

Trends and Issues of Digital Learning in Korea

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Abstract

This chapter aims to explore the trends and issues in digital learning in Korea, showcasing the country's progressive efforts primarily driven by the Master Plan for ICT in Education. Notably, Korea has taken significant strides towards digital transformation, embracing innovative changes in education through digital technology. The COVID-19 pandemic accelerated the adoption of various online learning platforms, facilitating a smooth transition to remote learning. As the 4th Industrial Revolution unfolds, Korea has implemented new initiatives like the 2022 Revised National Curriculum, the Digital-Based Educational Innovation Plan, and AI digital textbooks to revolutionize pedagogical approaches and equip students and teachers with essential 21st-century skills. The chapter examines Korea's digital learning ecosystem through six elements, encompassing leadership and budget, course design and delivery, student success in digital learning, evaluation and analytics, teacher and staff professional development, and technology infrastructure. The Korean government's persistent efforts have resulted in digital learning environments that foster meaningful and flexible learning experiences. Key trends include the integration of AI, diverse digital resources, teacher communities, software and AI literacy education, and expanded learning spaces. Despite these promising trends, challenges remain, such as addressing the learning gap, formulating clear guidelines for student data, handling ethical concerns regarding AI, enhancing teacher competencies, and providing socio-emotional support. In conclusion, Korea's trajectory in ICT in education underscores the significance of centralized efforts and a systemic vision to transform the teaching and learning environment through digital technology.

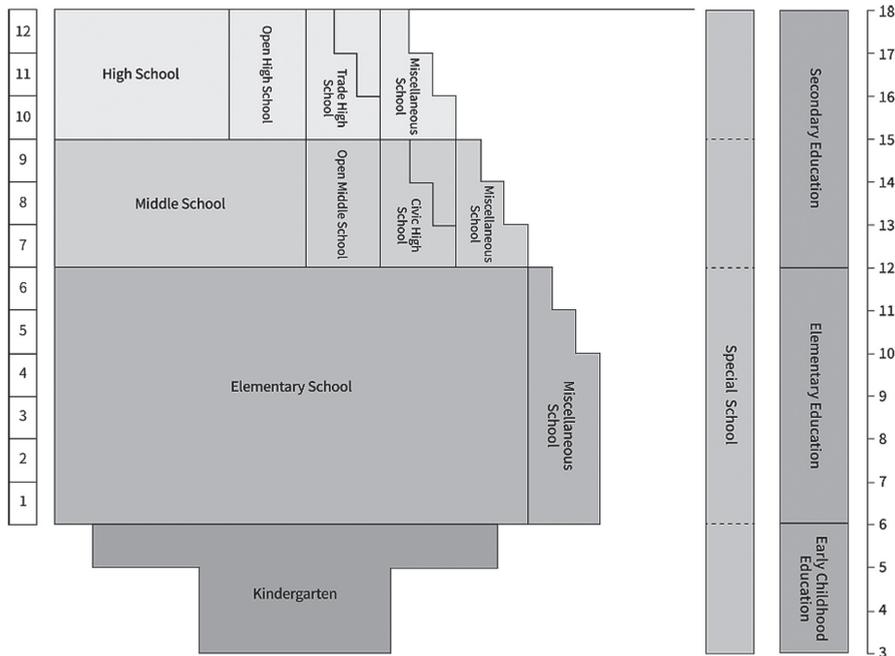
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Introduction

Embracing the era of Digital Transformation (DX), Korea, as a leading digital-competitive nation, has been making relentless efforts to leverage digital technologies in education. The country's aspiration is to create an all-encompassing digital learning ecosystem for every member of the K-12 school community. Before delving into the specific elements of digital learning in Korea, it is essential to understand the structure of its schooling system. As depicted in Figure 1, the schooling system in Korea entails early childhood education for ages 3 to 6, followed by six years of compulsory education in elementary school for ages 7 to 12. Subsequently, students undergo three years of compulsory education in middle school at ages 13 to 15. Finally, the K-12 curriculum concludes with another three years of education in high school for ages 16 to 18. Correspondingly, the ISCED levels align with this system, where kindergarten corresponds to ISCED level 0, elementary school to level 1, middle school to level 2, and high school to level 3.

Examining the status of digital learning and its infrastructure, the majority of K-12 schools in Korea are currently in the second stage of their digital transformation journey where schools reorganize and optimize educational activities by using various digital tools for teaching and learning. This chapter aims to explore the trends and issues in digital learning in Korea as it progresses towards the third stage, Digital Transformation, which is marked by innovative and disruptive changes in education to transform teaching and learning environments with digital technology. To accomplish this, this chapter first examines the contexts of digital learning and its infrastructure, identifying five key features of digital learning based on this analysis. Subsequently, the chapter highlights the trends and issues in digital learning, building upon the insights gained from the earlier sections.

Figure 1 Schooling System in South Korea



The Status of Digital Learning

Contexts of digital learning

Digital learning policies

The Ministry of Education (MOE) spearheads the formulation of key policies concerning nationwide digital learning, supported by a decentralized implementation structure. The execution of these policies is entrusted to 17 Metropolitan and Provincial Offices of Education (MPOE) and relevant agencies, which undertake state-wide policy actions tailored to the specific needs of

local communities and districts. The MOE plays a pivotal role in establishing a long-term national trajectory for digital learning through a diverse array of initiatives. Within this context, this section presents three significant ongoing initiatives in the domain of digital learning: (a) the 6th-phase Master Plan for ICT in Education (Ministry of Education [MOE], 2019), (b) the 2022 Revised National Curriculum (MOE, 2022e), and (c) the Digital-based Educational Innovation Plan (MOE, 2023a).

The 6th-phase Master Plan for ICT in Education (2019-2023)

In a systematic endeavor to advance ICT in education, the Korean government has enacted a legal mandate for the periodic formulation and execution of the Master Plan for ICT in Education every five years since 1996. The 6th-phase Master Plan for ICT in Education (6th MP) was implemented between 2019 and 2023, guided by the overarching vision of "Creating the Environment for People-Centered Intelligent Future Education." By aligning with diverse socio-cultural, economic, and technological transformations within society, the 6th MP aimed to facilitate a paradigm shift in education towards a more human-centered approach, characterized by the integration of intelligent technology (MOE, 2019). To realize its vision, the 6th MP outlined four primary objectives:

- *Future*: Creating a future-oriented ICT environment for realizing future dreams
- *Sustainable*: Innovating ICT in education for improving continuity between elementary, secondary, and tertiary education
- *Personalized*: Providing customized educational service using ICT to create equal opportunities for learning
- *Sharing*: Establishing digital infrastructure to promote communication and the sharing of educational information

The government's dedication to fostering an innovative educational landscape through ICT integration is evident in its pursuit of a more inclusive and intelligent future in education. Table 1 outlines 13 significant policy actions aimed

at achieving these objectives. Among these actions, three main tasks from the 2022 plan (Educational Safety Information Bureau, 2022) hold particular importance for the future of digital learning in K-12 schools. The first action, "Establishing an ICT convergence teaching and learning support system," places emphasis on personalized education for students through digital textbooks and AI-based mathematics and English-speaking practice systems. Additionally, it facilitates teacher support through the comprehensive platform "ITDA," enabling the creation and sharing of teaching materials. The fourth action, "Establishing a future classroom where imagination becomes a reality," strives to enhance the digital infrastructure of elementary and secondary schools. This includes implementing wireless networks in all learning spaces and expanding ICT education classes, creating an environment conducive to imaginative and interactive learning experiences. The 12th action, "Integrating digital infrastructure for educational information," aims to transition educational information resources to the 4th generation Intelligent NICE, a public cloud for education information and management. This step ensures efficient access to educational information, fostering a technologically advanced learning environment.

Table 1 Specific Policy Areas and Actions in the 6th-phase Master Plan for ICT in Education (2019-2023)

Policy Area	Policy actions
I. Creating a future-oriented smart education environment	<ol style="list-style-type: none"> 1. Establishing an ICT convergence teaching and learning support system 2. Supporting the construction of an intelligent academic and research ecosystem 3. Reinforcing digital capabilities to respond to future changes in society 4. Establishing a future classroom where imagination becomes a reality
II. Establishing sustainable ICT in education innovation	<ol style="list-style-type: none"> 5. Expanding online learning to consider the life-cycle of education 6. Reinforcing lifelong learning and career and job information management systems 7. Enhancing educational administration services to increase work efficiency
III. Realizing customized educational services through ICT	<ol style="list-style-type: none"> 8. Reinforcing equal welfare services based on informatization 9. Promoting the opening of customized educational information based on big data 10. Establishing a safe operating system for each field of education information
IV. Establishing a shared educational information digital infrastructure	<ol style="list-style-type: none"> 11. Reinforcing channels for public policy communication 12. Integrating digital infrastructure for educational information 13. Expanding overseas information through exchange and cooperation

Note. Adopted from KERIS, 2021.

The 2022 Revised National Curriculum

The 2022 Revised National Curriculum represents yet another pivotal nationwide policy significantly shaping the future landscape of digital learning in Korea. Guided by the overarching vision of nurturing "An autonomous person

with inclusiveness and creativity," the 2022 Revised National Curriculum seeks to cultivate diverse and self-directed education programs tailored to the unique characteristics of individual students. Officially released by the MOE in 2022, the Revised National Curriculum is slated for gradual expansion, culminating in full implementation by 2025. This comprehensive curriculum outlines essential human traits and core competencies that future education endeavors to instill, while delineating educational objectives to be achieved across various school levels.

The High School Credit System stands out as a key initiative within the framework of the 2022 revised curriculum, leveraging digital technology to foster flexible learning. This system empowers students to exercise choice in selecting subjects based on their interests and academic aptitude. By meeting specific criteria for each subject, students can accumulate credits, ultimately leading to graduation (MOE, 2021a). However, a foreseeable challenge accompanying the implementation of this innovative system revolves around instances wherein individual schools encounter difficulties in securing qualified teachers to conduct certain courses or when there is insufficient student interest, potentially compromising the feasibility of course offerings. In response to this issue, a prospective solution has been proposed in the form of the "Online Joint Curriculum." This proposal aims to promote collaboration among multiple high schools, thereby facilitating the collective provision of online courses to students from diverse schools. In support of the Online Joint Curriculum, the ClassOn platform (<https://edu.classon.kr>) operates as an online digital learning platform, enabling real-time interactive online classes. By integrating these cutting-edge initiatives, Korea's educational landscape continues to evolve, offering students more personalized learning experiences and overcoming traditional constraints associated with course availability and geographical boundaries.

Moreover, the 2022 Revised National Curriculum places significant emphasis on "Digital-Based Innovation in Teaching and Learning" as a key priority

(MOE, 2021d). This important initiative strives to create versatile and pioneering digital learning environments that seamlessly integrate both online and offline learning experiences. To support the successful implementation of digital learning innovations in schools, Table 2 outlines a range of curricula and operational guidelines within the framework of the 2022 Revised National Curriculum. The table demonstrates that the 2022 revised curriculum places digital learning at the forefront, playing a pivotal role in realizing student-centered personalized learning at the national level. Through this strategic integration of technology, the curriculum seeks to foster dynamic and tailored educational experiences that empower each student to thrive in their learning journey.

Table 2 Digital-Based Innovation in Teaching and Learning in the 2022 Revised National Curriculum

Curriculum	Teaching & Learning Assessment	Implementation Support
<ul style="list-style-type: none"> • Development of General guidelines for the curriculum that integrates online and offline learning • Provision of various distance learning types for the curriculum • Online and offline learning and an online joint curriculum that considers community and school contexts 	<ul style="list-style-type: none"> • Development of various distance learning models and fair assessment criteria • Use of big data and AI for personalized learning, teaching, and assessment • Enhancement of online assessment and process-centered evaluation in distance learning • Enhancing assessment for the development of creativity, critical thinking, etc. 	<ul style="list-style-type: none"> • The operation of attendance and evaluation using the learning management system (LMS) • Development of various types of learning content for different types of distance learning • Development of various distance learning, teaching, and assessment models • Supporting the enhancement of teacher competence in distance learning

Note. Adopted from MOE, 2021d.

The Digital-Based Educational Innovation Plan

The Digital-Based Educational Innovation Plan (MOE, 2023a), unveiled in 2023, stands as a comprehensive nationwide strategy formulated on the foundations of the two aforementioned policies. Guided by the overarching vision of "Realizing Customized Education for All," this plan caters to the unique competencies and learning pace of individual students, harnessing the transformative potential of digital technology. At its core, the plan seeks to "restore the essence of education" by focusing on two specific directions. The first direction involves fortifying concept-focused and problem-solving-oriented education to cultivate essential human skills such as creativity, critical thinking, and collaboration, which remain irreplaceable by AI. In this regard, the plan aims to equip students with abilities that distinguish them as individuals and foster their adaptability in an ever-evolving world. The second direction aims to establish a personalized education system that aligns with students' distinct learning goals, capabilities, and pace while nurturing meaningful teacher-student connections.

Central to achieving this vision of digital-based personalized learning is the AI Digital Textbook project, which plays a pivotal role in supporting the plan's objectives. Beyond acting as a personalized tutor, the AI textbook offers a diverse array of learning options, including multimedia content, virtual reality (VR), augmented reality (AR), and more. This dynamic integration enables students to pursue their learning seamlessly, transcending the confines of time and space. Learners can grasp fundamental concepts at their own pace through AI digital textbooks outside of school, while in the classroom, they actively participate in discussions and engage in project-based learning alongside their peers, applying their knowledge to real-world problem-solving scenarios.

Under this plan, teachers are encouraged to design and implement diverse lessons and assessments using digital technologies. The online platform, Knowledge Spring (<https://educator.edunet.net/>), serves as a valuable space

where teachers can exchange knowledge, ideas and resources, enhancing their digital competence. Furthermore, as members of the TOUCH (Teachers who Upgrade Class with High-tech) group, teachers can actively engage in boot camp-style training programs, both online and offline, to collaboratively share AI-integrated instructional methods with fellow teachers.

Digital learning implementation in K-12 schools

Digital learning has become fully integrated into South Korea's education system, spanning across all school levels and learning domains. Schools and students have access to a variety of nation-wide online learning systems, such as e-Hakseupteo, EBS Online Class, and AI Digital Textbooks. These platforms provide digital learning content across a wide array of subjects, accommodating students from various grades and needs. The public online learning services such as e-Hakseupteo and EBS Online Class provide digital learning content in various learning areas for all grades of elementary, middle, and high school. In detail, e-Hakseupteo is being operated for elementary and middle school students, while EBS Online Class is for all school levels. This section presents three representative platforms for digital learning that have been actively used by K-12 students.

Firstly, e-Hakseupteo (<https://cls.edunet.net/>) is a public online learning service specifically designed for elementary and middle school students. The main objectives are to enhance the quality of public education and narrow educational gaps by providing quality online resources for teaching and learning. Before the COVID-19 pandemic, e-Hakseupteo served as a platform offering diverse content for supplementary after-school classes. However, with the advent of the pandemic, e-Hakseupteo evolved into a prominent online learning platform that effectively supports distance learning. Within "e-Hakseupteo," students have access to the individual learning history management, enabling them to view content lists, track their progress, and monitor assessment statuses to facilitate self-directed learning. Moreover, the platform provides an

online classroom feature, empowering teachers to create virtual classrooms within the platform. In these virtual classrooms, teachers can organize content for students to study and assign various tasks and activities.

Secondly, EBS (Educational Broadcasting System) plays a significant role in lifelong learning and public education, offering valuable educational broadcasts that complement school education. EBS operates two prominent platforms: "Online Class" and "EBS Elementary, Middle, and High School Sites." In February 2020, EBS launched Online Class (<https://www.ebsoc.co.kr/>) to support public education and minimize learning gaps. This comprehensive platform provides not only a Learning Management System (LMS), but also features like interactive video classes, enabling two-way communication between students and educators. EBS Elementary, Middle, and High School Sites (<https://www.ebs.co.kr/>) predominantly offer level-specific learning content, covering a broad range from kindergarten to high school. The content is categorized into basic, fundamental, and advanced levels, catering to students' individual learning abilities. To further personalize learning experiences, AI Danchoo by EBS provides tailored learning services, allowing students to set their preferred learning levels. The primary services of AI Danchoo encompass seven key features: AI problem recommendation, test paper creation, AI course recommendation, problem searching, pre-learning diagnosis, and a mathematics MAP service. These AI-driven features empower students to access targeted learning materials and support their academic progress.

Finally, the AI Digital Textbook (<https://dtbook.edunet.net/>) stands as the latest initiative in elevating digital learning experiences through intelligent technology. Digital textbooks were introduced to complement printed textbooks, to enhance classroom teaching, and to support self-directed learning. In 2023, the MOE unveiled the AI Digital Textbooks as an integral component of the "Digital-Based Educational Innovation Plan," aligning with the overarching vision of personalized education for all (MOE, 2023a). The current features of the AI Digital Textbooks encompass personalized subject learning and AI tu-

toring (Ahn & Cha, 2023). Students can access personalized learning concepts for each subject, assessment questions, corresponding learning materials, and the results of their assessments. Additionally, AI tutors offer an array of functions, including personalized learning material recommendations, learning data and activity analysis, question and answer services, and more. For specific subjects, the AI Digital Textbooks are designed to leverage ITS (Intelligent Tutoring System) functions in Mathematics to support personalized learning, utilize voice recognition to enhance English listening and speaking practice, and provide enriching coding education experiences and practical activities in Information Education. The introduction of AI Digital Textbooks is planned for gradual implementation, initially targeting selected grades in Mathematics, English, and Information Education from 2025 onwards. This strategic approach ensures a well-structured integration of advanced AI technology into the educational landscape, fostering tailored and effective learning experiences for students in key subjects.

Digital learning during the COVID-19 pandemic

The COVID-19 pandemic has instigated substantial disruptions across various sectors in the country, encompassing social, economic, political, and educational realms. While the pandemic has resulted in adverse outcomes, such as learning disparities and diminished social-emotional aptitude among students, it has also propelled positive transformations toward digital learning in schools. Given the suspension of school openings nationwide due to the pandemic, online remote learning emerged as the sole feasible means to sustain educational provisions to students. Consequently, from April 9 to 20 in 2020, all school students throughout the country commenced their learning journeys via online courses. This section explores the acceleration of digital learning during the COVID-19 pandemic in Korea, focusing on four key aspects: a) technology support for digital learning, b) policy support for digital learning, c) advancement of teachers' digital competence, and d) implementation of blended learning approaches.

Technology support for digital learning

The nationwide implementation of online remote learning in response to the COVID-19 pandemic has spurred significant advancements in technology support for digital learning. The Ministry of Education (MOE) undertook initiatives to enhance digital learning platforms and learning management systems (LMS) while ensuring widespread access through the comprehensive distribution of wireless networks and smart devices to all schools. Following the outbreak of COVID-19, the MOE introduced public LMS platforms, namely the “E-learning Site” operated by the Korea Educational Research Information Service (KERIS) and “The EBS Online Class,” operated by EBS, which is capable of accommodating up to 3 million users daily (MOE, 2022b).

To bridge the digital divide and ensure equitable access to digital learning, the MOE distributed smart devices to students and facilitated the establishment of wireless networks in all schools. As of March 2022, wireless networks were installed in 386,000 learning spaces across elementary, middle, and high schools, and 250,000 devices were upgraded to the latest laptops, desktops, and tablets (MOE, 2022b). Additionally, during the second semester of 2021, 180,000 smart devices were allocated to students (MOE, 2022b), and subsequently, each MPOE has actively promoted a project to provide one smart device per student. These collective efforts have substantially improved Korea's digital learning landscape, which undoubtedly augurs well for the future of digital education in the country.

Policy support for digital learning

To effectively and systematically implement quality digital learning during the pandemic, the Ministry of Education has laid a robust foundation for nationwide digital learning initiatives. One of these significant efforts is the formulation of the "Operation Standards for Distance Learning" (MOE, 2020a). These standards delineate the concept of distance learning, categorizing it into three

distinct types as shown in Figure 2: a) real-time interactive learning, b) content-centered learning, and c) task-centered learning. The first type involves conducting classes with real-time interaction, wherein teachers engage with students through video conferencing tools or social network services (SNSs). The second type encompasses content-based online classes, wherein teachers either create the content themselves or utilize various resources from national e-learning platforms such as EBS, e-Hakseupteo, and digital textbooks. The third type pertains to assignment-based online classes, where teachers assign projects and homework for students to submit via a LMS, necessitating students to demonstrate self-directed learning skills to complete the assignments. Since each of these three types of online classes presents distinct strengths and weaknesses, the MOE suggested that schools should adopt the most suitable approach based on their specific contexts and student needs.

Figure 2 Three Types of Online Classes during COVID-19



Note. Adopted from MOE, 2020a.

Another crucial endeavor is the enactment of the “Framework Act on the Promotion of Digital-Based Distance Education” (promulgated on September 24, 2021, and effective from March 25, 2022) (MOE, 2021c). The prime aim of this legislation is to elevate the quality of distance education and facilitate its systematic implementation (MOE, 2021c). This law furnishes a detailed legal framework encompassing fundamental principles of distance education, content quality management, operational standards, and the designation and functioning of specialized institutions. Subsequently, this legislation formed the legal basis for the “Operation Standards of Distance Classes for Elemen-

tary, Secondary, and Specialized Education” (MOE, 2022a). Collectively, these foundational initiatives through policy and legal actions, established in response to the pandemic, have been instrumental in setting digital education as the new norm nationwide.

Advancement of teachers' digital competence

The success of digital learning during the pandemic owes much to the dedicated efforts of teachers who adeptly designed and implemented remote online learning with digital technology. With the establishment of online platforms and comprehensive teacher training programs, both pre-service and in-service educators honed their digital competencies to ensure seamless online learning experiences. The abrupt onset of COVID-19 presented an unprecedented challenge, necessitating teachers' immediate adaptation to online teaching without adequate preparation. In response to these challenges, the MOE proactively established online teacher communities such as “the Community of 10,000 Representative Teachers,” “School On,” and “the Knowledge Spring” (MOE, 2022b). These communities provided invaluable spaces for teachers to share information, collaborate on solving digital learning-related issues, and forge connections with various experts in the education domain (MOE, 2022b).

As the pandemic persisted, the MOE took an innovative step by curating high-quality content from these online communities, culminating in the creation of a dedicated online platform for teachers known as ITDA (the ICT-based Teacher Development Assistance platform) (<https://itda.edunet.net/>). ITDA emerged as a comprehensive resource hub, offering teachers a diverse array of tools to enhance their teaching skills and deliver effective distance learning. Serving as an integrated platform, ITDA empowers teachers to efficiently search for, collect, re-organize, produce, share, and communicate a wide range of educational content suitable for their teaching and assessment needs.

In addition, the MOE supported the professional development of both in-

service and pre-service teachers, particularly for enhancing their digital competencies. In 2020, the “Center of Future Education” was inaugurated with the primary objective of fostering digital and future education skills among pre-service teachers (MOE, 2021b). Across the nation, 28 Centers of Future Education were established within the National University of Education and College of Education (MOE, 2022b). These centers boast state-of-the-art facilities, including distance learning simulation and online content production rooms, offering pre-service teachers’ opportunities to acquire hands-on knowledge and skills essential for digital teaching. Through activities such as creating digital teaching materials, engaging in various digital learning activities, and utilizing digital learning platforms, pre-service teachers are expected to be well-equipped to effectively employ digital teaching methods in schools (MOE, 2021b). In addition, the MOE also facilitated systematic training programs for in-service teachers. In response to the pandemic, traditional face-to-face group training for in-service teachers was promptly transitioned to interactive online training (KERIS, 2021). These initiatives aimed at elevating teachers' digital competencies proved instrumental in delivering quality remote learning experiences to students during the challenging period of the pandemic.

Implementation of blended learning approaches

In response to the COVID-19 pandemic, the MOE took proactive measures to foster blended learning environments by proposing a range of teaching models and methods. One notable initiative was the distribution of “The Handbook for Curriculum Operation in Response to COVID-19” (MOE, 2020b), which played a pivotal role in this movement. The handbook served as a comprehensive resource, offering practical examples of blended learning in practice tailored to each grade level and subject area. Emphasizing flexibility and adaptability, the MOE encouraged schools to freely modify and tailor the handbook to suit the specific needs and characteristics of their students. Within the handbook, various blended learning models are introduced, including real-

time interactive learning, content-centered learning, and task-centered learning. Moreover, the document presents detailed lesson plans and related activities based on various blended learning models. Importantly, the handbook provides recommendations for utilizing various tools and platforms, such as Zoom, EBS Online Class, QuizN, and others, that are well-suited for specific subject areas. This proactive approach aimed to empower teachers with practical guidance, ensuring seamless implementation of blended learning strategies to meet the evolving educational needs during the pandemic.

Digital learning infrastructure

Since the inception of the First Master Plan for ICT in Education in 1996, Korea has been steadily establishing and enhancing its digital infrastructure for teaching and learning. The first MP played a pivotal role in laying the foundation for building the basic ICT infrastructure in schools. With the advent of the COVID-19 pandemic, there has been a remarkable surge in progress within the ICT infrastructure to effectively support online digital learning in schools. This section examines the digital learning infrastructures in Korean schools, through the lens of the six elements proposed by Fox et al. (2021).

Leadership and budget

To ensure the successful and equitable implementation of digital learning nationwide, the government has established and executed the "Master Plan for ICT in Education" every five years. As seen in Table 3, the 6th-Phase Master Plan for ICT in Education (6th MP) spanning from 2019 to 2023 received budget allocations aligning with its overarching goals and specific policy areas (KERIS, 2022). Notably, in 2020, the MOE budget experienced an increase compared to 2019 and 2021. This rise was primarily attributed to investments made by the MOE and the Metropolitan and Provincial Offices of Education (MPOE) in establishing wireless infrastructure, enabling elementary and middle school students to access online education seamlessly.

Furthermore, in 2021, a substantial budget increase was allocated for the "Creating a future-oriented smart education environment" (see Table 4). This increase aimed to expand the provision of smart devices to students while also enhancing content, information infrastructure, and educational administrative service systems. These allocations were directed towards realizing two major areas within the 6th MP: Policy area 3 - Realizing customized educational services through ICT, and Policy area 4 -Establishing a shared educational information digital infrastructure. Such strategic funding allocations demonstrate the government's commitment to advancing digital learning and fostering a technologically enabled educational ecosystem.

Table 3 Budgets for ICT in Education by Organization Type (unit: Million KRW)

Organization	2019	2020	2021	2022
MOE	227,499	958,324	419,904	383,363
MPOE	525,635	503,117	1,165,988	1,096,556
Affiliated organizations	6,994	6,358	7,856	8,700
Relevant organizations	46,597	48,336	57,191	69,501
Total	807,725	1,516,135	1,650,939	1,557,670

Note. Adopted from KERIS, 2022.

Table 4 Budgets for ICT in Education by Policy Area (unit: Million KRW)

Policy area	2019	2020	2021	2022
1. Creating a future-oriented smart education environment	286,832	1,017,726	1,102,636	928,843
2. Establishing sustainable ICT in education innovation	388,242	329,025	399,100	450,289
3. Realizing customized educational services through ICT	98,043	115,325	112,009	131,454
4. Establishing a shared educational information digital infrastructure	34,608	54,059	37,194	47,084
Total	807,725	1,516,135	1,650,939	1,557,670

Note. Adopted from KERIS, 2022.

Course design and delivery

The Korean government has taken significant strides to harness the potential of digital learning, with a keen focus on providing equal learning opportunities to students at all levels of education. Table 5 provides an overview of digital learning platforms specifically tailored to a diverse range of student needs. These platforms address the requirements of students with disabilities, student athletes facing challenges in regular attendance, students from multicultural backgrounds, and individuals who had previously dropped out of school or missed secondary education opportunities. The implementation of these digital learning platforms reflects the government's commitment to promoting inclusive access to education and offering flexible learning experiences that cater to the unique needs and characteristics of each student.

One such platform is "Online Supplementary Courses" (<https://onlineschool.or.kr>), which operates both "Supplementary learning" and "Unopened courses" programs. The "Supplementary learning" program ensures that students have access to learning opportunities in subjects they may have missed due to transfers or other reasons. On the other hand, the "Unopened courses" program allows students the opportunity to choose subjects that may be challenging to offer within their school due to internal constraints. As of 2022, this platform offered online courses in 163 subjects (75 for middle schools and 88 for high schools). The availability of diverse subjects on this platform empowers students to pursue their academic interests and fill any learning gaps they may have encountered, thereby fostering a more inclusive and enriched educational experience.

Secondly, "e-School" (<https://hs.e-school.or.kr>) has been developed specifically to cater to the needs of student-athletes who may face absences due to their sports-related commitments. The primary objective of this platform is to safeguard the learning rights of student-athletes and provide supplementary learning support for students with inadequate academic achievements. The main

programs offered by e-School include the "Regular Semester Curriculum" and the "Run-up Curriculum." They encompass a wide range of subjects, incorporating both regular curriculum content and specialized material tailored to meet the specific needs of student-athletes.

Thirdly, "Open Middle and High Schools" (<https://www.cyber.ms.kr>, <https://www.cyber.hs.kr>) represent a unique educational opportunity aimed at serving a diverse student population, ranging from teenagers to individuals over 80 years old. These online schools are committed to broadening access to secondary education and facilitating students' acquisition of academic qualifications. Their approach revolves around a blended education model that can be personalized to cater to the unique needs of individual learners. A noteworthy aspect of these schools is the consideration of learner characteristics, with over-60-year-olds constituting 58.3% of the student population (KERIS, 2022). The learning methods employed consist of 90% distance classes and 10% offline classes. Additionally, microlearning has been integrated into the instructional approach, which includes topic-centered video content, activity-centered learning materials, and various difficulty levels of formative assessments.

Fourthly, online learning platforms cater to the needs of students with disabilities, ensuring inclusive educational opportunities. "School for You" (<https://www.s4u.kr>) offers online education using diverse video content, VR, and AR platforms specifically designed for elementary and middle school students with health impairments and students in hospital schools. Its main objective is to maintain academic continuity for students facing health-related challenges, thereby facilitating their participation in regular school activities. Additionally, "Open Learning Ground" (<https://class.nise.go.kr>) serves as an integrated platform that supports teachers, students, and parents in the field of special education. This platform provides both synchronous and asynchronous digital teaching and learning experiences by offering live video classes and personalized content on various topics.

Lastly, the "National Center for Multi-Culture Education" (<http://www.edu4mc.or.kr/>) plays a crucial role in ensuring the educational rights of multicultural students. This platform aims to support the integration of multicultural students into the public education system, and offers various online educational resources to aid their adaptation to school life. A key feature of the platform is the provision of "Bilingual textbooks" and "Curriculum aid materials" to facilitate distance learning for multicultural students. The "Bilingual textbooks" encompass languages such as Russian, Cambodian, Thai, Mongolian, and Indonesian, providing students with the opportunity to learn their parents' native language and culture. The "Curriculum aid materials" offer "Self-learning vocabulary in the curriculum," helping students grasp curriculum-related vocabulary more effectively and enhancing their basic academic skills.

Table 5 Digital Learning Platforms Tailored to Various Student Groups and Needs

Student Groups	Digital Learning Platforms	URLs
Transfer Students	Online Supplementary Courses	https://hs.onlineschool.or.kr/main.do
Student-Athletes	e-School	https://hs.e-school.or.kr/main.do
School drop-outs and adult learners	Open Secondary Schools	https://www.cyber.ms.kr/portal/index.do (middle school) https://www.cyber.hs.kr/portal/index.do (high school)
Students with Disabilities & hospital schools	School for You	https://www.s4u.kr/
Students with Special Educational Needs	Open Learning Ground	https://class.nise.go.kr/hre/cm/mcom/pmco000b00.do
	Eduable	https://www.nise.go.kr/main.do?s=eduable
	Online Learning Room for Students with Disabilities	https://www.nise.go.kr/jsp/onlineedu/index.jsp
Multicultural Students	National Center for Multi-Culture Education	https://www.edu4mc.or.kr/

Student success in digital learning

This section examines students' success in digital learning concerning (a) their access to digital devices and (b) digital learning competencies. In pursuit of promoting students' digital learning experiences, Korea has taken proactive measures to support the distribution of digital devices, as demonstrated in Table 6. Notably, as of 2022, elementary schools exhibited the highest distribution of digital devices, with 6,359 schools benefiting from this initiative (KERIS, 2022). On a per-user basis, the distribution to students accounts for a significant proportion at 60.97%. This noteworthy progress in providing digital devices to students was made possible by a substantial increase in the budget allocated for the "Creating a future-oriented smart education environment" in 2021 under the 6th MP.

Table 6 Distribution of Digital Devices by School Level and User Type

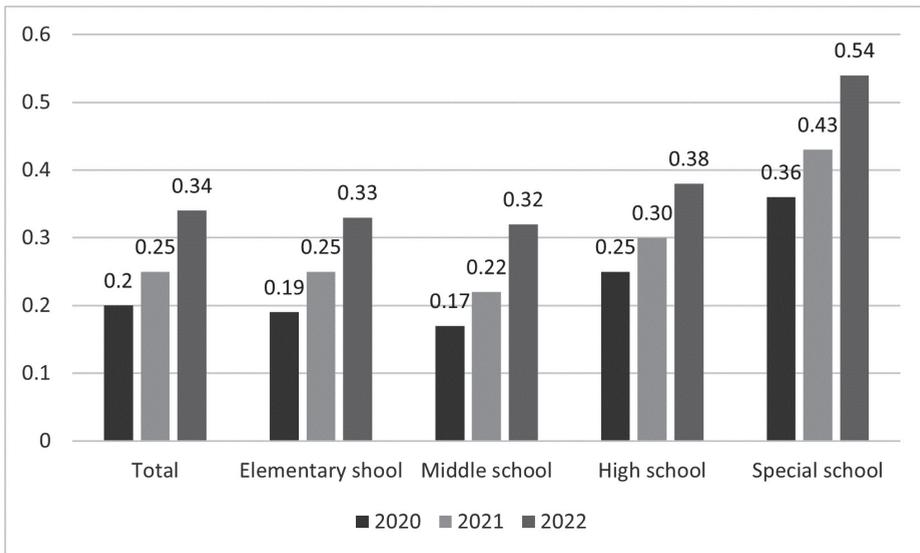
Category	Total number of schools	Total number of units per user				
		Total	Students		Teachers	
			Units	%	Units	%
Total	12,209	2,954,631	1,801,379	60.97	891,373	30.17
Elementary school	6,359	1,372,307	876,197	63.85	367,013	26.74
Middle school	3,278	727,993	429,403	58.98	234,979	32.28
High school	2,379	814,425	480,406	58.99	270,593	33.23
Special school	193	39,906	15,373	38.52	18,788	47.08

Note. 1. * Number of units for other school staff is not indicated in this table.

2. Adopted from KERIS, 2022.

Examining the data on the number of digital devices per student in the past three years, as depicted in Figure 3, a consistent upward trend is evident. In 2020, the ratio stood at 0.20 devices per student, which then increased to 0.25 devices in 2021. By 2022, this number had further risen to 0.34 devices per student. Such advancements reflect the concerted efforts and commitment of the educational authorities to equip students with the necessary digital resources, ensuring enhanced access for successful digital learning experiences.

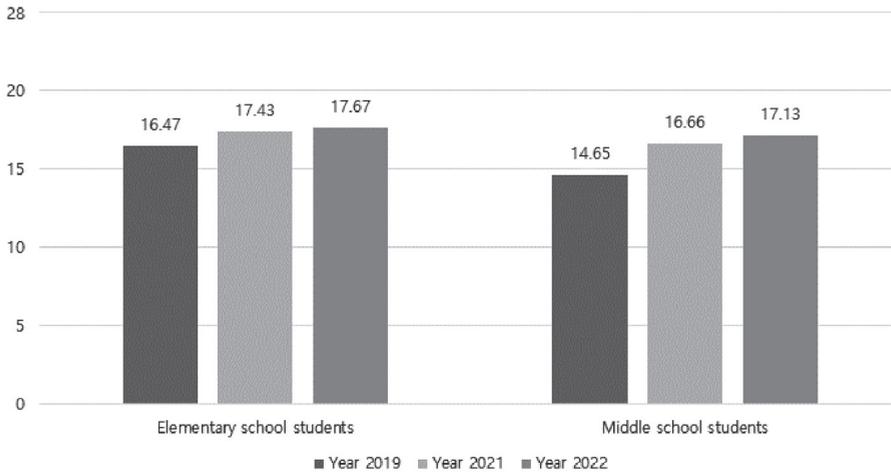
Figure 3 Number of Students per Digital Device in 2020-2022



Note. Adopted from KERIS, 2022.

Secondly, students' digital literacy skills have been showing gradual improvement with the MOE's steadfast support for enhancing digital learning in schools. As shown in Figure 4, the level of digital literacy skills has been measured annually from 2019 to 2022 (Yi et al., 2022). Focusing on elementary school students, their digital literacy score witnessed a positive trajectory. In 2019, the total score was 16.47 out of 28, which climbed to 17.43 in 2021 and further increased to 17.67 in 2022. Middle school students exhibited a similar trend of improvement. Their digital literacy score was 14.65 in 2019, showing an increase to 16.66 in 2021, and reaching 17.13 in 2022. These encouraging trends in digital literacy skills highlight the tangible benefits of the MOE's dedicated efforts in bolstering digital learning support. As students' digital competencies continue to improve, the foundation for successful and effective digital learning experiences becomes stronger, positioning learners for a future that embraces the opportunities of a digitally connected world.

Figure 4 Comparison of Student Digital Literacy Levels by Year 2019-2022



Note. 1. Year 2020 data is missing due to COVID-19

2. Adopted from Yi et al., 2022.

Evaluation and analytics

To enhance teachers' evaluation expertise and streamline the evaluation process, two essential platforms are currently in use: a) the Student Evaluation Support Portal and b) NEIS (the National Education Information System). Firstly, the Student Evaluation Support Portal (<https://stas.moe.go.kr>) offers a valuable search service that grants access to high-quality evaluation tools and resources categorized by school grade and subject. This platform ensures the availability of reliable evaluation materials sourced from the MOE, MPOE, and reputable research institutions. Additionally, the portal promotes collaboration among teachers by offering a materials repository where teachers can share their evaluation resources, fostering a sense of community and knowledge-sharing among teaching professionals. Furthermore, the portal provides a wealth of supplementary materials and training videos to enhance teachers' proficiency in conducting evaluations effectively.

Secondly, NEIS (<https://www.neis.go.kr>) serves as a comprehensive platform designed to facilitate efficient educational administration across all schools in South Korea. Since its launch in 2002, NEIS has been actively utilized and has continuously evolved to meet the evolving needs of schools. Its core features empower schools and educational organizations to carry out administrative tasks based on the data stored in NEIS, while also ensuring that the public can access valuable educational information. In 2023, the introduction of the 4th generation intelligent NEIS service marked a significant advancement, incorporating various cutting-edge technologies and transforming into a forward-thinking information system. This new iteration promotes future-oriented education by encouraging active participation from students and parents, streamlining administrative processes for schools and educational offices, and fostering collaboration with government agencies and private sectors. Since its inception, NEIS has played a vital role in facilitating seamless educational administrative tasks and contributing to the digital learning innovation in South Korea.

Teacher and staff professional development

Teachers play a critical role in providing meaningful digital learning experiences to students. To equip them with the necessary digital competencies, several teacher professional development (TPD) programs have been introduced. This section presents four representative initiatives that aim to enhance teachers' digital competencies through systematic TPD courses and programs: a) The KERIS Education Training Institute and Knowledge Spring, b) Distance Education Training Support Center, c) Learning Nuri Center, and d) AI Convergence Education Major.

The KERIS Education Training Institute (<https://www.cet.keris.or.kr>) serves as a central hub for providing TPD courses to teachers. Over the past five years (KERIS, 2022), the institute has offered various courses focusing on three main areas, as summarized in Table 7. In particular, the "Knowledge

Spring” (<https://educator.edunet.net/>) platform was specifically developed in response to the paradigm shift from face-to-face to distance training due to the impact of COVID-19. This platform facilitates synchronous sharing of essential knowledge on digital learning where teachers can create and offer courses, sharing their expertise with other teachers. Moreover, teachers have the flexibility to choose and enroll in customized courses based on their specific preferences and needs.

Table 7 Teacher Training by the KERIS Comprehensive Education and Training Institute

Areas		2019		2020		2021		2022.6	
		NC*	NT*	NC*	NT*	NC*	NT*	NC*	NT*
Enhancing ICT competencies in elementary and secondary education	SW and AI education	4	2,475	6	1,309	5	531	3	298
	Digital textbooks	11	1,344	3	229	-	-	80	1,436
ICT in education-based training	Enhancing NEIS competency	2	122	1	65	1	68	-	-
	Prevention of cyber violence and Information and Communication ethics	1	170	1	417	1	718	-	-
	Copyrights related to education	1	67	1	48	2	51	-	-
Enhancing EduTech competencies	Knowledge Spring	-	-	236	1,306	1,802	10,216	1,204	7,420
	ICT utilization training	2	104	1	17	12	330	11	360

Note. 1. *NC: Number of Courses, NT: Number of trainees who completed courses

2. Adopted from KERIS, 2022.

Next, the Distance Teacher Training Support Center (<https://ttc.edunet.net>) aims to provide teachers with diverse and high-quality distance training content. As teachers seek to strengthen their digital competencies during the pandemic, the demand for distance training has surged. As such, the Learning Nuri Center (<https://manage.study.go.kr>) was launched in 2022 as an integrated teacher training platform (MOE, 2022f). The main objective is to move away from traditional passive training methods and empower teachers to actively create their learning path. Leveraging big data and AI, the platform analyzes teachers' training processes and provides personalized dashboards. Based on teachers' demands and interests, the platform also recommends tailored training courses and offers access to external courses such as K-MOOC, KOCW, TED lectures as well as a wide range of micro-learning content.

Lastly, the “AI Convergence Education Major” initiative was established in response to the growing interest in AI education. Starting in September 2020, the government collaborated with universities to establish AI convergence education majors within graduate schools, aiming to enhance teachers' AI education competencies. Currently, 42 universities across the nation offer AI convergence education programs (Lim et al., 2020). These programs cover essential topics such as educational programming, data science, computational thinking, problem-solving, instructional design, and educational data analysis. The focus on AI education underscores the government's commitment to equipping teachers with the necessary skills and knowledge to navigate the evolving digital landscape effectively.

Technology infrastructure

To establish a future-oriented educational environment based on ICT, the Korean government is diligently developing wired and wireless network infrastructures in schools nationwide (KERIS, 2022). The wired infrastructure is facilitated through the nationwide Schoolnet service, granting schools unrestricted Internet access. It also diagnoses and resolves any local area net-

work issues within schools and addresses central equipment malfunctions to optimize performance. Regarding wireless infrastructure, between 2017 and 2020, a total of 18,255 wireless access points (APs) were deployed in 5,413 schools across the country, with 340,046 smart devices distributed (KERIS, 2022). The sudden impact of COVID-19 led to the establishment of giga-level wireless networks in schools to cope with the changing circumstances. As part of the government's New Deal project, the first phase was initiated in July 2020, creating giga-level wireless infrastructures in classrooms and replacing outdated computers for teachers. In February 2022, the second phase was implemented to establish wireless networks in 380,000 learning spaces. With the development of giga-level wireless infrastructures in all schools, it became possible to utilize immersive content such as AR and VR in classrooms.

As mentioned earlier, various platforms and infrastructures have been developed to offer effective digital learning experiences to students while supporting teachers with various teaching materials and professional development opportunities. These platforms, including "ITDA," "e-Hakseupteo," "Digital Textbooks," and "Knowledge Spring," are integrated and accessible through the "Edunet T-CLEAR" (<https://www.edunet.net>) site. Edunet T-CLEAR, which stands for Teacher-Curriculum, Learning Evaluation, and Activity Resources, functions as an integrated education information service managing various platforms, thereby allowing students and teachers to benefit from easy access to essential resources.

Features of digital learning

Digital learning in Korea can be summarized by five main features that highlight the country's commitment to providing equitable and innovative education. First, Korea has been establishing national-level Master Plans for ICT in Education since 1996, guiding the development of digital learning through five core values: accessibility, innovation, competency development, openness, and inclusiveness. These plans are implemented through systematic

and government-led initiatives in five-year intervals, allowing for continuous progress in digital learning and effective responses to unforeseen events like the COVID-19 pandemic.

Second, there is a strong emphasis on providing diverse training opportunities to enhance teachers' competencies. Even before COVID-19, teacher training was actively conducted through face-to-face and distance learning programs. Initiatives like the "Distance Education Training Support Center" and the "Learning Nuri Center" platform aim to empower teachers to actively create learning paths for their future competencies. Furthermore, the "AI Convergence Education Graduate School Program" fosters teachers' AI competencies through varied learning approaches as well as supporting teachers to receive an academic degree in the graduate school program.

Third, Korea has developed learner-centered platforms to ensure students' right to education and accommodate diverse learning needs. With the accelerated adoption of distance education due to COVID-19, digital learning platforms have evolved to include personalized features. For instance, "AI Danchoo" provides personalized recommendations, test paper generation, and learning diagnostics for individual students. Platforms like "Online Supplementary Courses," "Open Middle and High Schools," and "School for You" cater to educationally marginalized groups and students with learning needs, ensuring equitable learning opportunities.

Fourth, AI digital textbooks have emerged as a major medium for digital learning in public education. Originally introduced in 2009 to provide multimedia learning environments beyond traditional text-based content, these textbooks have evolved into AI digital textbooks with more intelligent features. AI digital textbooks analyze learner data and offer personalized learning experiences, facilitating flipped learning and learner-centered approaches. This transformation in the education landscape is driving significant changes, promoting collaboration and application of knowledge in the classroom.

Lastly, Korea's high-speed Internet connectivity and advanced ICT infrastructure in schools play a crucial role in smoothly implementing digital learning initiatives. This robust infrastructure has fostered the development and utilization of various national-level learning services and platforms, contributing to the successful implementation and widespread adoption of digital learning across the country. Overall, these five key features demonstrate Korea's dedication to providing quality and equitable digital learning experiences for students and teachers alike, establishing the nation as a global leader in digital education.

Trends and Issues in Digital Learning

Trends in digital learning

Integrating artificial intelligence in digital learning

Korea has witnessed a notable trend of incorporating AI technology into digital teaching and learning. With the rapid advancements in AI technology coinciding with the pandemic, there has been a continuous effort to integrate AI into various digital learning platforms. For instance, EBS's AI Danchoo offers various features, such as analyzing students' performance data to recommend suitable courses. Similarly, AI digital textbooks, currently under active development, aim to provide personalized learning based on students' learning and assessment data. Edunet T-CLEAR and School for You have embraced AI technology since 2021 to foster personalized and student-centered learning approaches, further enriching their capabilities. This growing integration of AI in digital learning promises to revolutionize educational experiences and enhance learning outcomes for students.

Offering diverse digital learning resources

Korea offers a wide array of platforms dedicated to facilitating digital learning for both students and teachers. A standout feature of these platforms is the abundance of digital content available for teaching and learning purposes. For instance, the e-Hakseupteo platform offers curriculum-based learning content, foundational materials, and interactive experiential activities. Open Middle and High Schools cater to educationally marginalized groups by providing topic-centered video content and activity-oriented learning materials to help students acquire academic qualifications. For teachers, the Learning Nuri Center platform serves as a valuable resource by providing access to K-MOOC, KOCW, TED lectures, and micro-learning content. These diverse offerings ensure that educators have a wealth of materials to create engaging and effective lessons. Additionally, many of these platforms incorporate microlearning formats and recommendation systems, tailoring content to individual learners' needs and preferences. The availability of diverse digital learning resources through these platforms is revolutionizing the landscape of education in Korea, catering to the unique requirements of both students and teachers, and fostering a transformative shift in learning approaches throughout the country.

Fostering teacher communities for strengthening digital learning competencies

Teachers are now active participants in the digital learning landscape, not just as consumers but also as content creators. As they enhance their skills and prepare teaching materials, the emphasis is on fostering teachers' digital learning competencies through platforms like "Knowledge Spring," which facilitate knowledge and content sharing among educators. Additionally, platforms like "ITDA" enable teachers to create, utilize, and exchange teaching materials. These platforms promote active interaction among teachers, fostering a supportive online teacher community that helps them strengthen their digital learning competencies.

Expanding software and AI literacy education for both students and teachers

Since the announcement of the National Talent Development Policy in 2020, there has been a concerted effort to enhance software and AI education, focusing on improving students' and teachers' digital skills as well as fostering their creativity and collaborative problem-solving abilities. A strong foundation for literacy education has been established, aiming to promote SW and AI convergence education, to ample digital learning opportunities, and to bridge the digital divide. Starting in 2020, the expansion of AI education leading schools has been a priority, serving to bolster the groundwork for AI education. In 2022, significant efforts were made to develop and distribute teaching and learning materials for digital literacy education. Teachers also have the opportunity to attend training programs at the KERIS Comprehensive Education Training Institute, which consistently covers topics related to SW education, AI, and ICT integration. As training formats have shifted to online platforms, the Knowledge Spring platform offers a variety of courses related to SW and AI literacy. Some of the recently popular courses on this platform include "Innovation in Training through ChatGPT," "Application Development," and "Python Coding Education."

Expanding online learning spaces

The digital learning infrastructures examined thus far have significantly broadened the horizons of school education spaces. The imperative of digital learning became evident during COVID-19, prompting the active utilization of existing online learning platforms like e-Hakseupteo and Edunet T-CLEAR. Even with the resumption of face-to-face education in schools, these online platforms continue to facilitate teacher-student interaction and support personalized learning. Moreover, the High School Credit System, introduced in the 2022 Revised National Curriculum, leverages the ClassOn platform, enabling multiple high schools to collaborate on joint educational programs with

real-time and interactive online classes. Consequently, learning experiences are no longer confined to physical school settings but extend to digital learning spaces. This empowers students to explore diverse academic subjects and chart their learning paths based on their interests and aptitudes, unrestricted by time and location constraints.

Issues in digital learning

Widened learning disparities during COVID-19

The learning gap has emerged as one of the significant challenges in Korea. As mentioned earlier in the Contexts of Digital Learning, the COVID-19 outbreak compelled all students to take full responsibility for their education, exposing various environmental and individual factors that hindered their engagement and academic progress. Consequently, disparities in academic performance among students widened significantly. According to Kye et al. (2020), approximately 79% of teachers nationwide observed a widening learning gap between students during the initial phase of COVID-19 and digital learning implementation.

To tackle this issue, the MOE has made considerable efforts to provide personalized support to individual students. The MOE is also actively expanding the distribution of one digital device per student in schools to bridge the digital divide. As of December 2022, the distribution ratio stood at 0.47 devices per person for elementary school students, 0.65 for middle school students, and 0.47 for high school students. The MOE aims to increase this ratio to 0.69 devices per person by the end of 2023 (MOE, 2023b). Furthermore, the "Comprehensive Plan to Ensure Basic Academic Skills (2023-2027)" (MOE, 2022d) was introduced to ensure basic academic skills for all students. This comprehensive plan outlines the implementation of an AI-based diagnostic assessment and personalized support system, aiming to guarantee that every student possesses essential academic competencies. By leveraging advanced

technologies, the MOE is committed to addressing the learning gap and creating more equitable learning opportunities for all students.

Lack of clear guidelines on student data

Despite South Korea's progressive steps towards personalized education using AI, there remains a lack of clear standards for the secure collection and management of student learning data (Ahn & Cha, 2023). The development of the AI Digital Textbook by the MOE relies on systematic and secure data collection, management, and analysis of learners' data. However, the absence of common standards for learning data poses various challenges that must be addressed and agreed upon. Key issues include personal information security, delineating responsibilities, establishing indicators for common data set standards, and defining guidelines for data collection, transmission, and copyrights.

To ensure the safe utilization of students' learning data for educational purposes, it is essential to establish comprehensive guidelines that clearly define the collection and management system and the scope of usage and authority regarding learning data. By addressing these concerns, it is possible to safeguard the privacy and security of students' personal information while leveraging the potential of AI and data analytics to enhance personalized learning experiences. Establishing robust guidelines will not only protect students' data but also foster a conducive environment for utilizing their learning journey effectively and securely in the pursuit of better education outcomes.

Ethical issues of AI in education

The emergence of OpenAI's ChatGPT in late 2022 has reignited ethical concerns surrounding AI in education. In Korea, the controversial AI chatbot, "Lee Luda," sparked heated debates due to its use of offensive and discriminatory language targeting women and minorities. This incident brought to light

the pressing need for addressing ethical issues related to AI and its impact on education. In response, the Ministry of Education (2022c) issued the "Ethical Principles of Artificial Intelligence in Education Supporting Human Growth." This comprehensive document outlines 10 detailed principles, all under the overarching concept of "AI that supports human growth," to ensure the safe and responsible use of AI in supporting learners' development in education.

Recognizing the importance of fostering students' understanding of AI's potential opportunities and risks, the Ministry of Science and ICT (MSIT) and the Korea Information Society Development Institute (KISDI) took actions by publishing AI Ethics Textbooks tailored to each school level in 2023 (KISDI, 2023). These educational materials aim to equip students with the knowledge needed to engage with AI responsibly and ethically. However, the fast-paced advancements in technology continue to pose challenges. Generative AI, exemplified by ChatGPT and Midjourney, has introduced new issues such as cheating, copyright violations, and the dissemination of false information. This highlights the necessity of constantly updating AI ethics in education to effectively address the novel opportunities and challenges presented by generative AI. Maintaining a proactive and up-to-date approach to AI ethics in education is crucial to ensure the ethical and responsible implementation of AI technologies, safeguarding the learning environment and fostering a positive and secure learning experience for all students.

Challenges in teachers' digital competency development

Despite teachers' willingness to embrace digital transformation, several challenges hinder their progress in developing digital competencies. Jeong (2023) conducted a survey of 1,000 teachers nationwide to explore the status of digital technology utilization and teachers' perceptions of digital transformation in schools. The findings revealed that teachers generally perceived themselves, their colleagues, and school administrators as receptive to digital technology (56.7%, 43.9%, and 47.7%, respectively). Moreover, 41.6% of teachers ac-

knowledgeed the need for digital transformation and expressed their proactive willingness to prepare for it. This positive attitude towards digital learning is further supported by the MOE's various initiatives for in-service and pre-service teacher professional development, as discussed in the Teacher and Staff Professional Development section.

Despite these positive outlooks and improved competencies, however, teachers face significant obstacles in integrating digital technologies for teaching and learning in schools. Teachers are often burdened with various responsibilities, including high teaching load, parent and student counseling, and administrative tasks, leaving limited time for utilizing their newly acquired digital skills. Jeong's study (2023) also highlighted that the primary factor hindering teachers' acceptance and utilization of digital technology in schools is the lack of supporting environments (59.6%). This finding suggests that teachers perceive their workload and time constraints as major barriers to effectively incorporating digital technology in the classroom. Addressing this issue is crucial for digital learning to become a sustainable norm in education. Therefore, urgent attention is required to reduce teachers' workload while improving their working environment.

Insufficient socio-emotional support

In the realm of digital learning in Korea, there has been relatively little emphasis on addressing the social and emotional aspects of students' learning. In a digital learning environment where face-to-face interactions are limited, the need to support students' emotions and social interactions becomes even more crucial. Furthermore, the challenges posed by the COVID-19 pandemic have led to an increase in students experiencing the “COVID-19 blues” and “Back-to-School blues” (Sung et al., 2023). Despite this pressing issue, digital learning in South Korea has tended to prioritize cognitive and academic aspects, inadvertently neglecting the social and emotional dimensions of learning.

In recognition of this concern, the MOE responded by releasing the "Comprehensive Plan for Educational Recovery" (MOE, 2022a), aimed at nurturing socially and emotionally well-rounded individuals. Another notable initiative, the "Study of EdTech-Based Emotional Support Model for Students" (Sung et al., 2022), strives to leverage educational technology in supporting students' social and emotional development. These nationwide actions reflect Korea's dedication to bridging the gap in socio-emotional support and steering towards the holistic well-being of students in the digital learning landscape.

Conclusion

Korea has been diligently laying the groundwork for digital learning since 1996 through the systematic implementation of the Master Plan for ICT in Education, a comprehensive five-year strategy to revolutionize digital learning in schools. This strong foundation in technological infrastructure proved instrumental in handling the unforeseen challenges posed by the COVID-19 pandemic. As the country ventures into the era of the 4th Industrial Revolution, it becomes evident that significant changes are required in teaching and learning environments to harness the potential of digital and intelligent technologies, equipping students with essential 21st-century skills to excel in the global landscape. The introduction of the 2022 Revised National Curriculum, emphasizing student agency, creativity, and problem-solving skills, along with various policy initiatives like the Digital-Based Educational Innovation Plan, has supported this digital transformation.

This chapter explored the digital learning ecosystem in Korea based on Fox et al.'s (2021) six elements of digital education infrastructure. The analysis of the current digital learning infrastructure reveals the Korean government's continuous efforts to build a digital learning ecosystem that fosters meaningful and

flexible learning experiences. The dominant trends in digital learning encompass integrating AI into educational practices, providing diverse digital learning resources, fostering teacher communities for digital learning practices, promoting software and AI literacy education, and expanding learning spaces to embrace digital environments. However, amidst these promising trends, schools in Korea also face several challenges related to digital learning. These issues are a result of the rapid development of digital technologies, coupled with the socio-economic changes driven by AI. The key issues include addressing the learning gap, establishing clear guidelines for student data usage, addressing ethical concerns surrounding AI in education, enhancing teachers' digital competencies, and providing sufficient socio-emotional support for students.

Yet, Korea is actively turning these challenges into opportunities for digital transformation in education. With the forthcoming 7th-phase Master Plan for ICT in Education in 2024 and the full implementation of the revised curriculum in 2025, Korea is taking significant strides towards comprehensive digital transformation. The passion for education combined with a solid technological foundation promises a transformative future ecosystem for digital learning in Korea.

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