

Development of a Promotion Model on the Digitization of Education in K-12 —A Report on the Progress at a University-Affiliated Elementary School—

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Abstract: This paper is a progress report on the digitization of education in a Shinshu University-affiliated elementary school. We became a promoter and set up a promotion team, studied the trends related to the digitization of education, listened to teachers, and designed and installed network and Information and Communication Technology (ICT) hardware. In addition, we set up a project and completed the infrastructure for education using ICT for a short term of about three months. The last aim of this study is to develop a model for the digitization of education in schools. We will practice in an open class using ICT based on the network infrastructure and ICT hardware described in this paper by the end of this year.

Introduction

With the rapid development of social computerization, it has been suggested that teaching and schools for the 21st century should be developed by using Information and Communication Technology (ICT) to its maximum potential. “A New Strategy in Information and Communications Technology” was developed at the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (2010) on May 11, 2010. As an important aspect of educational policy, it was intended to develop an environment that can lead to a form of education that is appropriate for the 21st century so that through ICT, there is i) development of easy-to-understand classroom environment where students taught and learned from one another, ii) reduction of burden on teachers and school staff, and iii) expansion in students’ capability to utilize information. In addition, “A New Economic Growth Strategy,” which was approved by the Prime Minister of Japan and His Cabinet (2010), showed that it could support the use of an optical network for entire population to improve the convenience and quality of services by the profit application of ICT to education.

In response, the Ministry of Education, Culture, Sports, Science and Technology (2011a) in Japan has released a report on the digitization of education that is a general promotion policy for 2020. The report shows that learning innovation and the enhancement of software, hardware, and human resources as comprised in cloud computing can become the basis of educating students in the 21st century. Learning innovation in conjunction with the existing forms of learning through teaching promotes collaborative learning, in which students both teach and learn, and individualized learning, which is based on the abilities and characteristics of each student. In addition, cloud computing is a service for saving data on the Internet, not on one’s computer and mobile phone. We can read, edit, and upload data with various environmental computers and mobile phones (mainly a smartphone) from home, a company, a net cafe, a school, or a library.

In teacher-training courses taught in faculties of education, including attached schools, to enhance the opportunities for a student who wants to be a teacher, practicing with an information terminal, digital gadget, and the software in a class and in practice teaching is necessary. ICT is expected to play a role as an engine for the digitization of education and as a learning innovation for the 21st century in advanced schools and attached schools that offer practice teaching and study in the field of education in close coordination with the faculty of education. Therefore, we decided to perform the digitization of education in our attached schools.

Issue of the Digitization of Education in Schools

In Japan, twenty schools (elementary school: 10; junior high school: 8; and special education schools: 2) are leading in ICT education through the Future School Promotion Project sponsored by the Ministry of Internal Affairs and Communications (2011) and the Educational Innovation Project sponsored by the Ministry of Education, Culture, Sports, Science and Technology (2011b). The former is intended as a demonstration experiment for the digitization of education through an approach to infrastructure and hardware, and the latter takes an approach based on educational content and cases.

Both projects are aware of an issue currently being investigated concerning the use of ICT in Programme for International Student Assessment (PISA) and Programme for the International Assessment of Adult Competencies (PIAAC) by Organisation for Economic Co-operation and Development (OECD). In particular, according to the results of digital reading assessment in PISA2009, Japan was fourth out of nineteen countries, but in the “making of multimedia work” it was last and in the “making of a graph using a spreadsheet” it was below the OECD mean. Therefore, these projects allocated many funds to each school and provided support to create an educational environment in which students can use ICT. In these twenty schools, a high-speed wireless network was installed, an interactive whiteboard was set up in each classroom, and each teacher and student was given a tablet computer. The results showed that the understanding and knowledge of students deepened through collaborative learning with ICT, and these projects achieved some positive results.

In previous studies, we discovered the number and types of ICT hardware that have been installed and how teachers used it, but we could not determine how to implement the digitization of education in a general type of school that included elementary and secondary students as well as special education students. For example, what kind of human resources is necessary, what should we be aware of in constructing a network, how should we support teachers and students, and so on. Moreover, it is an ideal situation when each teacher and all students have a tablet computer and each classroom contains an interactive whiteboard, such as in the above projects. However, it is difficult for many schools to provide a tablet computer to each teacher and student and to install an interactive whiteboard in each classroom owing to a limited budget.

In addition, ministries and ICT companies directed the installation of the ICT hardware and network infrastructure in the above projects, but the board of education of a municipality and teachers did so in others. It is difficult for them to focus on promoting the digitization of education in their schools, such as the above projects, because they are not experts in networks and ICT and have many professional responsibilities. However, it is difficult to outsource all this work and consulting to a company because of the expense. Even if a school can outsource to a company, a supervisor should have some knowledge of how to customize the existing ICT educational promotion model for his/her school. Therefore, we think that it is necessary to have a promoter or an ICT supporter on the board of education or in each school who can design the appropriate ICT environment for each school and support teachers and students in using ICT.

Purpose of this Study

To solve the above issues, we must determine i) which and how much ICT hardware—computers, interactive whiteboards, and so on—there will be in a school and ii) what kind of human resources there are, and how to provide support for teachers and students. We think that based on the previous case and model, many schools will design and customize a system for their own school and create an environment by themselves or

with a commissioned company. It is necessary for a school to develop a basic model to promote the digitization of education. Such a model reflects the solutions mentioned above, and it is necessary for a promoter or an ICT supporter to be able to individually design and install a network and the ICT hardware.

Therefore, the purpose of this study is to develop a basic promotion model for the digitization of education in schools.

Research Approach and Objective

In this study, we become a promoter and developer of a basic promotion model for the digitization of education through a pilot project at Nagano Elementary School, which is a Shinshu University-affiliated elementary school in Nagano City, central Japan. There are two or three classes each school year for grades one to six and between thirty-five and forty students in each class. Nagano Elementary School has an important part to play in i) the practice teaching of students in the department of education and training of teachers, ii) the study of the facts and theories of education in elementary school, and iii) the development of local education through open classes and the presentation of study results. Moreover, Nagano Elementary School is intended to develop i) kind and clear-sighted, ii) creative and hard-working, and iii) cooperative and self-motivated students.

We clarify the necessary requirements of a promoter on the basis of our work on the digitization of education in Nagano Elementary School. In addition, we clarify the steps for digitizing education on the basis of this case and the development of a model. In this paper, we discuss a process involving the digitization of education and the installation of a network, as illustrated through a pilot project at Nagano Elementary School.

Process Involving the Digitization of Education at Nagano Elementary School

We promoted the digitization of education in Nagano Elementary School by taking the following steps from June 2012.

Step 1: Set Up the Promotion Team

First, we set up the promotion team, which was headed by a department chair in our faculty. There were eight members, including the assistant principal of Nagano Elementary School, ICT university staff members, and office staff.

Step 2: Trend Report on the Digitization of Education

In the first meeting, ICT university staff reported on talking the pulse of the digitization of education, as noted above. In addition, we confirmed the need to digitize education and to promote it on the basis of the previous cases: the Future School Promotion Project and the Educational Innovation Project.

Step 3: Design of Network and ICT Hardware

It was necessary for us to design and install a network and ICT hardware for a class to use ICT, because in the Future School Promotion Project and the Educational Innovation Project, the teachers set up an interactive whiteboard to display the data of each tablet computer and set up the data of the educational tools or questions to be transmitted from the teacher's computer to each tablet computer for students in the network.

However, regarding both the network and ICT hardware, the schools used a variety of designs. The situation was divided broadly into approaches in eastern Japan and approaches in western Japan, but the detailed wiring, models, and usage were different for every school. Therefore, we made the following checklist for developing a detailed network and ICT hardware model.

A. Network

- 1) Does it allow students at the school to use a computer? Does it allow for a computer to be used only in a regular classroom or even a specific classroom?

- 2) Which method, the “roaming method” or the “fixation method,” does the wireless Local Area Network (LAN) employ? With the “roaming method,” the wireless LAN is automatically available to use without a setting change even if the computer is moved between classrooms for the students. With the “fixation method,” a wireless LAN access point is identified, and a computer for students and a band of the wireless is secured surely.
- 3) Does the wireless LAN provide a secure network?
- 4) Where should the server to save the digital teaching materials and learning history be installed?
- 5) Do we install a system to support the school affairs office? When it is introduced, where should its server be installed?

B. Computers for Students

- 1) What kind of activity does the computer enable students to engage in? (Table 1)
- 2) Which type of computer is better for students, a notebook computer or a tablet computer?
- 3) Does the input method of the touch panel have the best effect when students use a tablet computer, a pressure-sensitive method, an electrostatic capacity method, or an electromagnetic induction method? (Table 2)
- 4) Which shape is better when students use a tablet computer, the convertible type or the straight type? The convertible type also has a keyboard, but with the straight type, the screen is touched and operated directly because it does not have a keyboard.

Table 1: The ICT Hardware Corresponding to a Kind of Activity for Students

	Digital Pen	Key-board	Printer	Camera	Application		
					For-warding	Coop-erating	Sharing
Students present their idea and discuss in the class	✓	✓			✓	✓	
Teach and learn in a group	✓	✓	✓		✓		
Collect and review the experiences and repots	✓	✓	✓	✓	✓	✓	
Using a digital textbook					✓		
Each student checks with a combination of paper and ICT	✓		✓				✓
Individualized learning		✓			✓		
Teach and learn with remote area				✓		✓	

Table 2: The Feature of Each Input Method with Touch Panel

	Pressure-sensitive	Electrostatic Capacity	Electromagnetic Induction
How to perceive	Detect a crimp part	Use static electricity of the human body	Detected magnetic force of a pen point with a sensor coil
Interface	Stylus pen or finger	Stylus pen or finger	Special pen
Multi-touch	Impossible	Possible	Impossible
Feature	A student is able to write, touching screen with his/her both hands.	A student must not touch screen with his/her both hands when he/she write.	A student has same sense such as writing to a paper.
Write	Like penciling	Feeling to pat	Feeling to write to a paper

- 5) Does a digital camera or a digital video camera have to be installed separately? Or does the computer have a camera function?
- 6) Do we allow students to take a computer home for their homework to use?

C. Educational Equipment and Tools

- 1) What shape of an interactive whiteboard is the best, an all-in-one board or an attachment to a blackboard? The all-in one has a white board and a projector together or a large, thin monitor. It is easy to use for class preparations but is expensive. The board has a white board and a projector that are separate. It is easy to move, but it takes time to prepare it for class. The attachment to a blackboard attaches an interactive whiteboard to a blackboard, and it can be slid aside and thus uses less space.
- 2) Do we install a digital visualizer? Which is better for a digital visualizer, use with a computer or without a computer?
- 3) Do we install a printer? Where do we place a printer when we install it?
- 4) Do we install digital textbooks for the students and teacher?

Step 4: Listening to Teachers

We heard how teachers who will use ICT in class would like to employ it. Results showed that the teachers sent us the following requests:

- Students should be able to share what they photographed with a digital camera in each class with an interactive whiteboard.
- We would like to make students gather what another student presents with each poster on a computer. A student makes a presentation of each assigned point in the group, with a computer for each student, and the students join together and finally present what they have learned.
- We would like students to record their move through video and show it immediately on the spot.

Based on these hearing results, we decided to install some iPads and digital pens that they desired.

Step 5: Installation of Network and ICT Hardware

As a result of the review in Step 3, we decided to install a routing method for a network and to keep it safe by using a secure net at Nagano Elementary School. The secure net at Shinshu University is a network that has authentication with a User ID and a password published by the university. However, a computer for students does not need the new certification because of Media Access Control (MAC) address filtering.

Moreover, because students cannot view academic evaluations and teaching materials without permission, we distributed the network segment for students and teachers separately. Specifically, we distributed the wireless network access for the students and teachers in each wireless LAN access point with Virtual Local Area Network (VLAN). The VLAN is a function that can logically connect multiple independent LAN to one switch. Hence, it was possible to distribute network segments for the students and teachers and save costs and space at the same time. In addition, there is an information outlet that is not a secure network in each classroom, and we were able to connect the computers for the teachers to a wired network so they could download or upload large traffic data.

As a result of the review in Step 3 and Step 4, we decided to install digital pen, iPad, Windows tablet computer, and interactive whiteboard. The digital pen can save in its memory, which is built in, so that if students write a character on a page, like they do with a regular pen when writing by hand, then it is changed into digital data through a computer.

It was deemed desirable to have a computer, if available, for each child, and an interactive whiteboard in each classroom, but this was impossible because of a budget shortfall. Therefore, we suggested that the students in two classes share computers. The Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (2010) determined that forty sharing computers for students in regular classroom were the minimum requirement. We decided to set up digital pen, iPad, and Windows tablet computer among each forty students, and something extra for backup and an interactive

whiteboard in each classroom in addition to the existing ones. There was sufficient amount of money in the budget to provide this equipment for one rural school for the promotion of ICT.

Conclusions

The purpose of this study was to develop a basic promotion model for the digitization of education for schools. Therefore, we became a promoter and installed network and ICT hardware to support the digitization of education at Nagano Elementary School, which is a Shinshu University-affiliated elementary school.

We have set up the promotion team, studied the trends in the digitization of education, heard from the teachers, and designed and installed a network and ICT hardware since June 2012. We established the project and completed the infrastructure for education using ICT for a short term of about three months.

This study is a step in the process. We will install computers for students and study educational methods that use ICT for an open class on December 1, 2012. After that, we will practice in other attached schools at Shinshu University in the following year, and complete the basic support model for the digitization of education in the future.

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