The Report of the Joint UNESCO Project: SmartEDU @ GSE2022

United Nations Educational, Scientific and Cultural Organization

UNESCO Institute for Information Technologies in Education

Rethinking and Redesigning National Smart Education Strategy

An exploration of the idea and solution on infusing technology into education for and beyond Education 2030 Agenda

Working Collaboratively to approach the future with smart education

We (UNESCO IITE, COL, ISTE, HSE, BNU) collaboratively launched the joint UNESCO project on Rethinking and Redesigning National Smart Education Strategy (SmartEDU) since August 2020, and worked together to identify the major issues and trends of education and explore the solution of infusing technology into education to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Context

The COVID-19 pandemic has brought unprecedented challenges to education. In this special situation, lots of students have to learn online, which tested the resilience of ICT in education in every country. Preparing individuals and communities to adapt to the Futures of Education, which we should rethink and reshape at this critical moment as launched by UNESCO, is an essential issue for the development of education, especially for this moment from disruption to recovery. For education, we shall work out strategic solutions on how to reshape the education to adapt to an uncertain, complex and diverse world.

Aim

To foster human and social development worldwide through rethinking and redesigning national smart education strategies and elaborating the most up-to-date and adequate policy agenda to expand access to quality education and relevant lifelong learning opportunities for all, which will be achieved through pursuing the main project's outcomes and primary objectives.

To help educational communities promote transformative role of ICT in education, develop a transferable skill, including critical thinking, creativity, communication and collaboration, evaluate progress in view of the SDGs and associated targets of the 2030 Agenda for Sustainable Development.

The Five Activities

UNESCO IITE and BNU coordinate with ISTE, COL, and HSE for the collaborative pursuit of five main project activities within the joint UNESCO Project. Each activity has its main contributors to conduct the final outcomes.

1. Build the framework for smart learning and education to recognize the characteristics of smart education, to propose the framework of smart education, to explore the route to realize smart education. (ISTE, BNU & UNESCO IITE)
2. Review the policies on smart education for futures of education to rethink about the ecosystem of education and extra-curricular education, to share a forward- looking vision of what education and learning might yet become. (COL, BNU & UNESCO IITE)
3. Identify the indicators of smart education to assess and monitor the status of smart education at country level, to provide a clear structure of the indicators for the computation of the index, to support case study countries to assess and monitor relevant policies and practices. (HSE, BNU & UNESCO IITE)
4. Develop the national public services for smart learning to elucidate the function and structure of national public services, to offer strategies, solutions, and support for national smart education public services. (BNU & UNESCO IITE)
5. Draft guidance of smart campus to accelerate the application of emerging technology in campus construction, to help schools plan and design smart campus. (UNESCO IITE & BNU)

Outcome 1: National Smart Education Framework

Accelerating Education 2030 Agenda

The application of emerging technology in teaching and learning improves the quality of education and promotes educational equity. Transforming education through technology to achieve inclusive and equitable quality education will accelerate the SDG4 Education 2030 Agenda. However, the COVID-19 pandemic has brought unprecedented challenges to education. Therefore, we need to rethink the roles and resilience of ICT in learning and teaching during the post-pandemic and also the futures of education.

There are some challenges to integrating emerging intelligence technologies into teaching and learning, such as inclusion and equality problems, technology governance, ethics, accountability, transparency, and security of smart technologies. However, to adapt to an uncertain, complex, and diverse world, a community of shared future for all humankind should be built, and education is the cornerstone of human well-being. Therefore, smart education should be constructed for humankind.

Smart Education

Smart education is considered as the educational behaviors (system) provided by schools, regions, or governments, with the characteristics of the high learning experience, learning content adaptation, and teaching efficiency. Modern science and technologies are used to provide diversified support and on-demand services for students, teachers, and parents, the data of participants and learning and teaching processes are recorded and used to promote the quality and equity of education.

Three Layers of Smart Education

Smart education system could be transformed into three realms, including smart learning environment, new model of technology-enhanced learning and teaching, and evidence-based governance of education. Smart education continuously improves knowledge production capacity from the three aspects of effect, efficiency, and benefit, promoting educational equity and quality by adapting the education system and objectives.

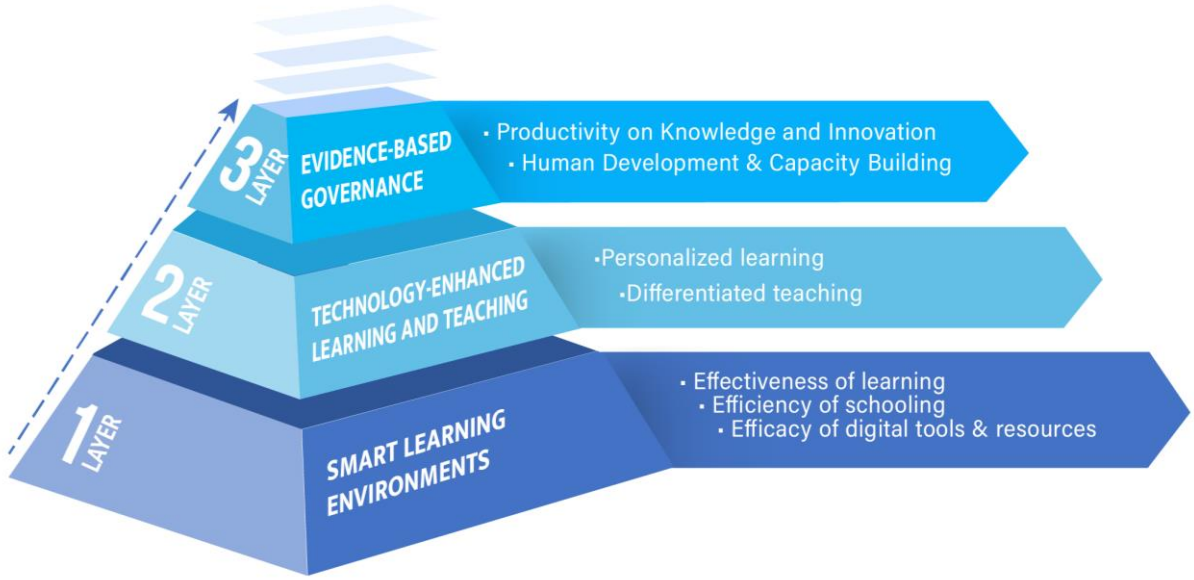


Figure 1. Three Layers of Smart Education

National Smart Education Framework

Government leaders and stakeholders recognize the urgency to modernize the digital learning ecosystem to provide inclusive and equitable educational opportunities to all students. To accomplish this, leaders need to align their priorities to overarching considerations of equity, continuous improvement, and multi-sector cooperation. Thus grounded, they then focus their energy on three key leverage points centered on transforming teaching and learning, building smart digital learning environments, and implementing forward-thinking policy.

Figure 2. National Smart Education Framework

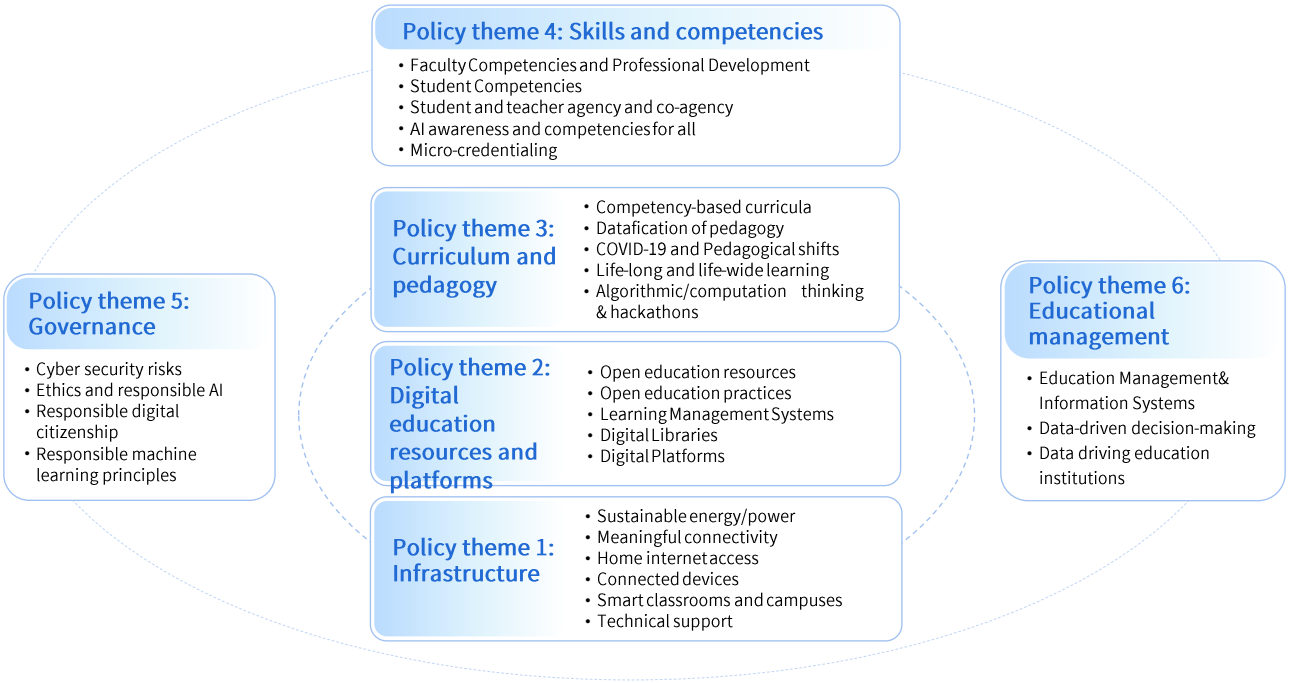
Outcome 2: Review of Policies on Smart Education

Smart Education Policy Analysis

The framework identifies the way national public smart education policies articulate a shared vision that serve as an aspirational guiding frame. It also surfaces the way key principles and values are informed by the formulation of policy rationale and the framing of problems that policies have proposed to address. The analytical framework further identifies six inter-related salient themes that have emerged consistently across all policies as well as three themes related to the practice and enactment of policy which is the framework refers to as implementation mechanisms.

Policy Context	Vision, Values & Principles
The framework situates smart education policy in context by surfacing the influences of historical, cultural, socio-economic, political, environmental factors and the growing global EdTech market and meta-EdTech shaping and influencing the design of smart education policy.	Vision statements reflect a desired ideal that the education system is striving towards. The guiding principles tend to place emphasis on inclusion and equity imperatives, including gender equity; and on principles focused on transparency and openness; humanistic, empathetic, auditable; responsible and ethical technology design; and user safety.

6 Inter-related policy themes



3 Salient policy implementation mechanisms

Leadership, system strengthening & change management

- Leadership & leadership development models
- Managing large system change

Partnerships, finance & resource mobilisation

- Financing & funding
- Resource mobilisation

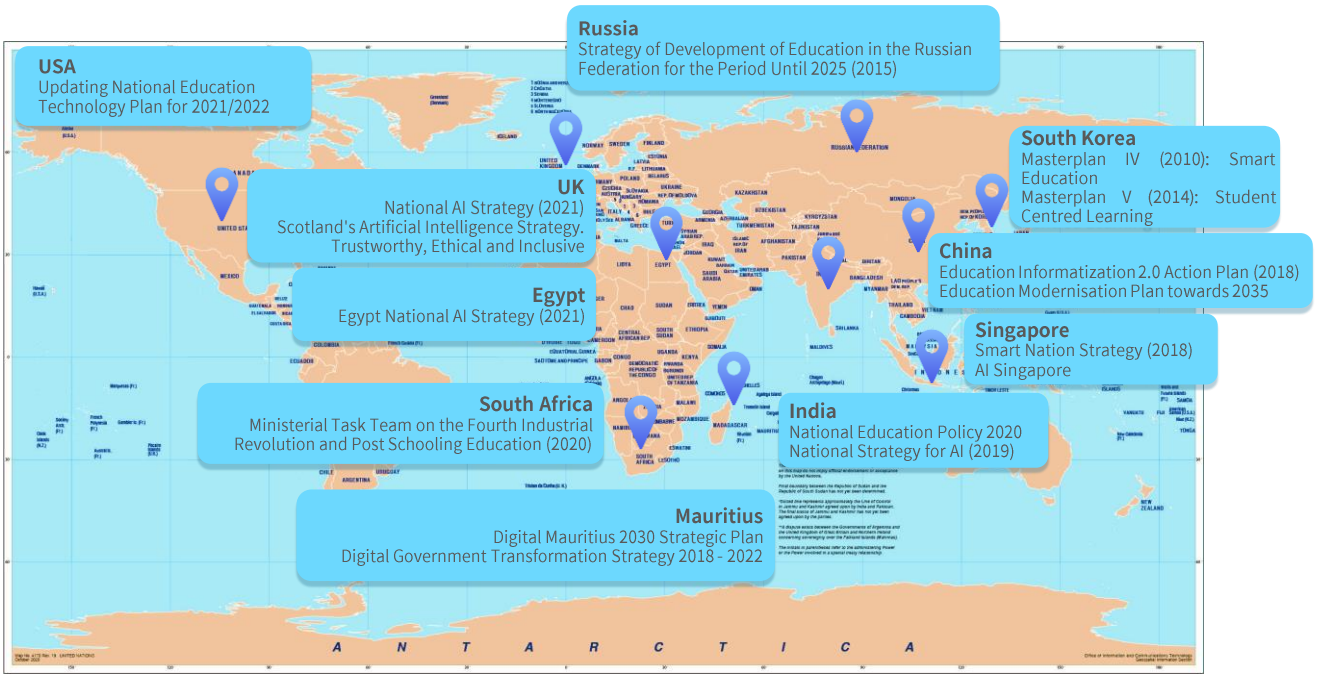
Research, innovation & Evaluation

- Investment in AI research
- Research partnerships
- Research accelerators & evidence intermediaries
- Smart education research institutes & AI Centres of Excellence

Figure 3. A Critical Analytical Framework for Smart Education Policy

Typical National Policies Toward Smart Education

National Smart Education Policies and Case Studies provides a brief policy discourse analysis of the emerging smart education policy texts in each of the 10 case study countries. It builds on numerous toolkits and policy analyses of ICTE policies and master plans in the extant literature. Because of the attention to education system policy responses to emerging fourth industrial revolution (4IR) and exponential technologies, the focus is on policy texts in more recent transversal government policies and strategies on AI or as dedicated smart education or 4IR in education reports that serve to inform future policy development. In cases where explicit 4IR and smart education policies are not developed, it analyses the most recent ICTE policy texts.



Map Source: https://www.un.org/geospatial/content/map-world

Figure 4. Typical Policies Toward Smart Education

This framework also identified 15 cases of policy-linked interventions that relate to the way emerging smart education policy is being implemented by governments and their partners. The case studies are structured along the implementation mechanisms and policy themes highlighted in the critical analytical framework.

Policy Themes	Cases	Country
1. Infrastructure	Tablets for Grades 1 and 2 Learners	Mauritius
2. Curriculum and pedagogy	Datafication of assessment: blockchain in unified state exam	Russia
	Machine-based School Dropout Early Warning System	India
	AI Basics & AI Mathematics as Subjects in K-12 Curriculum	South Korea
3. Digital education resources and platforms	Online Merge Offline (OMO) Learning	China
	#GoOpen	USA
4. Skills and competencies	Micro-credentials for teachers in Dysart Unified District	USA
	AI for Everyone	Singapore
	AI for Apprenticeships	Egypt
5. Governance	Scottish AI Alliance	Scotland, UK
6. Management and administration	National Education Information System	Korea
Implementation Themes	**Cases**	**Country**
1. Partnerships	Shift Digital Partnership towards youth into digital jobs	South Africa
	California Community Schools Partnership Programme	USA
2. Research, innovation and evaluation	Centre for AI Research	South Africa
	Evidence Intermediaries: UK EdTech Impact	UK

Outcome 3: Indicators of Smart Education at Country Level

Global Education Monitoring (GEM) Report aims to track the progress toward SDG4, in which using ICT to benefit the learning environment has favored sustainable education, which has helped bring forth responsible and more aware students. As a kind of thematic education indicators of GEM, it is important to identify the assessment indicators of smart education to transform education by infusing emerging technologies for inclusive, equitable, and quality education.

Assessment Rationales

Several core principles should be considered for monitoring smart education, including considering national cultural diversity, the transformation of ICT in education, and the guidance of evaluation theories.

- ✓ The purpose of monitoring smart education is to reflect the status of educational digital transformation and identify the future strategies for developing smart education.
- ✓ The national cultural diversity will be respected. Moreover, it is necessary to recognize the differences in purposes, contents, approaches, and developments of the use of ICT in education among countries, regions, and schools.
- ✓ Smart education can be recognized as the advanced stage of ICT in Education, and the stages of utilizing ICT in education, from emerging to transforming, should be considered.
- ✓ The monitoring of smart education will be implemented under the guidance of the latest evaluation theories; meanwhile, the involvement of stakeholders, such as students, teachers, parents, etc., will be emphasized.

Concerns on Monitoring Smart Education

Smart education could be monitored as part of Global Education Monitoring, or it could be monitored independently to show the challenges and trends of ICT in education. In designing the smart education monitoring, the following dimensions could be considered:

The **Input Dimension** measures the status of the government's policy and plan, funding, infrastructure, and resource building. The **Process Dimension** measures the changes in teaching, learning, and management during the transition to smart education at the national level. The **National Level Dimension** considers the national enablers and resources as the key guidance and foundation for the transition to smart education at the national level. The **School Level Dimension** recognizes the school as a basic unit for promoting the transition to smart education. Finally, the **Teachers Level Dimension** recognizes the situation of teachers as the key innovator within the transition process to smart education.

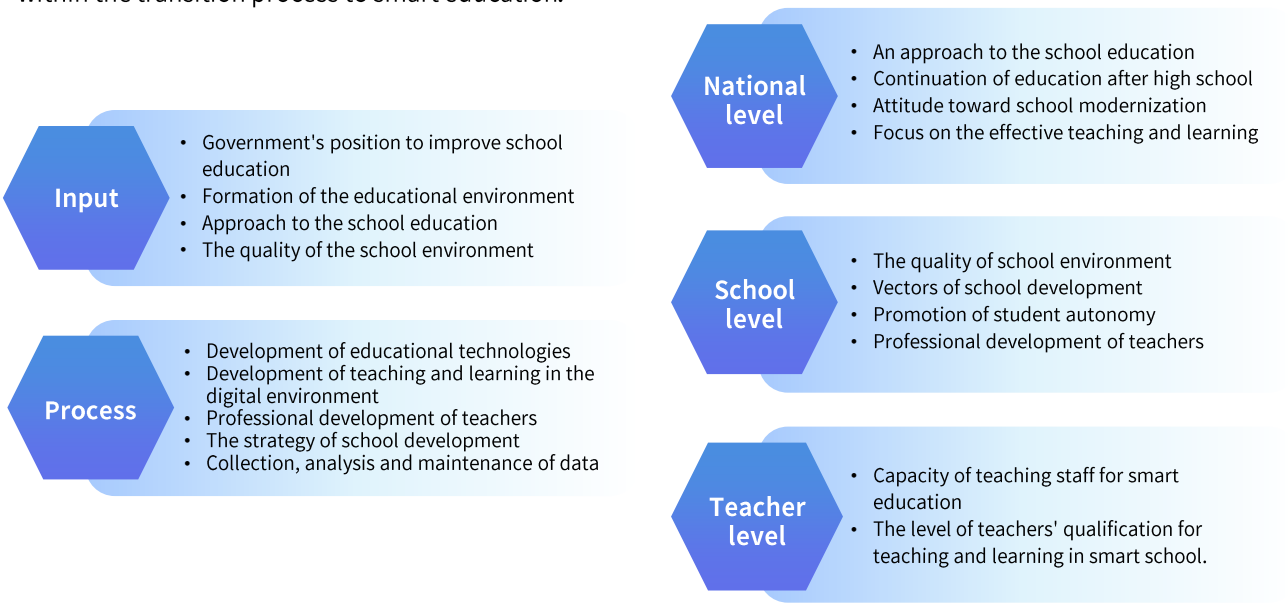


Figure 5. Concerns for Smart Education Monitoring

Criteria of Indicators Selection

Indicators selected for the assessment of smart education need to meet a range of standards to ensure technical strength, feasibility, frequency of reporting, cross-national comparability and interpretability, and availability of data over time. Identifying the indicators for the dimensions of smart education is the next key step for the monitoring, so the research team comes up with the following criteria for the selection of indicators:

- ✓ Each indicator should be well-defined, independent, and have a clear relationship with every single dimension of smart education.
- ✓ Indicators should reflect various countries' conditions/perspectives and capture differences in smart education at the country level.
- ✓ Indicators should be portrayed by measurement data that are sufficiently reliable to permit confident interpretation;
- ✓ Indicators should be quantitative where possible and qualitative where appropriate;
- ✓ Indicator measurement data or information should be gathered at a reasonable cost in time and money in most countries.

Data Collection at Country Level

Various sources of measurement data should be considered to make sure the quality of data sources and the full coverage of indicators and dimensions of smart education. The research team has been working on the following four methods to collect quality data for monitoring smart education.

- ✓ **Open source data from international organizations**: policy text, research and statistical data on social, economic, cultural, technological, and educational development of countries.
- ✓ **Educational statistics from the country**: the authoritative government education data generated in the sector management and services, collected by specialized government functions, and obtained from open sources.
- ✓ **Big data on the process of learning, teaching, and administrating**: the automatically generated data on the characteristics of teachers and students, process of teaching and learning, and also the management and governing practices, etc..
- ✓ **Schooling data collected by using a toolkit:** A toolkit should be developed to make it easy for collecting the necessary data for schools, regions and stakeholders.

Outcome 4: National Public Service for Smart Education

The public services for smart education could help to achieve educational equity, large-scale education, personalized learning, enhance the quality of education, and promote the realization of SDG 4 goals. In addition, providing national public services for smart education is one of the solutions to meet the needs of a country's digital transformation of education.

Typical Services for Smart Education

Students and teachers need services for smart learning and teaching. Learning management system is popularly used for the services of administration, documentation, tracking, reporting, automation, and delivery of educational courses. Open education resources provide teaching, learning, and research resources that reside in the public domain or released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution. For smart education, the following typical services should be provided to students and teachers:

- ✓ **Provision:** offering the necessary digital resources of compulsory curriculum for all schools and the support for active learning both in school and at home.
- ✓ **Evolution:** developing the platform for sharing ideas, resources, and experiences for differentiated teaching and professional development.
- ✓ **Collaboration:** converging digital educational resources across schools and regions, including domestic and international rural areas and major cities.
- ✓ **Innovation:** innovating the supply and sharing mechanism of educational resources among all the stakeholders, including assessment, copyright, cost sharing, distribution, etc.

Digital Education Service Structure

Easy, engaged, and effective learning should be provided for students, and the services should be provided from the perspective of the three layers of smart education, i.e. smart learning environment, smart teaching and learning methods, and smart governance. Services of information infrastructure, digital education resources, learning and teaching support, career planning and employment, educational information management, teacher professional development, etc. should be provided by different suppliers under the governmental strategy.

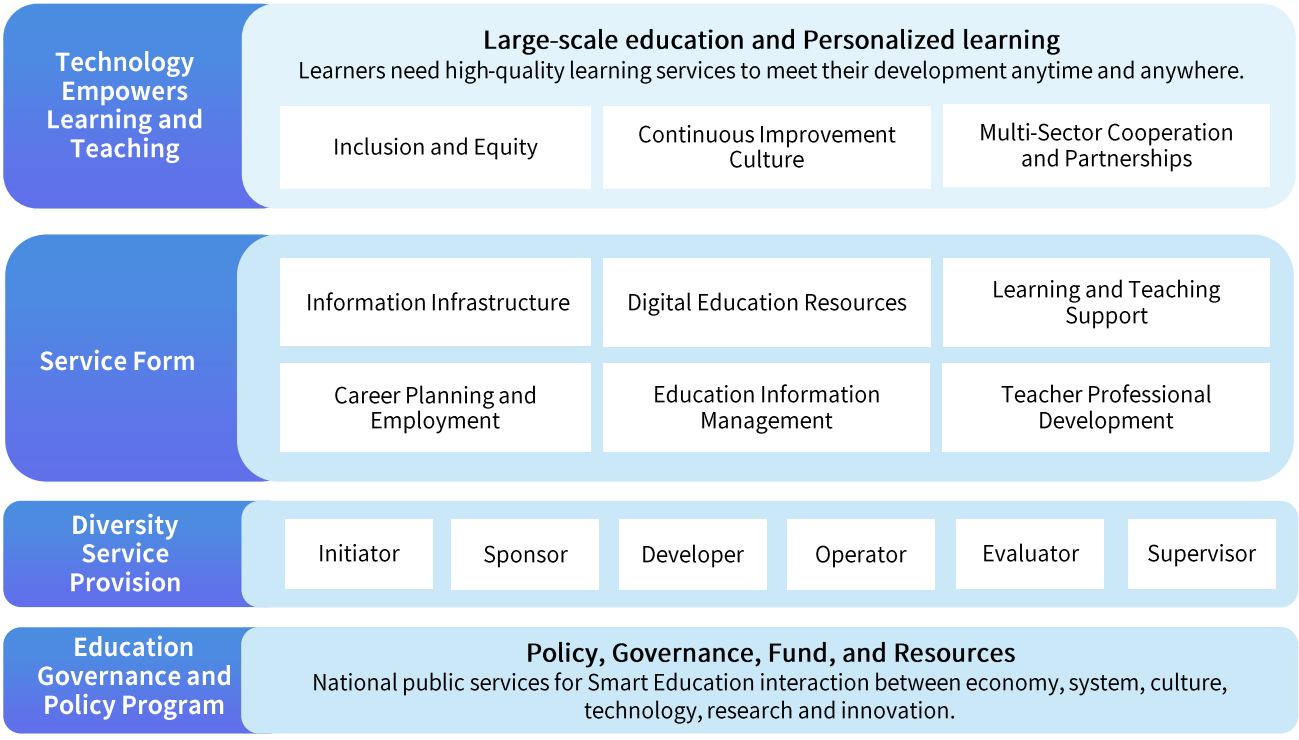


Figure 6. Digital Education Service Structure

Examples of Digital Education Service

Many countries and international organizations have provided digital education service systems based on digital technologies in different aspects for aiding teaching and learning to achieve fairness and high quality of educational development and promote the digital transformation of education.

Initiator (alphabetically)	Platforms/Services
Australia	• Digital educational resources Platform (SCOOTLE) • Support services for teaching and learning (Digital Technologies Hub) • Student well-being services (Student Wellbeing Hub) • Vocational education and training services (My skills)
EU	• Information and knowledge-building, Community of practice, Acceleration of best practices services (European Digital Education Hub) • The self-reflection tools (European Commission) • Digital Skills and Jobs Platform (DSJP)
Russia	• Russian electronics school Platform (RESH) • Research, application and monitoring in the field of education digitalization; Develop and use information technology to serve educational transformation (Federal Institute of Digital Transformation in Education)
U.S	• Reopening safely, student support, educator support services (Safer Schools and Campuses Best Practices Clearinghouse) • #GoOpen (Open Education Action)

National Public Service Platform for Smart Education

On March 28, 2022, the China Ministry of Education announced the launch of the National Public Service Platform for Smart Education. The platform integrates the National Primary and Secondary School Platform, the National Vocational Education Platform, the National Higher Education Platform, and the 24/365 Service Platform (a platform providing employment services for university students for 24 hours a day and in 365 days every year). The platform provide rich curriculum resources and educational services.

Platforms	Services for
National Primary and Secondary School Platform	K12 education
National Vocational Education Platform	Vocational education
National Higher Education Platform	Higher education
The 24/365 Service Platform for University Student Employment	Employment Services

Outcome 5: Guidance of Smart Campus for Future Education

Smart Campus for Future Education

"… a kind of open education and teaching environment with convenient and comfortable living space. This kind of Smart Campus is providing with several features, such as personalized services for teachers and students, comprehensively perceived the physical environment, identify the individual characteristics and learning situations of learners, seamlessly network communication, and effectively supports for the analysis, evaluation and intelligent decision-making of teaching process".

Designing Smart Campus

Utilizing emerging technologies, such as 5G, cloud computing and AI etc., to design smart campus for future education, the following five features should be considered:

- Context awareness. Comprehensive perception in smart campus includes two aspects: one is that sensors can sense, capture, and transmit information about people, equipment and resources anytime and anywhere; The second is the perception, capture, and transmission of learners' individual characteristics (learning preference, cognitive characteristics, attention state, and learning style.) and learning situations (learning time, learning space, learning partners, and learning activities.).
- Seamless connectivity. Based on network and communication technology, especially mobile Internet technology, smart campus supports the connection of all software systems and hardware devices. After information perception, it can be transmitted quickly and in real-time, which is the basis for all users to learn and work together in a new way.

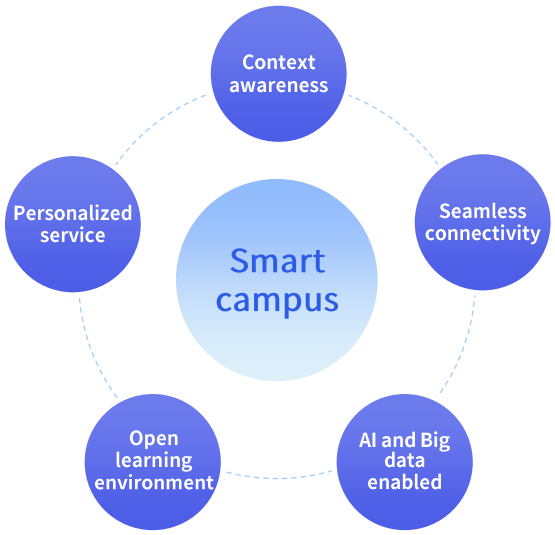


Figure 7. Features of Smart Campus

- AI and big data enabled. According to data mining and modeling technology, smart campus can build models based on "massive" campus data, establish prediction methods, and analyze, prospect, and predict the trend of new information. At the same time, the smart campus can integrate all aspects of data, information, rules, and other contents, make rapid response and active responses through intelligent reasoning and reflect intelligence.
- Open learning environment. The core idea of education is the cultivation of innovation ability. The campus is facing the demand of moving from "closed" to "open." Smart campus supports the expansion of resources and environment to let students break through the restrictions of textbooks; Supports the expansion of time environment to expand learning from class to after class; Supports the expansion of spatial environment so that effective learning can occur in real and virtual situations.
- Personalized service. The smart campus environment and its functions are based on the concept of personalized service. Therefore, applying various key technologies aims to effectively solve many practical needs of teachers and students in campus life, study, and work, which has become an indispensable part of reality.

Smart Campus Powered by Cloud Service

Type	School size	ICT sector	Technical requirement	ICT infrastructure	Funding
Cloud-based Smart Campus	Small	Few support staff	Low	Weak	Inadequate
Well-equipped Campus	Large	Sufficient support staff	High	Advanced	Adequate
Smart Hybrid Campus	Average	Necessary support staff	Middle	General	Average

As a new generation learning environment, smart campus provides diversified smart education services for students and staff. According to the technical mode of providing services, smart campus can be divided into three types: A cloud-based smart campus usually has small size, few support staff, low technical requirement, weak ICT infrastructure, and inadequate funding; a Well-equipped campus usually has a large size, sufficient support staff, high technical requirements, advanced ICT infrastructure, and adequate funding; Smart hybrid campus has the advantages of both a cloud-based smart campus and a well-equipped campus and is becoming a new trend in future campus technology architecture.

Smart Campus Enabled by 5G Technologies in China

With the gradual application of emerging technologies such as 5G/ AI / big data in the smart campus, the school's digital transformation has increasingly become a new trend of the future campus. As a result, there are many new applications in smart campus, such as dual-teacher classroom, live classroom, smart classroom, intelligent assessment, virtual & simulation experiment, green campuses, and school administration.

In September 2021, the Ministry of Industry and Information Technology and the Ministry of Education of China launched the "5G enabled Smart Education" Application Pilot Project. The project mainly focuses on five aspects: 5G-based interactive teaching, 5G empowered security on examination, 5G enabled multimodal evaluation, 5G enabled smart campus, 5G enhanced regional education decision making. In the future, it is suggested to accelerate the adoption of 5G, WiFi 6, AI, IoT, and other technologies to promote the development of smart education.

5G has the potential to change the smart campus in the future, which could be used to create a smart environment that improves the experience of students and staff. The school usually leverages 5G to adequately support the coverage of very large outdoor areas across many buildings throughout the campus. There are many 5G-based business applications in smart campus. In co-taught classes, Ultra HD video and course materials can be transmitted to remote classrooms simultaneously through 5G networks.

The Five Initiators

UNESCO Institute for Information Technologies in Education (UNESCO IITE) was established as an integral part of UNESCO by the General Conference of UNESCO at its 29th session (November 1997) and is located in Moscow, Russian Federation. IITE is the only UNESCO category 1 institute that holds a global mandate for ICT in education.

Commonwealth of Learning (COL) is an inter governmental organization created by Commonwealth Heads of Government in 1987 to promote the development and sharing of open learning and distance education knowledge, resources and technologies.

International society for Technology in Education (ISTE) is an international organization, which is the home to a passionate community of global educators who believe in the power of technology to transform teaching and learning, accelerate innovation and solve tough problems in education.

National Research University - Higher School of Economics (HSE) is a leader in Russian education and one of the preeminent economics and social sciences universities in eastern Europe and Eurasia. Having rapidly grown into a well-renowned research university over two decades, HSE University sets itself apart with its international presence and cooperation.

Beijing Normal University (BNU) initiated teacher training in China's higher education since 1902. BNU has become a comprehensive and research-intensive university with its main characteristics of basic disciplines in sciences and humanities, teacher education and educational science.

Secretariat

Smart Learning Institute (SLI) of BNU is an experimental platform involving scientific research, technology development, and instructional teaching. SLIBNU focuses on finding learning patterns powered by ICT, creating smart learning environments and platforms for lifelong learning and supporting digital learners' diversified, personalized, and differential learning needs.

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The Five Recommendations

1. Teachers, administrators, and stakeholders should recognize that smart education is critical for strategical plan to transform education by digital technology and AI, and to accelerate SDG 4 Education 2030 Agenda for inclusive, equitable and quality education.

2. Governments, according to their governing structures and specific conditions, should develop smart education from three key leverage points of transforming teaching and learning methods, building smart digital learning environments, and implementing forward-thinking policy. The overarching considerations of equity, continuous improvement, and multi-sector cooperation for the above leverage points should be fully considered.

3. Policy makers are encouraged to review, analyze and rebuild policies on ICT in education from the policy themes of ICT infrastructure, digital education resources and platforms, curriculum and pedagogy, skills and competencies, governance, educational management and administration, toward smart education.

4. Local authorities and school leaders are recommended to design and employ smart campus and new learning environments in effectiveness of learning, efficiency of schooling, efficacy of digital tools & resources, and innovate and monitor the new model of learning and teaching enhanced by technology in personalized learning and differentiated teaching, at region and school level.

5. All relevant stakeholders are recommended to promote and reinforce their cooperation driven by smart education strategy to build public services of smart education, such as access to compulsory curriculum, learning and technical supports, and learning analytics in the large-scale learning platforms and open education practices across regions.

Creating and sharing ideas for smart education

The initiative looks for further partners and collaborators to contribute visions and insights on smart education. Inputs from individuals, networks, and organizations are welcomed. Please feel free to contact us.

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