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# Classroom revolution through SMART education in the Republic of Korea

Case study by the UNESCO-Fazheng project on best practices in mobile learning

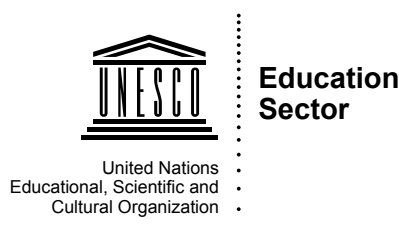


-  Approach: Top-down
-  Implementing organization: Ministry of Education
-  Year launched: 2011
- Authors:**  
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Published by the United Nations Educational, Scientific and Cultural Organization 7, place de Fontenoy, 75352 Paris 07 SP, France Unit for ICT in Education Education Sector UNESCO

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Produced by UNESCO

CLD 74\_19

## Acknowledgments

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UNESCO would like to thank the following individuals for their valuable contributions to the “Best practices in mobile learning” project and case study series.

Fengchun Miao, Chief of Unit for ICT in Education at UNESCO Headquarters, conceptualized the study and led the development of the criteria for the selection of best practices in cooperation with the Expert Panel of the project. He also coordinated the drafting and production of the report and served as the principal editor.

Anett Domiter, Associate Project Officer at the Unit for ICT in Education at UNESCO, supported the selection of initiatives through an open call for proposals and assisted the drafting and editing processes.

We owe special thanks to the authors, Cheolil Lim, Director, Center for Innovation of Future Education at the Seoul National University and Bokyoung Kye, Senior Researcher at the Korea Education & Research Information Services, for their invaluable contributions.

The Expert Panel of the project contributed to the development of the criteria for the selection of best practices, reviewed the applications and supported the drafting and editing of case studies.

The Expert Panel is composed of:

- Alexandre Fernandes Barbosa, Head, Regional Center for Studies on the Development of the Information Society, NIC.br/Cetic.br
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- Tarek Chehidi, Program Director, Results for Development, USA

Our acknowledgment is also extended to Susan Curran for copyediting and proofreading the text.

UNESCO would like to thank the Fazheng Group for the financial support it has granted to support the research on school-wide mobile learning initiatives through which this case study series was made possible.

## Abstract

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The Korean Ministry of Education and the President's Council on Informatization Strategies jointly established '*A Road to the Power of Talented Individuals! SMART Education!*' in 2011 and since then SMART Education has been one of the leading strategies of ICT education in Korea. SMART Education has been a central government-driven policy for improving the national education system to meet the demand for a customized and efficient learning environment for twenty-first-century learners. SMART Education aims to ensure *Self-directed, Motivated, Adaptive, Resource-enriched, and Technology-embedded Education*. The SMART Education model has been developed and distributed across the country, and it is divided into two types: the learning models for the *SMART classroom and online education*. Pilot schools had been selected for implementing and expanding different types of instruction based on the various models, and

for applying new technology into the school level. SMART Education has led to improvements in the skills particularly for twenty-first-century lives and careers, such as problem-solving and communication skills. Pre and post-test conducted in 2016 shows that students' creativity and innovation ability, critical thinking ability, and information literacy ability were improved after using digital textbooks (Kim et al., 2016). Key challenges of SMART Education were identified in the areas of the development and application of digital textbooks; reinforcement of the capability of teachers to practice SMART Education; procurement of high-quality contents and activation of free use; development of a SMART teaching/learning model; activation of online learning; creation of the foundation for cloud educational services; and reinforcement of ethics education in order to eliminate the possible negative side-effects of information (copyright) and communication abuse.

***The case study represents an excellent resource providing a strong overview of the approach adopted under the SMART initiative.***

***Not only does it provide the thinking behind the strategies, it also illustrates them with pertinent and practical examples. For instance, the use of technology to enable students to review and reflect on their performance leads to greater self-reflection and hence the development of self-directed learning skills. At the same time, the challenges shared provide good lessons for potential scaling of similar practices.***

**Cheah Horn Mun, Assistant Provost, Singapore University of Social Sciences**

### Keywords:

**Smart education, digital textbook, ICT education, mobile learning, Korea**



# 1. Introduction

The accelerating social, economic and demographic changes resulting from low birthrates, an ageing population, growth in youth unemployment due to decrease in manufacturing industry, and rapid development of technology are affecting the way people live in the Republic of Korea. With these changes, there is an increasing demand for customized education systems that can bridge the gap between these new and innovative fields and the education sector in a way that fosters student talent in this new age. The Republic of Korea has a relatively low international competitiveness rating (ranked 25th)<sup>1</sup> compared with the size of its economy (ranked 14th)<sup>2</sup>. While education in Korea has been considered as a leverage to boost the national competitiveness through developing 21st century skills, it has been also pointed out that Korean educational policy has limitations in fostering 21st century skills such as creative problem-solving, as its primary focus of national education policies is to manage the college entrance system.

Tackling the challenge of increasing the national competitiveness from the education sector, information and communication technology (ICT) has been promoted as a leading initiative since the early 2000s. However, problems have been encountered such as ageing internet infrastructure and the declining rate of utilization over the past 10 years. Therefore, as a means to solve such issues, the Korean Ministry of Education, Science and Technology (now changed to the Ministry of Education) and the President's Council on Informatization Strategies<sup>3</sup>

jointly established and announced '*A Road to the Power of Talented Individuals! SMART Education!*' in June 2011. Since then SMART Education has been one of the leading strategies of ICT education in Korea.

In this paper, SMART Education in Korea is examined and discussed as an example of central government-driven policy for improving the national education system to meet the demand for a customized and efficient learning environment for twenty-first-century learners. First, the SMART Education model in Korea is introduced in terms of goal and vision, objectives and system, mobile learning environment, and capacity-building and incentive strategies. School-wide SMART Education practices are examined in terms of classroom and online models. The challenges and lessons learned in implementing SMART Education are discussed, as is the issue of scalability. Finally, recommendations are proposed for the implementation of mobile learning based on the experiences of the Republic of Korea.



**Picture 1: Use of interactive board on class.**

- 1 In the competitiveness survey conducted by the World Economic Forum in 2013, Korea ranked 25th overall for national competitiveness.
- 2 South Korea's nominal gross domestic product in 2013 amounted to \$1.3 trillion and ranks 14th in the world (source: Bank of Korea).
- 3 This was a presidential advisory committee established to carry out the planning, implementation and inspection of the plan to present the national information vision and achieve it. It had thirty-one members including the prime minister, a joint civilian chairperson, the head of the central administrative agency related to the information system, fifteen civilian government officials and fourteen experts in the field of ICT.

## 2. The SMART Education Model

### 2.1 Goal and vision of SMART Education

The goal and vision of SMART Education is to ‘foster creative global talents’ through a comprehensive ‘classroom revolution’ including changes in educational content, teaching and learning methods, evaluation, and the learning environment. Together,

these form a new educational paradigm. As a driving force for innovating educational systems, SMART is an acronym for the five components of *Self-directed, Motivated, Adaptive, Resource-enriched, and Technology-embedded Education*. Its aim is to ensure an inclusive and equitable quality of education, and promote learning opportunities for all students.

<b>Self-directed</b>	<ul style="list-style-type: none"> <li>• <b>(Producers of knowledge)</b> Student roles change from recipients of knowledge to main producers of knowledge, teacher roles change from knowledge transmitters to learning facilitators (mentors).</li> <li>• <b>(Intelligence)</b> Self-directed learning method through online diagnosis of learning achievement and prescription</li> </ul>
<b>Motivated</b>	<ul style="list-style-type: none"> <li>• <b>(Experience-oriented)</b> Emphasizes the teaching/learning methods that can reorganize knowledge by experience, overcoming the formalized subject matter-based approach.</li> <li>• <b>(Problem-solving-oriented)</b> Aims at fostering creative problem-solving skills and process-based individualized evaluation.</li> </ul>
<b>Adaptive</b>	<ul style="list-style-type: none"> <li>• <b>(Flexible)</b> Reinforces the flexibility of the educational system and implements customized learning associated with personal preferences and future occupations.</li> <li>• <b>(Individualization)</b> Schools evolve from the place where knowledge is transmitted to spaces that provide individualized learning to promote student abilities and aptitudes.</li> </ul>
<b>Resource enriched</b>	<ul style="list-style-type: none"> <li>• <b>(Open market)</b> Utilizes rich contents developed by public, private and individual sectors based on cloud educational services for student learning.</li> <li>• <b>(Social networking)</b> Utilizes internal and external learning resources jointly through collective intelligence and social learning to expand collaborative learning.</li> </ul>
<b>Technology embedded</b>	<ul style="list-style-type: none"> <li>• <b>(Ubiquitous)</b> Students can learn anytime, anywhere, through information technology, and educational environments are provided in which learners can choose different instructional methods.</li> </ul>

**Table 1: Five components of SMART education in Korea**

Source: Republic of Korea, 2012. A Road to the Power of Talented Individuals: SMART Education. Seoul, Ministry of Education, Science and Technology and President’s Council on Informatization.

Key challenges in implementing this initiative include the development and application of digital textbooks; reinforcement of the capability of teachers to practice SMART Education; procurement of high-quality contents and activation of free use; development of a SMART teaching/learning model; activation

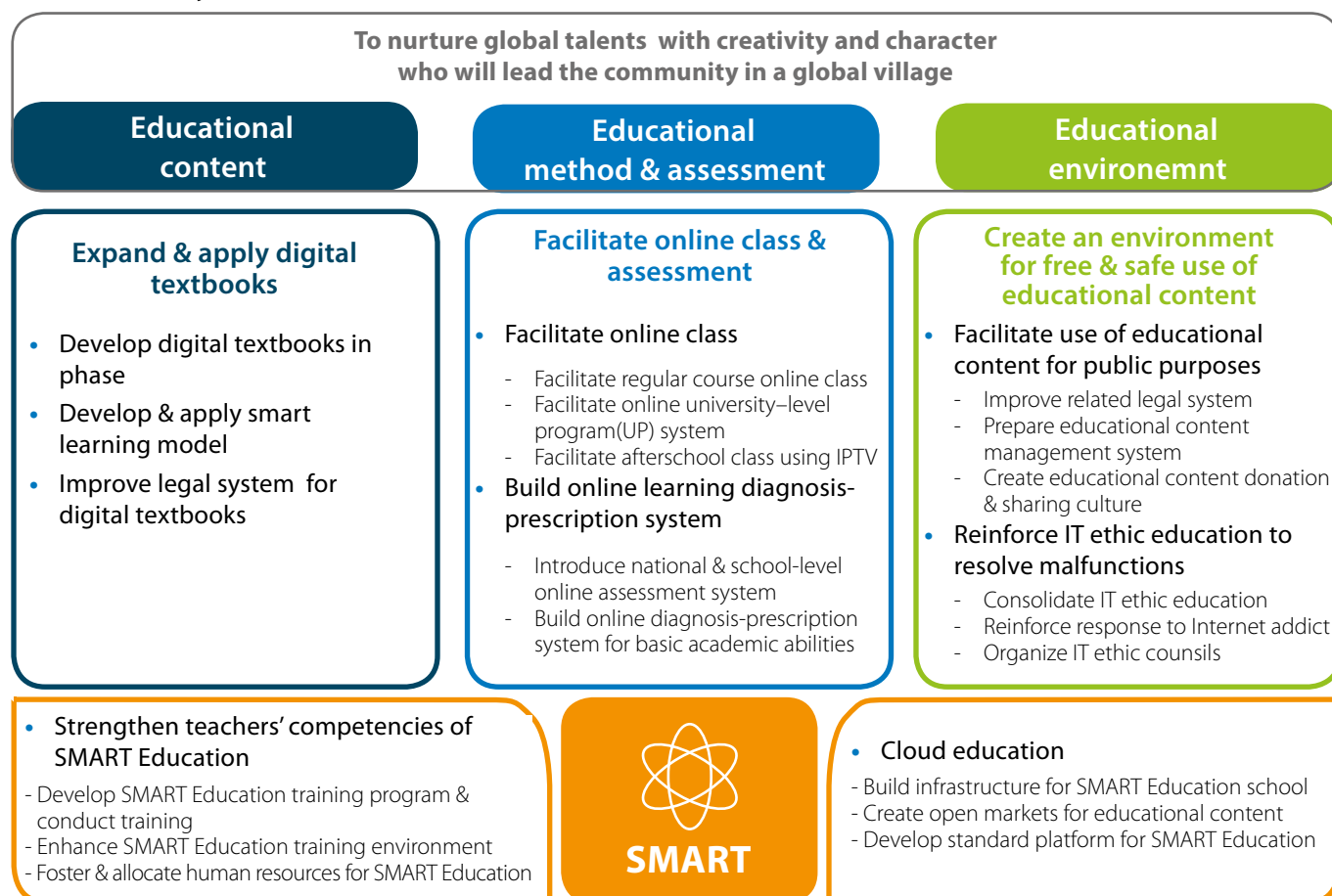
of online learning; creation of the foundation for cloud educational services; and reinforcement of ethics education in order to eliminate the possible negative side-effects of information (copyright) and communication abuse.

## 2.2 Objectives and system of SMART Education

The SMART Education initiative includes such objectives as

- transformation of the student role from being a recipient to a producer of information
- transformation of the teacher role from being a knowledge transmitter to an educational facilitator
- online diagnosis of achievement and prescription-based self-directed learning
- emphasis of the flexibility of the educational system
- implementation of customized learning associated with personal preferences and future jobs
- school-level provision of individualized learning to promote student aptitudes
- transition to a collaborative learning system using collective intelligence and social learning
- free usage of rich educational contents developed by individuals, public and private sector organizations based on cloud services.

The initiative aimed at introducing a system under which students can learn anytime, anywhere through information technology; an educational environment can be created where learning options are guaranteed through various instructional styles; teachers can expand their discretionary power according to the characteristics of their discipline; and an educational curriculum and programs can be developed under the leadership of teachers.



**Figure 1: Major tasks of the SMART Education system in the Republic of Korea**

Source: Republic of Korea, 2012. A Road to the Power of Talented Individuals: SMART Education. Seoul, Ministry of Education, Science and Technology and President's Council on Informatization.

The SMART Education initiative is focused on the creation of a virtuous-cycle educational ecosystem using smart technology. In creating these environments, teachers, private companies and related organizations aim to create an educational ecosystem by actively coming together to establish an 'open-market' system for facilitating the creation, distribution and utilization of educational content. The aim is to develop an educational platform (encompassing content creation, a learning community, learning analytics, and e-portfolio) where enriched resources (digital textbooks, compensatory/enrichment learning material, evaluation data, and material related to career paths and job hunting) are distributed and reproduced in a standardized form. SMART Education enables teachers to help students experience classroom instruction aiming at communication and cooperation through cloud service environments. Such environments include wired/wireless networks and devices at schools, adaptive learning through participation in online classes and online evaluations, and creative activities that promote positive personalities and attitudes to education. In this process, drawing on the participation of private-sector organizations and the consensus of parents and the community, and reinforcing the capabilities of teachers with the aim of stimulating the educational ecosystem, have become focal issues of importance. It is also seen as necessary to take a proactive approach to the negative side-effects of the application of ICT.

To implement the SMART Education initiative, the organization tasked with overseeing ICT in education has expanded its focus on SMART Education. The Ministry of Education is responsible for carrying forward the overall SMART Education plan, and organizing a separate SMART Education Promotion Committee which can act as a forum for deliberation on and resolution of major issues related to policies. The committee is expected to establish and operate the collaborative system. The metropolitan and provincial offices of education are responsible for establishing practical SMART Education execution plans, supporting the execution of SMART Education

in school units, and operating a model school. The Korea Education and Research Information Service (KERIS) is a research and standards development agency, and it supported the Ministry of Education in establishing and executing policies related to SMART Education.

### 2.3 Mobile learning environment for SMART Education

Sharing educational resources smoothly and creating an environment to promote cooperation on SMART Education are the fundamental tasks in implementing this initiative. A wired internet environment was established in schools nationwide in 2000, and now there has been a demand to switch into a wireless system. Wired/wireless network installation guidelines for each type of school have been developed and distributed. The aim is for teachers and students to be able to utilize laptops, smartphones and smart pads for educational purposes. Additionally, the establishment of wireless networks and the distribution of smart devices has been promoted by the metropolitan and provincial offices of education. One initiative designed to promote the use of these devices is the Smart Device Distribution Project. This is aimed particularly at students who require substantial financial support. It addresses the issue of financial inequality, and attempts to create sustainability and equality. Under the scheme, schools can obtain various devices and software products according to their needs through cooperation with private enterprises.

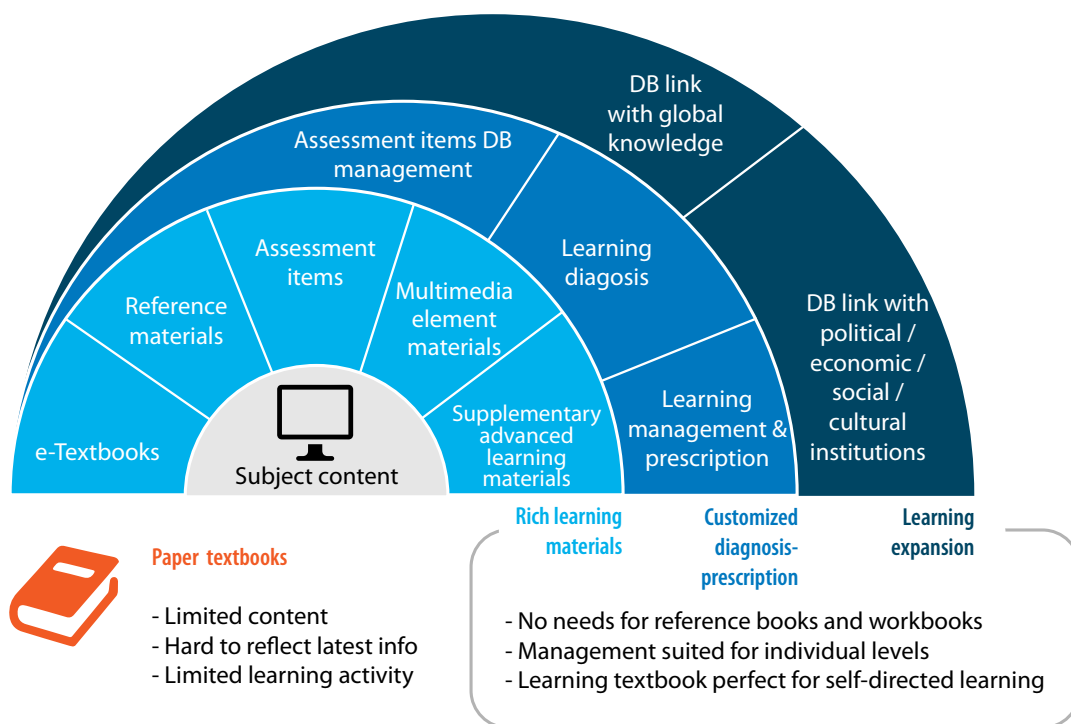
The Korean government also considered the introduction of a cloud computing environment, so that students can save various learning materials and records in a personal space on the internet, and access them at any time. This provides students with an environment where they can share data and cooperate with their friends. Existing educational services are distributed via the cloud, which means the cost of this information-oriented environment can be reduced significantly, while providing users with



the benefit of easy access to their own information. Thus, the cloud computing system has been evaluated as 'effective'. However, there have been some difficulties in establishing school-wide cloud environments, particularly related to the emerging user authentication and security issues that are involved in conforming with the Personal Information Protection Act and Information Communications Network Act.

At the same time, the Ministry of Education has pressed ahead with digital textbook development projects, designed to develop the basic contents dimension for SMART Education, in addition to legal system improvement projects to allow for the legal use of various educational contents (Figure 2). A digital textbook is a resource that adds various reference materials and learning support functions to the existing curriculum contents (Lim et al., 2012). It is developed and distributed in a manner that allows for usage on various devices including PCs, smart pads and smart TVs. Simultaneously, the

Ministry of Education has pursued the development and application of a teaching and learning model appropriate for the use of digital textbooks, securing a legal status for the use of digital textbooks, official approval system changes, distribution method changes, and copyright law improvements. The Ministry of Education has also started an educational contents donation and sharing movement, with the aim of establishing a library of free resources that can be used both in school settings and by local education offices. Improvements have been made to the system of copyright laws that permitted certain literary works to be used freely for instructional purposes in the classroom. Finally, the Ministry of Education introduced a compensation system to protect the intellectual property rights of the copyright holders, and improved the system that permitted the use of educational works online. In 2017, AR (augmented reality), VR (virtual reality) and manipulative interaction-based contents were added to increase the authenticity of learning and promote a sense of immersion.



**Figure 2: The major functions of digital textbook in Korea**

Source: Republic of Korea, 2012. A Road to the Power of Talented Individuals: SMART Education. Seoul, Ministry of Education, Science and Technology and President's Council on Informatization.

In addition, online classes and evaluation systems should be introduced to ensure the flexibility of the curriculum. As the society and learning contexts become more and more diversified, the social responsibility for giving careful consideration to the needs and situations of each student continues to increase. It is important to ensure that education in schools proceeds smoothly while also preparing to handle difficult situations and guarantee students' educational rights through providing hospital schools, sustaining educational rights in natural disaster situations, strengthening teacher capacities to teach subjects in which they did not major, and so on. Also, effort is being made to develop the regulations for giving credit for online courses in order to ensure that learning and accreditation continue with minimal disruption after natural disasters. It is also necessary to consider the situation on remote islands with small populations where schools cannot realistically provide a dedicated teacher for every subject.

### 2.4 Capacity-building and incentive strategies

The first priority in the activation of SMART Education was to strengthen the competencies of teachers. Teacher training policy related to Smart Education had been implemented reflecting those changes, as smart technology was spreading socially, communication through SMS had become a culture, and attempts of new teaching and learning methods had already been made on school sites.

The curriculum for teacher training was designed to develop and strengthen the learner competencies needed for the twenty-first century, such as creativity, cooperation and team-work, communication skills, critical thinking and problem-solving. Activities have been developed that could use smart devices and/or wireless environments to help develop those skills. Project activities at the group level were an important part of the curriculum.

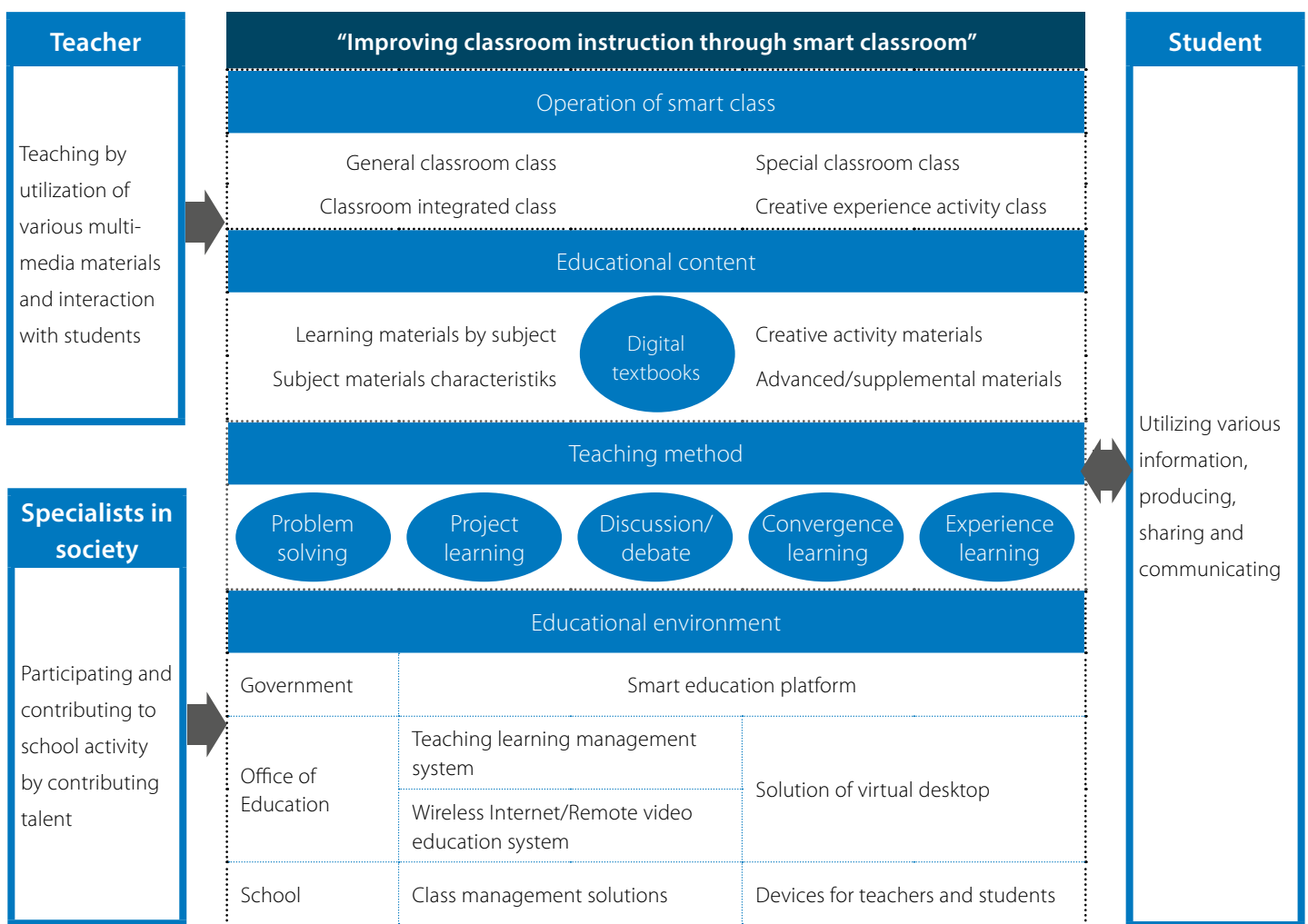
At the national level, cities and provinces in cooperation with private enterprises recommended individuals to act as lead teachers in using the SMART Education model and spreading the concept of SMART Education, and these were provided with training. Once trained, they returned to the metropolitan and provincial offices of education to act as lead teachers for cities or provinces, and to train teachers at the school level using a continuous cascade model. A 'SMART Education Talk Concert with Teachers' was designed to spread awareness on smart education and information. It took the form of a performance that encompassed case studies provided by the teachers, special lectures and movie previews. Official training courses, using both online and offline methods, were circulated in all sixteen metropolitan and provincial offices of education in Korea. Projects focused on regions and school grades included teacher study groups and club activities. The aim of all was this activity was to enable teachers to create a culture in which they could share the various SMART Education models they had created.

### 2.5 School-wide SMART Education practices

The Ministry of Education and KERIS have developed the model for SMART Education and distributed it across the country. This model aims to improve the teaching and learning in the classroom, reducing the education gap and expanding the right to learn for every student. The model for SMART education is divided into two types: the learning model for *the SMART classroom and online education*. The learning model for the SMART classroom is applied to the general class, special class, integrated class and creative experiential activities, and the online education model is utilized to the implementation of the selective subjects, intensive courses, acknowledgement of class attendance, supplementary intensive course after school, etc. These two models intend to support the creative instructional design and implementation in the context of various learning environments.

The model for SMART classroom was designed to improve the teaching and learning methods of classroom instruction. It utilizes various instructional methods such as problem-based learning, project-based learning, discussion, interdisciplinary education, and field study that provides the opportunities

for teachers, community experts, and students to communicate each other. The class is implemented by digital textbooks, and specific types of activities consist of general class, special class, integrated classroom, and instruction of creative experiential activity.

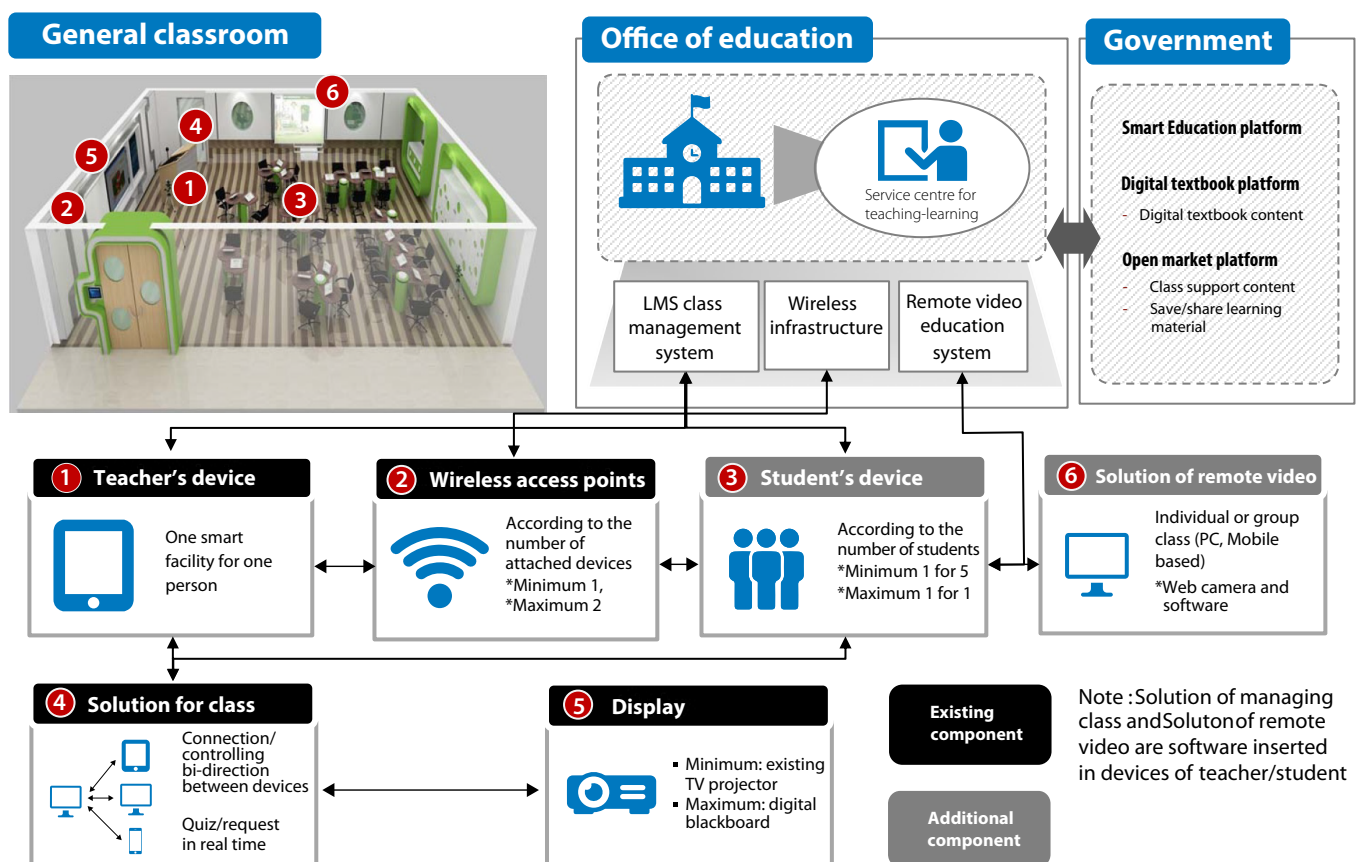


**Figure 3: "Smart Class" Lesson Model**

Source: Republic of Korea, 2012. The Implementation Strategies of SMART Education. Daegu, Republic of Korea, Korea Education and Research Information Service.

‘General class model’ is to implement the student-centered learning model such as problem-based learning, project-based learning, discussion individually or cooperatively among group members, that is close to the general classroom. ‘Special class model’ is for considering the level of students in each subject classroom, integrated classroom, and special subject room (music, library etc.), and ‘integrated

classroom model’ is for reducing the education gap by integrating classes including exchanges with international schools and small size classroom in remote area. Lastly, ‘Instruction for creative experiential activity model’ was developed in order to support diverse experiences of students considering the interests of each student.

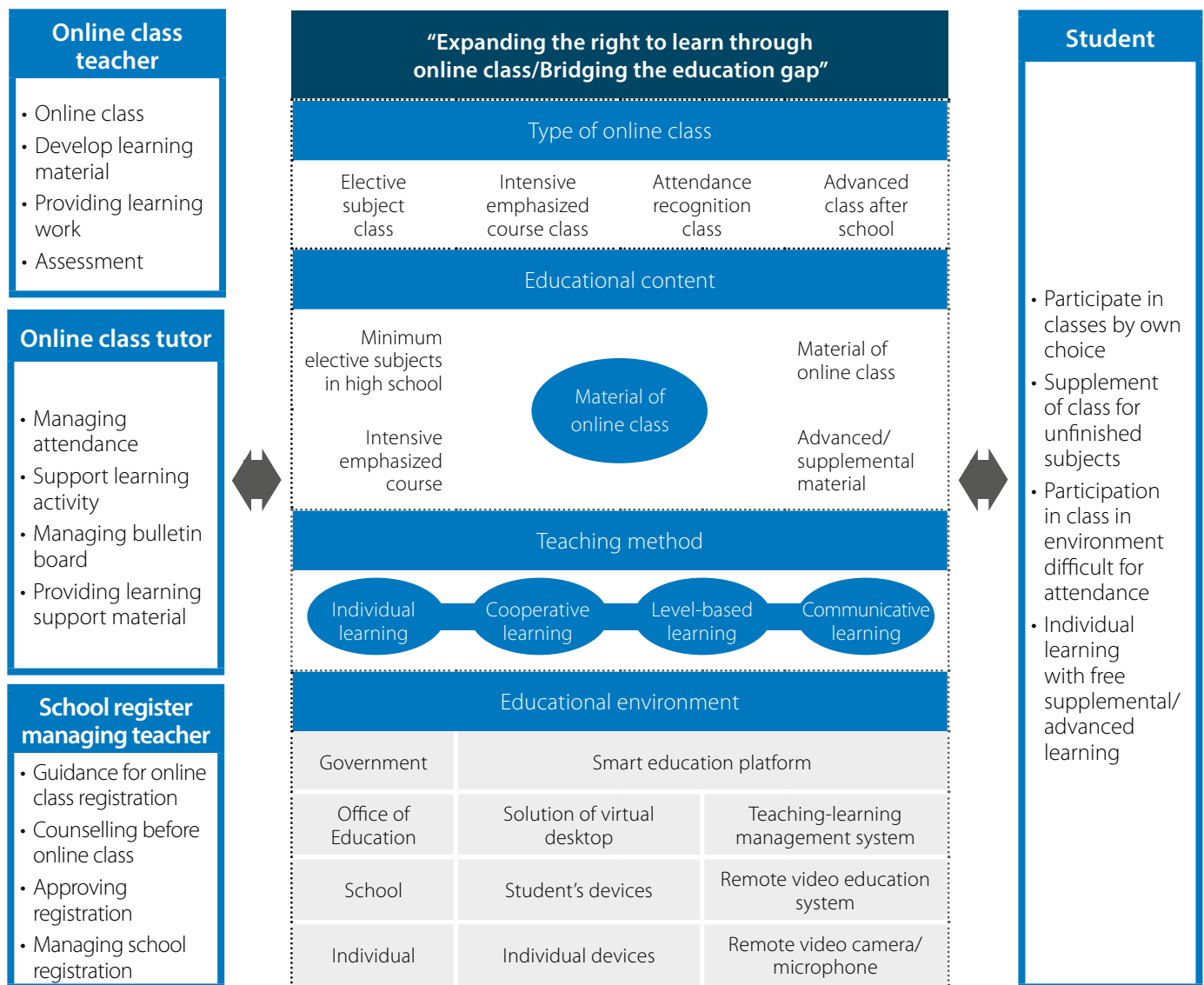


**Figure 4: General classroom and its technology for Smart Education**

Source: Republic of Korea, 2012. The Implementation Strategies of SMART Education. Daegu, Republic of Korea, Korea Education and Research Information Service.

Secondly, an online education model for SMART Education was provided for the expansion of the right to learn and assurance of the right to choose learning, and for reducing the education gap. This model was developed based on human resources: *an online teacher* who delivers the instruction, develops the learning materials, assigns homework, and evaluates learning activities, and *a class tutor* who supports the online classroom, and *a school register*

*managing teacher* who is in charge of guidance of the class and counseling. Based on the online learning materials, various instructional methods are being used, such as individual learning, cooperative learning, and differentiated learning, and it operates differently based on the purpose of the courses such as *elective subject class*, *intensive emphasized course class*, *attendance recognition class*, *advanced class after school*, etc.



**Figure 5: "Online education" Model**

Source: Republic of Korea, 2012. The Implementation Strategies of SMART Education. Daegu, Republic of Korea, Korea Education and Research Information Service.



'Elective subject class' is offering classes that are not provided at the offline school, and ensures student participation in the classes of their own choice. 'Intensive emphasized course' is for ensuring students' right for learning by offering the class when students transfer to other school. 'Attendance recognition class' is for replacing the regular class when students could not attend due to national disaster, disease, or long-term hospitalization, so that students minimize their learning gap with other students. Lastly, the 'advanced class after school' is an instructional model that enhances capacity of learning management of the student by enabling advanced study at home.

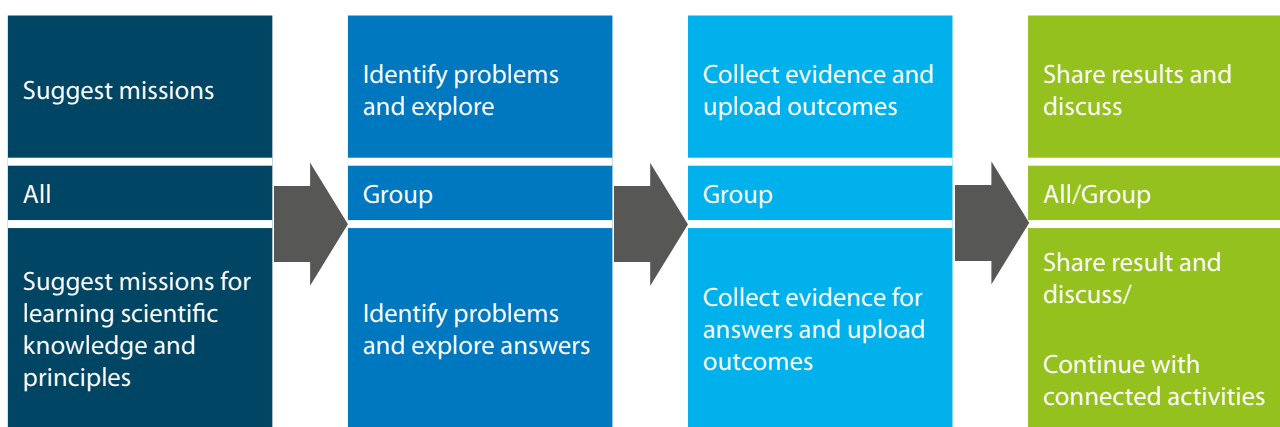
A pilot school was run for expanding various teaching and learning models, and for applying new technology into the school level. A representative pilot school was 'Seoul Itaewon Elementary School', which was the most universal school model of SMART education. For example, students in this school attempted to analyze the characteristic of planets of the solar system for designing a plan for space travel, and develop the most optimal space travel plan with the online collaboration tool. The class was designed to conduct the student-centered learning project throughout the entire process from selecting the topic to survey, research, presentation, and to the evaluation. Students learned to have an integrated view and deep understanding toward

subject knowledge through the integration of various subject matters such as science, language, and art. Although it took time for students to get used to utilize collaboration tools, to produce materials and effective communication, the productivity and effects of learning was increased by continuously utilizing smart collaboration tools through teaching and learning process day by day.

Also, SMART Education has been applied in different ways in educational settings that extend beyond classrooms and school grounds. Below are some cases of SMART Education that have been developed in various ways, and have received positive responses and attention in their specific fields.

### *Exploration model-based SMART Education: science*

*Chamsaem* Elementary School in the city of Sejong is a SMART Education model school. It is well known as a school that was created considering the SMART environment from the design stage. This school provides science and enquiry-based learning in association with the national educational curriculum. Learning topics focus on substances and materials that are in common use in our surroundings. The aim is for students to learn about objects, materials, plants and minerals that are easily found in their environment, and use them to solve daily problems.



**Figure 6:** The science and exploration activities scenario at *Chamsaem* Elementary School

Source: Lee, J., Gu, Y. M., Shin, G. J., Kim, D. I., Kye, B. K. and Jung, S. W. 2012. Study of Program Development for Operating Creative and Problem-solving Smart Education, Daegu, Republic of Korea, Korea Education and Research Information Service.

The four steps of each project are based on the scientific exploration model: setting out an assignment, understanding the assignment and what it requires, evidence collection and acquisition, and result-sharing and discussion. The tasks are explained to the students using stories based on the 'adventures of Prince Philip'. Students are formed into groups to receive their assignment. They collect QR code-based clues installed in every corner of the school and solve their assignment. After that, they carry out simulation activity to identify the characteristics of each material assigned to each group. They invent new materials that build on the strengths of the material or object and compensate for its weaknesses, name them, and design products of the future that could be made with these materials. Students also develop their creative thinking skills by making a story involving some or all, of the materials or objects that they have found while doing their assignment. Students who carry out projects such as these have shown increased motivation and interest, improved communication skills and enhanced cooperative capabilities. They treat searching for the hidden QR codes as a kind of treasure hunt, enjoy deciphering the clues, and participate in physical activities while exploring the

school surroundings. In this process, they acquire a deeper understanding of materials, increase their interest in learning, and enhance their cognitive abilities in a way that promotes the acquisition of scientific concepts (Lee et al., 2012).

### *Physical education and mathematics*

In Gyeseong Elementary School in Seoul city, students learn how to throw a discus in their physical education class using smart devices, which are easy to use and improve the class's performance. After a classroom-based lesson on the techniques of throwing, including watching a video which shows the fundamental positions, students are grouped in pairs. One student throws a discus and the other records their movements, then they swap positions. After that, they review their moves by watching the recorded video with their teacher. Replaying the video helps them identify and correct their failings. Using conventional teaching methods, a single teacher could not have provided in-depth feedback to each child. The students watch the video recording repeatedly and share it with their classmates or teachers many times.



**Picture 2:** Using smart devices in a physical education class at Gyeseong Elementary School

As another example, *Yulha* Junior High School in the city of *Gimhae* has pioneered using smart devices in math classes, to help the children with problem-solving. This school does not use any particular learning analytic software. Instead, the software supports the teachers, who can watch and monitor all the students' screens as they work on the problems online. The teacher can readily identify which students are having difficulty, and at what points in the assignment, and give individual students tips to help them progress. One great advantage of this system is that the students who have difficulty need not be identified to the class as a whole, but can be helped discreetly.

These learning activities can be shared with other schools, and can be redesigned and tried out in various ways. They use simple functions of smart devices rather than relying on advanced technology or a complex learning model. These cases have received consistently positive responses in schools and from their communities, and are being developed further.

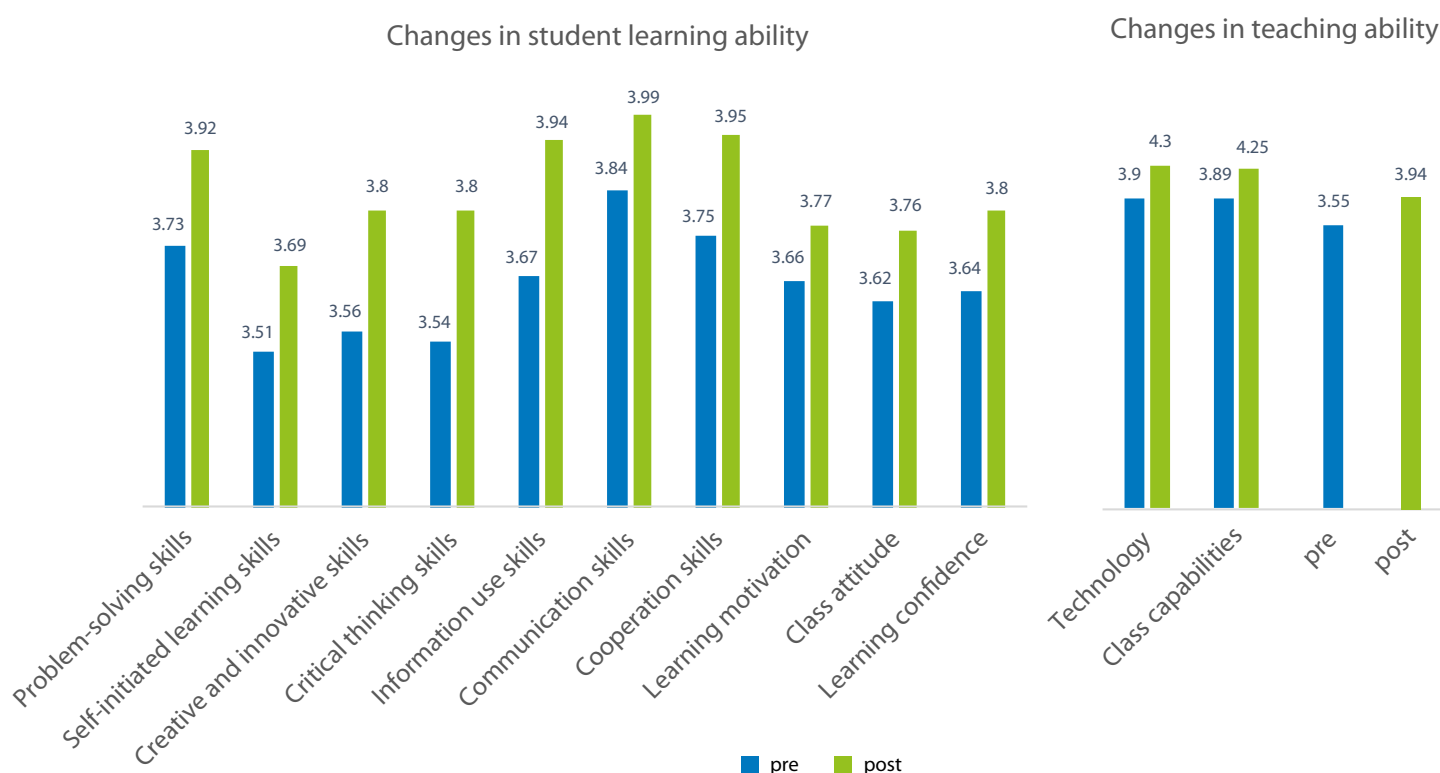


**Picture 3: Learning problem-solving in class through coding.**

### 3. Achievements

Assessments have been performed to identify changes in student capabilities by SMART Education especially through the use of digital textbooks (Ahn et al., 2014a; Kye et al., 2015, 2016). They have found that SMART Education has led to improvements in the skills particularly for twenty-first-century lives and careers, such as problem-solving and communication skills. According to these studies, creativity and innovation ability, critical thinking, and information utilization ability was improved. Pre and post-test conducted in 2016 shows that students' creativity

and innovation ability, critical thinking ability, and information literacy ability were improved after using digital textbooks (Kim et al., 2016). In regards to teachers' competencies, since the initiation of SMART Education, teachers have been found to be increasingly effective in such competencies as learning facilitation, communication skills and using smart devices. One recent study shows that there are changes in teaching ability of the participating teachers for SMART Education (**Figure 7**).



**Figure 7: Results of pre and post-tests of digital textbook implementation in a sample of schools in 2016**

Source: Republic of Korea, 2017. 2017 White Paper on ICT in Education Korea. Daegu, Republic of Korea, Korea



Education and Research Information Service. Through this process, 'star teachers' have been identified who are now well known for their expertise and who have obtained increased recognition. They, along with private enterprises and schools, have cooperated to create a new technology-based learning model, sometimes described as a 'school-teacher-enterprise cooperation model'. One objective in developing this model of new learning methods was for private enterprises to encourage other public or private enterprises to invest actively in the SMART Education model and its specific applications. Furthermore, the needs of schools led to the development of new techniques, which acted as a driving force for creating a market for teacher participation, and some teachers have become the chief executives of the educational technology enterprises.

Besides the students and teachers' progress, there have been various positive results because of the promotion of the SMART Education initiative.

- The institutional and legal foundation for improving copyright law has been established
- Materials have been made freely available for use in elementary, middle and high schools
- The innovation in the educational system has encouraged the recognition of online classes and the promotion of the introduction of new teaching methods (including various classes using SMART contents)
- There are further encouragement and standardization of international learning exchanges and the flipped learning approach.



**Picture 4: Teacher explaining inquiry-based learning activities using QR codes.**



## 4. Challenges and lessons learned

SMART Education was devised as part of the ICT convergence initiative, including smart work (the Presidential work report), smart health care, smart tourism and smart financing, in the same context as the previous presidential administration's SMART Korea initiative. SMART Education was designed as a means to innovate the educational environment, including educational contents, methods and evaluations, in accordance with the new educational paradigm focused on the twenty-first-century knowledge society.

SMART Education won great support for its vision and direction, but led to concerns regarding a number of negative side-effects such as overuse and abuse of digital devices by students, overexposure to video games and unwholesome websites, deteriorating eyesight, and physical problems such as neck and wrist conditions associated with long-term usage of smart devices. There was also concern about the deterioration of brain functions such as memory in connection with issues such as digital dementia. These matters began to attract immediate attention, and the verification results obtained by conducting related studies have led to an ongoing debate about the positive and negative effects of using ICT in education. On the positive side, findings from the Organization for Economic Co-operation and Development (OECD) PISA DRA (Programme for International Student Assessment – Digital Reading Assessment) show that the problem-solving abilities of Korean students are the world's best, and this has supported arguments for the appropriateness of further developing SMART Education in the Republic of Korea.

Pressure for the use of Smart Education has also come from the bottom up: that is, from students and teachers rather than as a political initiative. Both the students and teachers who were following the educational informatization policies and the

accelerating distribution and penetration of smart technology created an impetus to develop teaching and learning methods by SMART Education. Leading teachers gave classes using various OER (open educational resources) digital resources that were provided and shared by Edunet (the national education service), INDI-school (a teacher-led online educational content-sharing community) and EBS (the Educational Broadcasting System). These organizations had already been using various ICT tools to help promote ICT in education. Nevertheless, progressive educators' discontent with the policies promoted by the previous conservative presidential administrations was growing when the government's top-down policy was enacted. There was wide debate and a number of high-level accusations that the policies had been developed to benefit some large companies that manufactured smart devices. In addition to this, there was a backlash against the use of digital devices by students in schools because of the abuse of digital gaming. This led to several policy debates with some interest groups regarding the policy execution of SMART Education.

The awareness of teachers, students, parents and interest groups is a necessity for SMART Education. A number of efforts have been made to form a bond of understanding, while the implementation capacity has been concentrating on the improvement of public awareness. The distribution of personal devices and the establishment of wireless environments remained at a low level because of hostility against the participation of private enterprises, and trends in personal information protection and security reinforcement. For new technology utilization policies to be applied in educational settings, social contexts need to be considered in connection with social awareness.

The general population tends to agree with the social and technical changes of ICT policy, and

that the educational environment also needs to change towards the improvement of technology integration. However, there are concerns about causing confusion with the rapid changes in the educational environment, and it has been pointed out continuously that there is a need to take a careful approach including step-by-step application.

The Ministry of Education has investigated both the effectiveness and the adverse effects of SMART Education and digital textbooks. Leading research at the national level has included studies on the impact of SMART Education on the changes in learning capabilities (Kye et al., 2013), studies on the impact of digital textbook utilization on brain function (Kwon et al., 2014), and a three-year longitudinal analysis of the utilization and effects of digital textbooks (Kim et al., 2016). These studies aimed to address issues that might be caused with the introduction of SMART Education before its widespread dissemination, eliminate the adverse effects and threat factors, and draw up measures for improving its effectiveness. At the same time, this research has looked at the changing trends of ICT in education, student capabilities and impacts on learning. Additionally, observations were made on the measurement of ICT levels in education (Ahn et al., 2014a) on an annual basis, and continual national-level studies have been and are still being conducted on the evaluation of the ICT literacy levels of elementary, middle and high-school students (Ahn et al., 2014b).

One issue raised is that 'education using smart devices may ultimately lead to reduced learning ability because the learning effects are low, although it is easy to learn fast and conveniently'. (This was a question raised during the 2013 parliamentary inspection of the presidential administration.) It has also been suggested that 'digital media weakens the interpersonal relationship face to face between teacher and student' (a comment published in *Media Today* on 20 August 2013, and in *Kyunghyang*

*Newspaper* on 15 August 2013). Issues related to adverse effects resulting from the implementation of SMART Education have been researched under some of the following themes: time series effects in research schools (Chang et al., 2014), social network and peer relations (Kim et al., 2015), meta-analysis of performance in research schools (Jeong and Kye, 2014), and general adverse effects of ICT in education (Jeong et al., 2015; Kwon et al., 2014). Researchers have found that education through using digital devices in schools is largely concentrated on problem-solving and discussion so that students can develop their higher thinking skills (Hwang et al., 2014; Jeong and Kye, 2014; Kye et al., 2016). To solve the problem of weakening interpersonal relationships between teachers and students, emphasis on communication between teachers and students has been promoted and activated in various ways. Through these measures, researchers have found that student satisfaction with the relationship between students and teachers, and happiness at school have been improved (Kye et al., 2013), and various research studies conducted in this area point to enhanced social awareness and sympathy as a result of this diversified style of learning.

Regarding the scalability of SMART Education, the government has made diverse efforts to improve various laws and systems, creating the necessary foundation, reinforcing teacher capabilities, and forming a sense of understanding on educational policy to activate successful SMART Education across multiple academic disciplines. Especially, as part of efforts to establish the foundation for initiating SMART Education, the government designated research schools where financial aid and compensation points for performance were provided as incentives, and conducted performance briefings and teacher training at the school, city, provincial and national levels, so that the new teaching models developed by the research schools could be applied more generally.

Written consent was required from all teachers prior to designating a school as a research school. This encouraged the voluntary participation of teachers, and enabled teachers of various age groups and even those in charge of art, music and physical education to participate. In the research schools, first, all school teachers were encouraged to set and participate in individualized research tasks. Second, teachers focused on the improvement of teaching methods using digital textbooks. They developed and applied various instructional programs by considering learning models, learning environments, and use of devices and learning tools. This led to the creation of a school-based learning community, which has spread across the country to develop classroom models and share the results from instructional designs, applications and evaluations. Third, training programs were introduced to develop the lead teachers who can understand the school fields at the expert level. These programs took into consideration the needs and reality of school settings. Examples include the 'outreach service', which is a subject-specific research group, and 'customized training for teachers', which was expanded to cover teachers in general. Fourth, an emphasis was put on communication with parents. Training for parents was provided in a way that introduced digital textbook policies and explained in detail the prior research school results, by emphasizing the characteristics of schools and the responsibilities of students to improve the understanding and satisfaction level of parents. Finally, studies were conducted to find out how SMART Education affected teachers, students and parents. In particular, one study developed an index to measure the impacts of the research schools on teachers, schools and parents, and continuously collected feedback on research schools and analyzed their performance (Seo et al., 2014). The results showed that teachers' teaching/learning capabilities have improved and students' problem-solving abilities, communication skills and cooperation abilities have grown positively, while school and

class satisfaction also improved. In terms of parents, the project was shown to have had a positive effect on their understanding of and satisfaction with government policy.

Furthermore, guidelines were developed and disseminated on the environment for introducing SMART Education, introductory models, and related tools in other schools. In this process, knowledge came to be shared through SMART Education teacher study groups and Facebook sites. Various events were held in which leading teachers shared their experiences and promoted the advantages of SMART Education. A SMART Education Experience Center was created in each metropolitan city and province, and simultaneously the university curricula for pre-service teachers were improved to reflect SMART Education concepts.

Public hearings were held and supervised by the National Assembly with the interest groups who were against the SMART Education initiative. These shared the research results on the various positive and negative effects found in the research schools. From this, guidelines were developed and distributed on the utilization of appropriate smart devices. These involved real cases of activities to reinforce the communication and transparency of information, particularly regarding ethics education.

## 5. Conclusion and recommendations

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For the policy promoted by the government to be sustainable, it is of the utmost importance that a social consensus should be secured, and that the government provides continuous leadership. This needs to take the form of both system and financial support. The Republic of Korea announced the 5.31 (this refers to 31 May) New Educational Reform Plan in 1996, and subsequently enacted a special act known as the Korea Education Research Information Service Act (1999). By doing so, the Korean Government established the institutional framework for ICT utilization in education at the national level. Since then it has provided consistent financial support. The projects that are the basis for educational informatization have been sustainably supported financially by the Ministry of Education, and through the metropolitan and provincial offices of education. However financial aid for research and promotional efforts has been inconsistent, which has made these difficult to maintain. Therefore, in addition to the public sector, it has been exceptionally essential to build a system that can facilitate participation from the private sector.

For technology-based learning models that are introduced at school settings, such as SMART Education, the most important factor is to obtain a social consensus on the way forward. This enables policies to be shaped in ways that benefit both the public and the educational environment. If the policies fail to receive public support – even if this is because of misunderstandings or incomprehension on the part of the public – it will be difficult or impossible to sustain and develop them, since the use and promotion of ICT in education requires participants' input. The fact that new school and learning models are experimented upon by global enterprises including Microsoft, Google, and the Khan Academy suggests that even a good innovative policy that is not yet socially proven can encounter

a significant barrier to its application in the public sector throughout the enterprise, as this process requires a long time.

The driving force to break down barriers and minimize the timescale required to bring about change must come from local offices of education and schools. Their culture must support the execution of the policies. This puts emphasis on the leadership skills of the school administrators and teachers who are essentially in charge of setting the pace of change. However, many school principals would prefer to stick to traditional teaching methods and have a fear of change. They are often worried about causing problems to even a few students. This is why they are reluctant to introduce new policies. Educational superintendents in metropolitan and provincial offices of education are elected by public vote. Thus, it is difficult to persuade them to promote policies that do not obtain widespread public support. The most important task at the local level is to create awareness, followed by approval and participation, among parents and the local community, if sustainable policies on SMART Education are to be implemented.

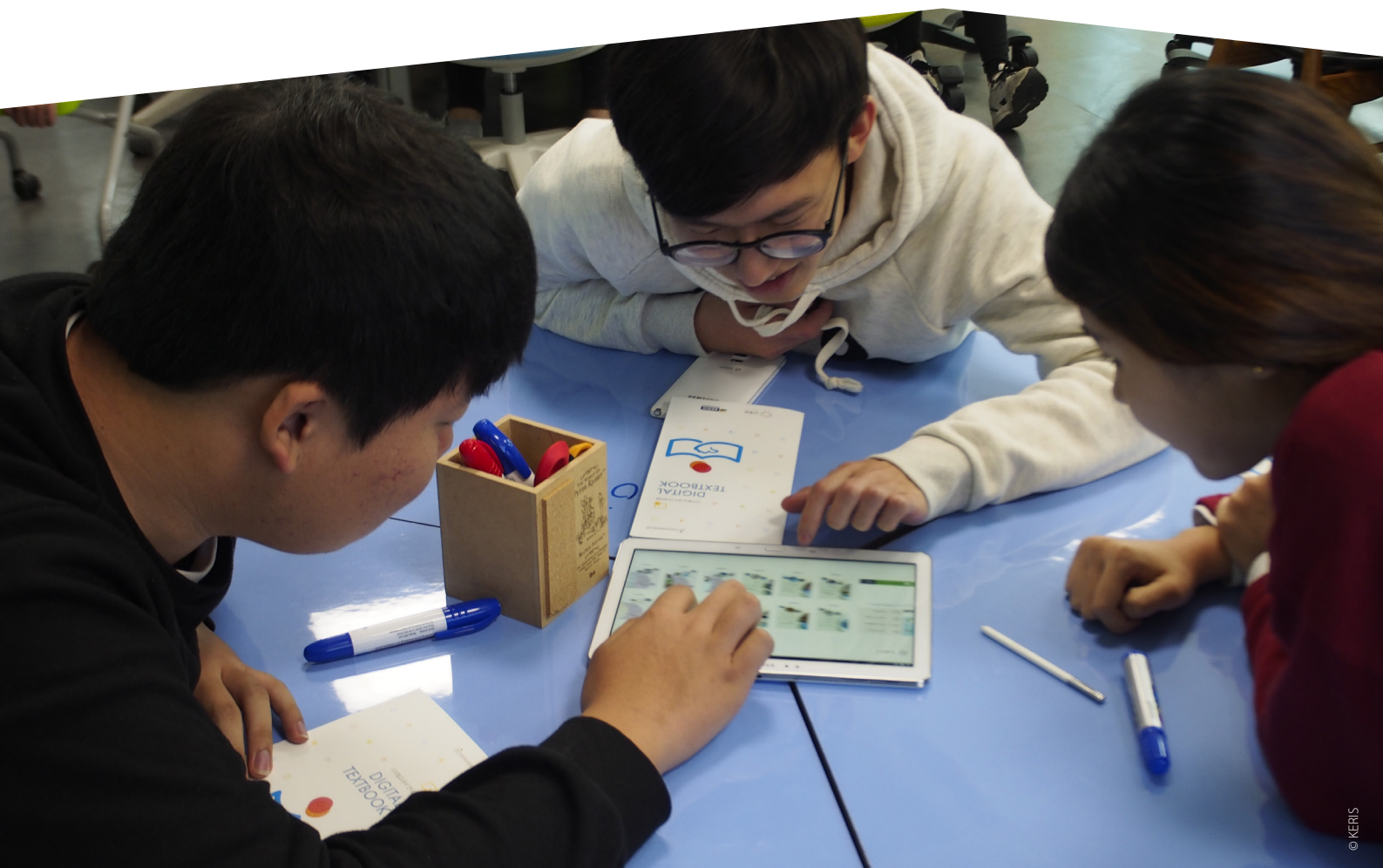
The SMART Education initiative has shown tangible results in implementing its specific visions and policies at the national level, and improving the legal systems for transition to the digital learning environment. The Ministry of Culture and the Korea Communications Commission have cooperated in working to resolve the problems. This initiative has contributed significantly to bringing about new drives for creating various new education models at the school level and improving the quality of teaching and learning in schools. But top-down policy drives have intrinsic limitations. Ultimately the participating agents must be empowered, come to accept policies as their own, and participate in the implementation process with a sense of ownership.



The government's initial strong drive for SMART Education was weakened when a change of administration occurred. Changes also take place in educational bodies. However SMART Education models have been developed and shared in a relatively stable way regardless of the changes in policy and leadership, largely because they have received enthusiastic supports from teachers and students. Teachers have been very positive about using smart technology to improve their instructional methods, without necessarily sticking to the theme of SMART Education. They have put voluntary effort into developing new applications and projects. Students have shown the ability to use tools and techniques related to problem-solving and cooperation, inside and outside class hours with skill and efficiency. This suggests that, in implementing what is initially

introduced as a top-down policy, the key is to pass ownership to participants, empower them, and allow sufficient time for the local culture to change and support the new system.

In this era when local education autonomy and individual school autonomy are being reinforced and the agents of educational services are becoming increasingly diversified, it is necessary to pay attention to establishing the strategy for empowering participating agents. A leader's visions can start the process but not complete it. Therefore, consistent and school-wide policy execution is the key consideration in establishing and executing educational policies at the national level. In this way, it becomes possible to create a sustainable virtuous-circle educational system.



**Picture 5: Group exercise using tablet.**



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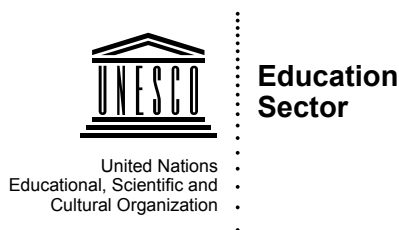
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### About the Fazheng Group

The Fazheng Group is a multi-business organization in China, which covers a wide range of interests including education. It has established a global school network providing comprehensive coverage of K-12 education.



### The project Best practices in mobile learning

Funded by the Fazheng Group, the project aims to guide the planning and implementation of school-wide mobile learning practices. The case study series consists of more than 15 initiatives including both top-down cases driven by governments and bottom-up cases initiated in individual schools, selected through desk research and a competitive call for proposals process.

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