-orchestrated learning pathways, immersive mixed-reality classrooms, lifelong and competency-based credentialing, and ethically governed AI applications. Faculty roles will evolve toward learning design and AI integration, while institutions will prioritize transparency, trustworthiness, and sustainability in educational technology, fostering an intelligent, equitable, and future-ready global learning environment.

7 Way Forward

Asha Singh Kanwar, Tao Zhan, Junfeng Yang, Haotian Zhu, Zhanshan Yang

7.1 Futures of Smart Education

With the deep integration of artificial intelligence technologies—especially large language models and intelligent agents—the definition, research, and practice of smart education are entering a new phase. This study argues that future smart education will center on human--AI collaboration and prioritize the cultivation of students' competencies. It will build data-driven, personalized learning pathways; create multimodal interactive environments with real-time feedback and open collaboration and ultimately achieve lifelong learning and the innovative development of future talents.

7.1.1 Evolving Definitions

The discussions among 18 experts from 14 countries highlighted that smart education is evolving beyond mere technology use to encompass a comprehensive model that integrates learner-centered pedagogies, innovative practices, and adaptive technologies. Key features of smart education include the necessity of leveraging AI for personalized learning, addressing digital inequities, redefining educators' roles to foster human-machine collaboration, and emphasizing ethical governance in AI deployment. AI in smart education is turning into a supportive associate for teachers and learners, that goes beyond cognitive support to take into account learners' feelings, preferences and specific situation. The shift towards AI-driven smart ecosystems and the need for a paradigm shift in teaching methodologies indicate that while the change may start incrementally, it could lead to a more radically redefined educational landscape over time. The future of education will not see AI replacing educators but rather augmenting and complementing their roles. Fostering collaborative relationships between teachers and AI could lead to innovative educational practices that prioritize creativity, critical thinking, and equity.

7.1.2 AI Agents and Human-AI Collaborative Education

As smart education advances into a new era, its core transformation lies in the deep integration of AI agents with educators and learners, forming a human-AI collaborative ecosystem for teaching and learning. AI agents, particularly those powered by GenAI, have evolved from simple conversational

interfaces into cognitive partners capable of understanding context, generating personalized content, and learning from feedback in real-time. Unlike traditional large language models that primarily respond to queries, these agents proactively plan, act, and adapt, forming a closed-loop cognitive-action system. AI agents in education serve as vital bridges between large-scale language models and real-world educational scenarios, becoming key drivers of digital transformation in education (Huang & Da, 2025). In the evolving landscape of human-AI collaborative education, AI agents typically operate in three major roles: personalized learning partners, teaching assistants, and management assistants.

First, AI agents act as always-available intelligent companions that guide students throughout their learning journey. AI agents not only provide instant responses to learners' questions but also deliver personalized content recommendations based on real-time learning analytics. They monitor learners' progress, identify knowledge gaps, and dynamically adjust the pace, difficulty, and mode of content delivery. For example, students struggling with a particular concept in mathematics might receive targeted micro-lessons, scaffolding prompts, or even multimodal explanations, such as visual simulations or analogies, adapted to their learning preferences. Through long-term interaction, the agent builds a learner profile, enabling it to offer longitudinal support, track improvements, and recommend learning goals aligned with the student's cognitive development.

Second, in teaching, AI agents are transforming the role of teachers from content deliverer to learning designer and facilitator. AI Agent-supported teaching provides educators with tools to analyze learner data, co-design lesson plans, and create adaptive instructional materials. During instruction, AI agents can function as co-instructors, managing routine tasks such as answering student queries, providing background resources, or guiding group work, thereby freeing up teachers to focus on more in-depth cognitive instruction and socio-emotional support. In post-instruction phases, AI agents support formative and summative assessments, enabling teachers to visualize performance trends, suggest personalized feedback for each learner, and recommend instructional adjustments.

Third, at the institutional level, AI agents are becoming pivotal in smart school management by enabling real-time, data-informed decision-making. AI agents can assist school administrators in areas such as timetable optimization, resource allocation, curriculum planning, and monitoring student behavior. For example, agents can analyze historical attendance, performance, and engagement data to optimize scheduling, allocate teaching resources according to demand, or

identify students at risk of dropping out. In human resources management, AI agents help match teachers to courses based on expertise and workload balance, improving overall teaching efficiency. In addition, AI Agents also enhance communication and coordination, automating repetitive administrative tasks like report generation, parent notifications, and compliance checks.

From the international survey, across different income-level contexts, teachers most frequently use GenAI for information search and research-and-writing support, with lower-income countries showing especially high reliance on these basic functions. Curriculum planning and content generation also feature prominently, whereas communication with parents and administrative applications remain relatively underutilized. Upper-middle-income countries benefit from more balanced usage across teaching, research, assessment, and administration—reflecting stronger digital infrastructure—while low- and lower-middle-income regions face notable deficits in availability of infrastructure, despite growing student exposure to AI tools. These disparities underscore the need for targeted policies to bridge the digital divide and ensure equitable integration of GenAI technologies in education systems.

Despite these advancements, several critical challenges remain. According to the survey, teachers express significant concerns about factual accuracy, ethical fairness, and data privacy in GenAI outputs, with low-income environments particularly wary of overreliance due to limited AI literacy. Moreover, the handling of massive amounts of personal data raises privacy and ethical concerns, especially in educational contexts where trust and safety are paramount. Developing robust ethical frameworks, transparent governance mechanisms, and accountability standards is essential to ensure responsible human-AI collaborative education.

7.1.3 The Role of Ethics, Inclusion, and Human-Centered Design

The impact of smart education will depend on approaches that recognize the role of technology as a tool to augment the work of teachers rather than replace them. All students including those from vulnerable and marginalised backgrounds, students with disabilities or women should have access to educational tools so that they can benefit from the opportunities offered by the digital economy. While using student data to help personalize learning, it is important to ensure that privacy and data security concerns are addressed. Human-centered design means ensuring that learning technologies fit users' requirements, backgrounds and preferences. There are several

regulations and guidelines in place to help policy makers and practitioners use AI in an ethical, transparent and responsible manner. The European Union's "Ethical Guidelines for AI in Education" is one example that states AI systems should be easy to understand, available to everyone and open for review to ensure trust and fairness in schools.

7.1.4 Future Focus

In the coming era, smart education will be defined by human-AI co-learning intelligent agents that will work alongside students and teachers as partners in knowledge construction, offering real-time scaffolding, multimodal content generation and personalized feedback. This symbiotic relationship will shift the educator's role from information transmitter to digital pedagogy designer-crafting blended scenarios that leverage AI-driven analytics, adaptive algorithms and immersive technologies (AR/VR/MR) to cultivate core competencies such as critical thinking, creative problem-solving, data literacy, collaboration and adaptability.

At the same time, micro-credentials, modular learning pathways and digital portfolios will be woven into curricula through deep industry-education integration. Universities, enterprises and government departments will co-design projects, apprenticeships and assessments that align classroom outcomes with real-world skills demands. Cross-departmental collaboration will establish unified standards for AI literacy, ethical use of technology and competency-based progression, ensuring that policy, funding and infrastructure investments reinforce one another.

Finally, an open, data-driven ecosystem will enable continuous course correction: interoperable platforms will surface actionable insights for teachers, administrators and policymakers, who can then refine teaching strategies, resource allocation and support services in real time. Open-source platforms, open access journals and open educational resources will fuel innovations that will produce a resilient, inclusive smart education ecosystem--one that empowers every learner to master the competencies needed for lifelong success in an AI-infused world.

7.2 Recommendations

From the studies in this report, it is evident that nations worldwide--regardless of their development stage--are confronting a common imperative: to transform traditional education into a Smart, AI-empowered ecosystem that drives national innovation, lifelong learning, and talent development. While several countries have already begun embedding smart education as a strategic pillar of their broader development agendas, many others still grapple with inadequate infrastructure, limited AI

literacy, and lack of clear direction. The global perspectives in this report highlight the urgent need for a comprehensive roadmap that aligns national vision with institutional and individual action. Building on lessons learned from diverse contexts, the following recommendations offer a blueprint for a resilient, inclusive and smart education.

7.2.1 Integrate Smart Education in National Plans

Countries, especially in the Global South, should establish comprehensive national strategies for smart education, aligned with SDG 4. The National Smart Education framework could be referenced, and AI infrastructure, AI enhanced teaching model and teacher training, ethical AI governance, and equitable access could be considered for the AI era. China's phased approach (e.g., Education Modernization 2035) serves as a model that can be adopted and adapted in different contexts.

7.2.2 Advance Ethical AI Governance in Education

The ethical risks of GenAI in education, such as misinformation, data privacy, and academic dishonesty, are gradually recognized. Government and institutions should establish transparent policies to mitigate risks like algorithmic bias, data privacy violations, and overreliance on AI. UNSW's AI governance framework offer templates for accountability and student protection. Several international, regional and national guidelines are available and can be used to develop context-specific tools for ministries and institutions.

7.2.3 Bridge the Digital Divide with Equity-Driven Policies

Address disparities in infrastructure (e.g., GPU/TPU access, cloud computing) and connectivity, particularly in rural and low-income regions. Mobile-first solutions, offline-enabled tools, and public-private partnerships can democratize access to quality education and training. Policies should prioritize marginalized groups (e.g., women, rural populations) to ensure inclusive economic participation.

7.2.4 Invest in Digital Infrastructure

It is essential to upgrade systems for deploying high-speed wireless networks, that provide ubiquitous connectivity. Mechanisms for shared and sustainable AI computing resources should be explored to improve efficiency and ensure equitable access. Combine AI with immersive technologies (VR/AR) and learning analytics to create future-ready environments.

7.2.5 Prioritize Teacher Capacity Building

While the role will change with the advent of AI, teachers will continue to be critical to the teaching-learning process. There is an urgent need to invest in upskilling

educators in digital pedagogy, AI literacy, and inclusive teaching practices. National strategies should incorporate AI literacy into teacher training programs, develop age-appropriate curricula for students, and establish standards and certification systems to assess AI literacy.

7.2.6 Scale Human-AI Collaboration Models

Integrate AI as a co-teaching tool (e.g., Tsinghua's AI agents) while preserving teacher autonomy. Focus on AI for automating administrative tasks (grading, lesson planning) to free educators for mentorship and critical thinking instruction. Both teachers and students should master the skills of collaboration with AI for more efficiency, without hurting the effectiveness of teaching and learning for the whole person development.

7.2.7 Foster a Culture of Continuous Improvement

Institutions should develop a scientific, reflective, and participatory decision-making culture. The continuous culture should be embedded in governance, infrastructure building, teaching, and learning. In the AI era, the national and institutional continuous improvement culture plays a key role in the smart education ecosystem.

7.2.8 Strengthen Multi-Sector Cooperation and Partnerships

Smart education ecosystems thrive on collaboration across public, private, and civic sectors. It is essential to clarify stakeholder responsibilities and establish robust coordination mechanisms. Governments, institutions, technology providers, research organizations, and families are supposed to operate within a shared governance mechanism to motivate every stakeholder's interests.

7.2.9 Design Culturally Relevant, Low-Bandwidth Solutions

It is clear that one size does not fit all. It is important to develop AI/EdTech tools that accommodate linguistic diversity, low connectivity, and local curricula. Examples include AI-powered language translation for multilingual classrooms and adaptive learning platforms for offline use.

7.2.10 Promote South-South and North-South Collaboration

Encourage knowledge-sharing and resource pooling among Global South nations (e.g., Africa-China partnerships) to leapfrog technological gaps. Initiatives like GSENet's webinars and regional forums can facilitate best-practice exchange between countries of the Global North and the Global South

References

Alawar, M. & Tarasova, E. (2025). HBMSU's Smart Learning Ecosystem: From Theory to Practice. Hamdan Bin Mohammed Smart University.

Banyue Tan. (2023). Education digitization: Opening a new door to education. Retrieved from http://www.banyuetan.org/jy/detail/20230227/1000200033136041677480094692065088_1.html

Central Committee of the Communist Party of China & State Council. (2019). China's Education Modernization 2035. Ministry of Education of the People's Republic of China. Retrieved January 15, 2025, from http://www.moe.gov.cn/jyb_xwfb/s6052/moe_838/201902/t20190223_370857.html

Central Committee of the Communist Party of China & State Council. (2025, January 23). the 2024-2035 Master Plan on Building China into a Leading Country in Education. Central People's Government of the People's Republic of China. Retrieved January 25, 2025, from https://www.gov.cn/gongbao/2025/issue_11846/202502/content_7002799.html

Chinese Academy of Education Sciences. (2023). China Blue Book on Smart Education (2022): Toward a digital transformation of Chinese education. Beijing: Educational Science Press.

Context of Digital Transformation. Beijing: Global Smart Education Network and Smart Learning Institute of Beijing Normal University.UNESCO. (2023). 2023 Global Education Monitoring Report Technology in education: A tool on whose terms? https://unesdoc.unesco.org/ark:/48223/pf0000385723

Cyberspace Administration of China et al. (2023, July 13). Interim measures for the management of generative artificial intelligence services. The State Council of the People's Republic of China. Retrieved June 30, 2025, from https://www.gov.cn/zhengce/zhengceku/202307/content_6891752.htm

Engida, T. & Wodon, Q. (2025). Constraints to Digitalization and the Adoption of Artificial Intelligence in Ethiopian Universities. UNESCO's International Institute for Capacity Building in Africa (IICBA)

First generation universities are those established in Ethiopia before 2000, including Addis Ababa University, Haramaya University, Hawassa University, Jimma University, Bahir Dar University, and Mekelle University. These universities tend to be among the most prestigious in the country.

GSENet. (2022). Rethinking and Redesigning National Smart Education Strategy.

GSENet. (2023). Consolidating Smart Education Strategies for SDG4.

Huang, R. & Da, T. (2025). Intelligent agents open the door for education to embrace the large model. China Education Daily. (02): 4.

Huang, R. (2022). Future learning requires constructing a new ecosystem for Smart Education. Guangming Daily, 6.

Huang, R. (2023). Integration of science and education to co-create the future of education. People's Education, (9), 16–20.

Huang, R.H., Liu, D.J., Kanwar, A.S., Zhan, T., Yang, J.F., Zhuang, R.X., Liu, M.Y., Adarkwah, M., Li, Z.S. (2024). Global Understanding of Smart Education in the Context of Digital Transformation

Matthew R, Halgali T (2019) Smart campus: the next-generation connected campus. New York, NY: Deloitte. https://www.deloitte.com/content/dam/assets-zone3/us/en/docs/services/consulting/2024/the-next-generation-connected-campus-deloitte.pdf.

Ministry of Education of China. (2023). Action Plan for Deepening Basic Education Curriculum and Teaching Reform from http://www.moe.gov.cn/srcsite/A26/jcj_kcjcgh/202306/t20230601_1062380.html

Ministry of Education of China. (2025). White Paper on China's Smart Education. http://en.moe.gov.cn/features/2025WorldDigitalEducationConference/Achievements/202505/t20250518_1191052.html

Ministry of Education of the People's Republic of China et al. (2021, July 21). Guiding Opinions on Promoting the Construction of New Educational Infrastructure and Building a High-quality Educational Support System. The State Council of the People's Republic of China. from https://www.gov.cn/zhengce/zhengceku/2021-07/22/content_5626544.htm

Ministry of Education of the People's Republic of China et al. (2022, April 11). Plan for

Strengthening Basic Education Teachers in the New Era(Document No. JYJY [2022] No. 6). from http://www.moe.gov.cn/srcsite/A10/s7034/202204/t20220411_616644.html

Ministry of Education of the People's Republic of China. (2023, February 14). Teacher Digital Literacy (JY/T 0646-2022). from http://www.moe.gov.cn/srcsite/A16/s3342/202302/W020230214594527529113.pdf

Ministry of Science and Technology et al. (2023). Measures for Scientific and Technological Ethics Review (for Trial Implementation) . Ministry of Science and Technology of the People's Republic of China. from https://www.most.gov.cn/xxgk/xinxifenlei/fdzdgknr/fgzc/gfxwj/gfxwj2023/202310/t20231008_188309.html

National Steering Committee for Basic Education Teaching. (2025, March 15). General education guide for artificial intelligence in K-12 schools (2025 edition). China Education Association. Retrieved June 30, 2025, from https://www.cse.edu.cn/upload/file/2025/20250315_AI_Guide.pdf

OECD Education Working Paper (2023). Digital equity and inclusion in education: An overview of practice and policy in OECD countries (OECD Education Working Papers No. 314). OECD Publishing. https://one.oecd.org/document/EDU/WKP(2023)14/en/pdf

Pedro, F & Liu, B. (2025). Smart Education in Colombia: UNAD, Powering a Revolutionary Model of Distance Education For Latam. UNESCO International Institute for Higher Education.

Ramirez, R. (2025). Building Sustainable Capacity for Digital Teaching and Learning in Jamaica through the ISTE Standards. The International Society for Technology in Education (ISTE) and The Association for Supervision and Curriculum Development (ASCD).

Tri, N. M., Hoang, P. D., & Dung, N. T. (2021). Impact of the industrial revolution 4.0 on higher education in Vietnam: Challenges and opportunities. Linguistics and Culture Review, 5(S3), 1–15. https://doi.org/10.21744/lingcure.v5nS3.1350

UNESCO (2020) Participation rate of youth and adults in formal and non-formal education and training. http://uis.unesco.org/en/glossary-term/participation-rate-youth-and-adults-formal-and-non-formal-education-and-training.

UNESCO IITE (2022) UNESCO IITE releases its new Medium-Term Strategy for 2022–2025. https://iite.unesco.org/wp-content/uploads/2022/03/UNESCOIITE-Medium-Term-Strategy-2022-2025.pdf. Accessed 2 Feb 2023

UNESCO IITE, BNU, ISTE (2022) Report on National Smart Education Framework. https://iite.unesco.org/publications/report-on-national-smarteducation-framework/.

UNESCO Institute for Statistics and Global Education Monitoring Report. (2025). Out-of-school children at all levels. https://www.unesco.org/gem-report/en

UNESCO Institute for Statistics. (2022). Higher education: Figures at a glance (UIS/2021/ED/FS/73) https://uis.unesco.org/sites/default/files/documents/f_unesco1015_brochure_web_en.pdf

UNESCO. (2023). Global report on teachers: Addressing teacher shortages [PDF]. Teacher Task Force. https://doi.org/10.54675/FIGU8035

United Nations. (2022). Transforming Education Summit 2022. https://www.un.org/sites/un2.un.org/files/report_on_the_2022_transforming_education_summit.pdf

United Nations. (2024). Summit of the Future, New York, 22–23 September 2024. Retrieved from https://www.un.org/en/summit-of-the-future/

Wang, Y., & Huang, R. (2024). Trends and strategic analysis of Smart Education development: From academic research to policy choices. Yuejiang Academic Journal, (5), 1–10.

Xia, S. (2019). Scene theory in the digital era. Cultural Horizons, (5), 88–97, 143.

Yang, J., South, J., Huang, R., Song, J.S., Ning, A., Castillo, M., Udayadas, G., Lin, R., Shi, G., Chu, J., Ren, J., Wang, Y., & Dvoretskaya, I. (2022). Report on National Smart Education Framework. https://iite.unesco.org/wp-content/uploads/2022/12/Report-on-National-Smart-Education-Framework.pdf.

Zhu, Z. (2014). Leading educational informatization innovation through Smart Education. China Educational Informatization, (9), 4–8.

Appendix A

Table A1: African countries with AI policies

No.	Country	Title	Type	Year
1.	Algeria	National Artificial Intelligence Strategy 2020-2030	Ministry Report	2021
2.	Benin	National Artificial Intelligence and Big Data Strategy	Ministry Report	2023
3.	Botswana	A Glimpse into Botswana's AI Readiness Landscape	Research Publication	2023
4.	Cameron	National Consultations on Artificial Intelligence (CONIA)	Ministry Press Release	2024
5.	Egypt	Egypt National Artificial Intelligence Strategy	Ministry Report	2021
6.	Ethiopia	The National AI Policy	Ministry Report	2020
7.	Ghana	Republic of Ghana National Artificial Intelligence Strategy: 2023-2033	Ministry Report	2022
8.	Mauritania	The National Artificial Intelligence Strategy of Mauritania 2024-2029	Ministry Report	2024
9.	Mauritius	Mauritius Artificial Intelligence Strategy	Ministry Report	2018
10.	Morocco	Artificial Intelligence Readiness Assessment Report	UNESCO Report	2024
11.	Nigeria	NITDA Seeks Stakeholders' Contribution To National AI Policy	Blog	2022
12.	Rwanda	The National AI Policy	Ministry Report	2023
13.	South Africa	South Africa's Artificial Intelligence (AI) Planning: Adoption of AI By Government	Ministry Report	2023

Table A2: African countries with ICT policies

No.	Country	Title	Type	Year
1.	Angola	Angola Digital Rights and Inclusion Report	Ministry Report	2021
2.	Burkina Faso	Candidacy to the Council of International Telecommunication Union (ITU) – 2019-2022 Term	International Telecommunication Union (ITU) Report	2019
3.	Burundi	National ICT Development Policy 2010-2025 (Politique Nationale de Développement des Technologies de l'Information et de la Communication, PNDTIC	Ministry Document	2018
4.	Cape Verde	Digital Cabo Verde Project	Ministry Document	2020
5.	Central African Republic	Digital Rights and Inclusion in Africa Report (Central African Republic)	LONDA report	2021
6.	Chad	Chad Digital Transformation Project (P180000)	World Bank Document	2023
7.	Comoros	The National Agency for Digital Development (ANADEN)	Ministry Press Release	2024
8.	Congo Brazaville	Congo Brazza: "Congo Digital 2025", The National Digital Development Strategy Officially Presented	Ministry Press Release	2019
9.	Congo Democratic Republic	National Plan Digital Horizon 2025	Ministry Report	2019
10.	Cote D'Ivoire	National Digital Development Strategy in Cote D'Ivoire by 2025	Ministry Report	2022

11.	Equatorial Guinea	Equatorial Guinea: New Report Proposes a Way Forward to Develop a Safe and Inclusive Digital Economy	World Bank Press Release	2024
12.	Eritrea	Eritrea Education Sector Plan (2018-2022)	Ministry Report	2018
13.	Eswatini	National Development Plan 2023/24-202//28	Ministry Report	2022
14.	Gambia	National Digital Economy Master Plan 2023 - 2033	Ministry Report	2023
15.	Guinea	Guinea Digital Road Map	Ministry Report	2023
16.	Guinea Bissau	Guinea-Bissau - Digital Economy Diagnostic	World Bank Document	2022
17.	Kenya	The Kenya National Digital Master Plan 2022-2032	Ministry Report	2019
18.	Lesotho	Draft: National Digital Transformation Policy 2024	Ministry Report	2024
19.	Liberia	Liberia Information And Communications Technology (ICT) Policy (2019-2024)	Ministry Report	2019
20.	Libya	Libya-Digital-Transformation-Strategy-2023	Ministry Report	2022
21.	Madagascar	“Digital skills” project: the MNDPT and IFC aim to train 6,000 young people in digital technology.	Ministry Press Release	2023
22.	Malawi	Malawi ICT and Digitalization Policy Roadmap 2022-2026 (Draft)	Ministry Report	2022
23.	Mali	Mali Digital 2020 (National Strategy of Development of the Economy Digital)	Ministry Report	2020
24.	Mozambique	Mapping Research and Innovation in Mozambique	UNESCO Report	2021

25.	Namibia	Ministry of Information and Communication Technology Strategic Plan 2017-2022	Ministry Report	2017
26.	Niger	Technology (Niger)	UNESCO Report	2024
27.	Sao Tome and Principe	Reimagining education through digital learning in São Tomé and Príncipe	UNICEF Press Release	2022
28.	Seychelles	Science Technology and Innovation Policy Review: Seychelles	United Nations' Report	2024
29.	Sierra Leone	Sierra Leone National Innovation & Digital Strategy (2019-2029)	Ministry Report	2019
30.	Somalia	National Innovation & Digital Strategy (2019-2029)	Ministry Report	2019
31.	South Sudan	Technology (South Sudan)	UNESCO Press Release	2024
32.	Sudan	ICT in Education In Sudan	World Bank Policy Document	2021
33.	Tanzania	Drafted National ICT Policy, 2023	Ministry Report	2023
34.	Togo	Digital Work Environment (DWE)	Ministry Report	2018
35.	Tunisia	Tunisia AI Roadmap	OECD.AI report	2021
36.	Uganda	ICT Sector Strategic and Investment Plan (2015/16 – 2019/20)	Ministry Report	2015
37.	Zambia	National Digital Transformation Strategy 2023 - 2027	Ministry Report	2023
38.	Zimbabwe	National ICT Policy 2022-2027	Ministry Report	2022

Table A3: Categorization strategy

Criteria	Description	Weight
Availability of Official Policy	Existence of a formal AI or ICT policy document from the country itself.	High
Year of Investment	The year the country began investing in AI or ICT initiatives.	Medium
Achievements and Challenges	Evaluation of key achievements and challenges based on summarized data.	Medium
Secondary Sources	Consideration of blogs, research publications, and press releases.	Low
Criteria	Description	Weight
Availability of Official Policy	Existence of a formal AI or ICT policy document from the country itself.	High
Year of Investment	The year the country began investing in AI or ICT initiatives.	Medium
Achievements and Challenges	Evaluation of key achievements and challenges based on summarized data.	Medium
Secondary Sources	Consideration of blogs, research publications, and press releases.	Low

Table A4: Categories of African countries based on their AI policies

No.	Country	Title	Type	Year	Category
1.	Mauritius	Mauritius Artificial Intelligence Strategy	Ministry Report	2018	High
2.	Ethiopia	The National AI Policy	Ministry Report	2020	High
3.	Egypt	Egypt National Artificial Intelligence Strategy	Ministry Report	2021	High
4.	Algeria	National Artificial Intelligence Strategy 2020-2030	Ministry Report	2021	High
5.	Ghana	Republic of Ghana National Artificial Intelligence Strategy: 2023-2033	Ministry Report	2022	High
6.	South Africa	South Africa's Artificial Intelligence (AI) Planning: Adoption of AI By Government	Ministry Report	2023	High
7.	Rwanda	The National AI Policy	Ministry Report	2023	High
8.	Benin	National Artificial Intelligence and Big Data Strategy	Ministry Report	2023	High
9.	Mauritania	The National Artificial Intelligence Strategy of Mauritania 2024-2029	Ministry Report	2024	High
10.	Morocco	Artificial Intelligence Readiness Assessment Report	UNESCO Report	2024	Medium
11.	Cameron	National Consultations on Artificial Intelligence (CONIA)	Ministry Press Release	2024	Medium
12.	Nigeria	NITDA Seeks Stakeholders' Contribution To National AI Policy	Blog	2022	Low
13.	Botswana	A Glimpse into Botswana's AI Readiness Landscape	Research Publication	2023	Low

Table A5: Category of African countries based on their ICT policies

No.	Country	Title	Type	Year	Category
1.	Kenya	The Kenya National Digital Master Plan 2022-2032	Ministry Report	2019	High
2.	Cote D'Ivoire	National Digital Development Strategy in Cote D'Ivoire by 2025	Ministry Report	2022	High
3.	Tanzania	Drafted National ICT Policy, 2023	Ministry Report	2023	High
4.	Zambia	National Digital Transformation Strategy 2023 - 2027	Ministry Report	2023	High
5.	Gambia	National Digital Economy Master Plan 2023 - 2033	Ministry Report	2023	High
6.	Uganda	ICT Sector Strategic and Investment Plan (2015/16 – 2019/20)	Ministry Report	2015	High
7.	Zimbabwe	National ICT Policy 2022-2027	Ministry Report	2022	High
8.	Libya	Libya-Digital-Transformation-Strategy-2023	Ministry Report	2022	High
9.	Malawi	Malawi ICT and Digitalization Policy Roadmap 2022-2026 (Draft)	Ministry Report	2022	High
10.	Angola	Angola Digital Rights and Inclusion Report	Ministry Report	2021	High
11.	Congo Democratic Republic	National Plan Digital Horizon 2025	Ministry Report	2019	High
12.	Eritrea	Eritrea Education Sector Plan (2018-2022)	Ministry Report	2018	High

13.	Liberia	Liberia Information And Communications Technology (ICT) Policy (2019-2024)	Ministry Report	2019	High
14.	Mali	Mali Digital 2020 (National Strategy of Development of the Economy Digital)	Ministry Report	2020	High
15.	Togo	Digital Work Environment (DWE)	Ministry Report	2018	High
16.	Guinea	Guinea Digital Road Map	Ministry Report	2023	High
17.	Eswatini	National Development Plan 2023/24-2028	Ministry Report	2022	High
18.	Somalia	National ICT and Policy Strategy (2019-2024)	Ministry Report	2019	High
19.	Sierra Leone	Sierra Leone National Innovation & Digital Strategy (2019-2029)	Ministry Report	2019	High
20.	Guinea	Guinea Digital Road Map	Ministry Report	2023	High
21.	Burundi	National ICT Development Policy 2010-2025	Ministry Document	2018	High
22.	Lesotho	Draft: National Digital Transformation Policy 2024	Ministry Report	2024	High
23.	Namibia	Ministry of Information and Communication Technology Strategic Plan 2017-2022	Ministry Report	2017	High
24.	Burkina Faso	Candidacy to the Council of International Telecommunication Union (ITU) – 2019-2022 Term	ITU Report	2019	Medium
25.	Tunisia	Tunisia AI Roadmap	OECD.AI report	2021	Medium
26.	Chad	Chad Digital Transformation Project (P180000)	World Bank Document	2023	Medium

27.	Central African Republic	Digital Rights and Inclusion in Africa Report	LONDA report	2021	Medium
28.	Niger	Technology (Niger)	UNESCO Report	2024	Medium
29.	Sudan	ICT in Education in Sudan	World Bank Policy Document	2021	Medium
30.	Guinea Bissau	Guinea-Bissau - Digital Economy Diagnostic	World Bank Document	2022	Medium
31.	Seychelles	Science Technology and Innovation Policy Review: Seychelles	United Nations' Report	2024	Medium
32.	Mozambique	Mapping Research and Innovation in Mozambique	UNESCO Report	2021	Medium
33.	Madagascar	"Digital skills" project	Ministry Press Release	2023	Low
34.	Comoros	The National Agency for Digital Development (ANADEN)	Ministry Press Release	2024	Low
35.	Congo Brazaville	Congo Brazza: "Congo Digital 2025"	Ministry Press Release	2019	Low
36.	South Sudan	Technology (South Sudan)	UNESCO Press Release	2024	Low
37.	Sao Tome and Principe	Reimagining education through digital learning in São Tomé and Príncipe	UNICEF Press Release	2022	Low
38.	Equatorial Guinea	Equatorial Guinea: New Report Proposes a Way Forward to Develop a Safe and Inclusive Digital Economy	World Bank Press Release	2024	Low

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Global Smart Education Network (GSENet)

Vision To network with leading partners and diverse experts to promote better education for all.

Mission To create a shared platfom that connects organizations and institutions for intercultural dialogue, leveraging smart learning technologies to enhance educational excellence and innovation for all through research, pollcy development,and capacity building.

ALECSO

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BEIJING NORMAL UNIVERSITY 1902

C·O·L

CONTACT NORTH NORD Access to Online Education and Training for Jobs and Careers

Globethics

Hamdan Bin Mohammed Smart University

INTERNATIONAL COUNCIL FOR OPEN AND DISTANCE EDUCATION

ifht INSTITUTO MULTIDISCIPLINAR DE FORMAÇÃO HUMANA COM TECNOLOGIAS

iste+ascd

Ai movement INTERNATIONAL ARTIFICIAL INTELLIGENCE CENTER OF MOROCCO

OUK OPEN UNIVERSITY OF KENYA

Open University of Mauritius

RP RWANDA POLYTECHNIC

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unesco International Institute for Capacity Building in Africa

Key Takeaways

- Smart education incorporates values such as intelligence, learner-centeredness, socio-emotional learning, collaboration, inclusivity, flexibility, and lifelong learning.
- A thoughtfully implemented smart education framework, underpinned by intelligent technologies, can serve as a powerful catalyst for educational transformation and a pathway for achieving Sustainable Development Goal 4 (SDG 4).
- Many developing countries face the dual challenge of bridging the digital divide while simultaneously transforming education systems to meet the needs of the 21st-century. An obvious gap is the lack of a smart education framework that is context-specific and fragmented efforts that may be inefficient in achieving successful smart education.
- GenAI has the potential to promote smart education in various income-level countries, yet concerns about robust policies, adequate resources and inadequate training remain critical.
- The future of education lies in “smart” collaborative approaches where human and artificial intelligence combine to construct lifelong learning systems that align with national plans and visions to build human capacity.