# Chapter 8
# Case Study on Distance Learning for K-12 Education in Japan: The Nagasaki-Takaoka Model

**Masaki Umejima, Cherry H. Y. Wong, Jiro Kokuryo, Jun Murai, David Farber, Keiko Okawa, and Kan Suzuki**

**Abstract** A pre-existing partnership between the Japanese Government and Keio University paved the way for K-12 education to embrace distance learning. The university has been engaging in the revision of educational ICT policies in Japan for many years. In Japan, universities have been accumulating knowledge in distance learning practices since the emergence of the Internet, though earlier educational ICT policy required the ICT system in K-12 education to depend on dedicated Internet lines. In December 2019, the Japanese Ministry of Education, Culture, Sports, Science, and Technology (MEXT) announced a new ICT policy to allow K-12 education to launch distance learning classes via public cloud on the Internet. The university's experience with running distance learning, bundled with the stipulations of the new educational ICT policy, enabled K-12 education to carry out distance learning. New subjects can be taught daily, and continuity of education is ensured in disaster situations, such as the Covid-19 pandemic. The research team at Keio University built the "Nagasaki-Takaoka Model" as a reference model with the added aim of ensuring data security and trust in the open network. In December 2020, Takaoka City successfully deployed the "Nagasaki-Takaoka Model" across all public schools.

## 8.1 Introduction

Keio University was established in 1858 by Yukichi Fukuzawa as a small school of Western learning. As such, Keio is Japan's very first private higher education institution. In over 150 years since its founding, Keio has fostered its founder's motto of

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*jitsugaku*, i.e., the use of empirical science in transforming Japan into a modern nation through contributions in education, research, and medicine. *Jitsugaku* is the expression of science in the truest sense of the word and a powerful tool in Keio University's never-ending search for practical solutions to real-life problems. Keio University leverages its strengths by offering a comprehensive curriculum to promote multidisciplinary research under the three values of longevity, security, and creativity.

Akira Haseyama, President of Keio University, explained the principle by which the university contributes to solving problems associated with Covid-19. Since its establishment in 1858, Keio University has overcome many hurdles and crises caused by wars and disasters, and as a private institution of learning it evolved into one of Japan's leading comprehensive universities with the cooperation of benefactors who share its philosophy. Whenever the university faces a crisis, the overwhelming support it receives through the power of *Shachu Kyoryoku* (the entire Keio community coming together and collaborating), fueled by students, alumni, faculty, and staff members, enables it to prevail [Haseyama, 2020].

The Keio University Shonan Fujisawa Campus (SFC) is Japan's pioneering center for project-based learning. From the start of university attendance, students participate in project-based learning through seminars to work on advanced research themes and issues while acquiring the ability to shape the future. Held online, SFC's project-based learning classes and curriculum are intended to motivate students to design solutions to real-world problems.

## 8.2 Universities: The Pioneers of Distance Learning in Japan

In December 1997, Japanese universities started distance learning in response to the report "Handling of Distance Learning According to University Establishment Standards," produced by the University Education Council of MEXT. Universities have developed practical knowledge based on successful cases in mutual, interoperable communication enabled by the Internet. Adopting the Internet for communication has allowed increased exchange of course content among teachers in different universities.

In 1996, one year prior to government de-regulation, Keio University, led by Professor Jun Murai (a well-known member of the internet Hall of Fame), launched the academic alliance aiming to set up School on Internet (SOI) Asia. The SOI Asia Project was formally launched in 2001 as a platform for inter-university education programs among universities throughout Asia, with the purpose of establishing an Internet-based education platform utilizing satellite technologies and collaborating with the AI3 project (Asian Internet Interconnection Initiatives project). Higher educational institutions were to jointly operate high-speed Internet backed by satellite telecommunication. By 2019 Keio University worked together with 28 leading universities in 14 Asian countries. For example, an entrepreneurship class at Keio University SFC is managed by three faculties in two universities, targeting startup businesses in the ASEAN market (Fig. 8.1).

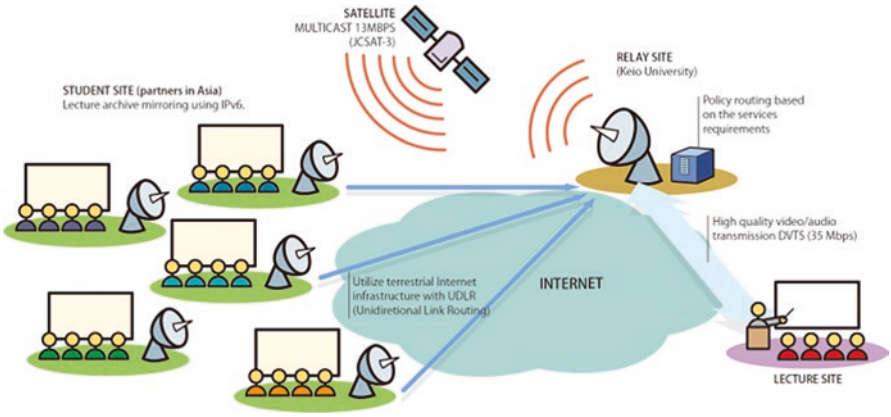


**Fig. 8.1** SOI Asia platform

## 8.3 Distance Learning: A System Used in Daily Education Becomes a Solution to Disrupted Learning in the Disaster Situation

A tailor-made system for disaster response does not work because teachers and learners cannot rely on external supports when the system is necessary. Our trial on distance learning in K-12 education showed that no teacher could identify the problem by Ping Test when the Internet was disconnected. This experience spotlighted how distance learning would increase the needs in daily education. Daily use is the best training to prepare for disaster.

## 8.4 K-12 Education System and Reform in Japan

### *8.4.1 The Principles of K-12 Education*

Kan Suzuki, the former Deputy Minister of MEXT and Professor at Keio University, says: *The 'Courses of Study' emphasize language competencies. However, the current university entrance examination does not assess such competencies. As a result, in high school, developing language-based skills is ignored. [Suzuki,* 2017*].*

The K-12 education system in Japan primarily consists of 6 years of elementary school and 6 years of secondary school. The latter is divided into 3 years of junior high school and 3 years of senior high school, from where education continues to junior college or university. Compulsory education lasts for 9 years through elementary and junior high school, with the objectives of building the foundations of education. One important principle in public education through elementary and junior high school is equity. Equity in education has two dimensions. The first is fairness, which entails that personal and social circumstances – for example, gender,

socio-economic status, or ethnic origin – should not be an obstacle to achieving educational potential. The second is inclusion, which ensures that everyone acquires a basic minimum standard of education – for example, the ability to read, write, and do simple arithmetic. These two dimensions are closely intertwined: tackling school failure helps to overcome the effects of social deprivation which is often shown to be the root of failure [The Public Affairs Division, Public Affairs and Communications, OECD, 2008].

MEXT determines the Courses of Study as broad standards for all schools, from kindergarten through upper secondary schools to ensure a common standard of education programs throughout the country. The Courses of Study are generally revised once every 10 years, with the latest revision having been carried out in 2017–2018.

## 8.5 Reform of the High School and University Articulation System

The new Courses of Study are aimed at increasing the number of classes with an emphasis on the balance between acquiring basic and fundamental knowledge and skills and fostering the ability to think, make decisions, and express oneself. For instance, the study requirements at junior high schools are stated as follows: (1) commitment to an education that enables students to solidly acquire basic and fundamental knowledge and skills, fosters their ability to think, make judgments, and express themselves to solve problems, and cultivates an attitude of proactive learning in developing individuality and the capacity for working together with diverse people and (2) enhancement of student activities helpful to creating the foundations of learning, such as language skills and other abilities, giving consideration also to the developmental stages of students, to cooperation with student families, and to the establishment of good study habits [Ministry of Education, Culture, Sports, Science and Technology, 2017].

However, the present high school and university articulation system, such as the National Testing Center for university admissions, tends to favor rote memorization and recall of information. As a result, competencies such as taking an attitude of proactive cooperation with a diverse cross section of people using intellection, problem-solving, and self-expression – that is to say, true scholarly ability – has not been cultivated or recognized.

In 2020, reform of the university entrance examination system began with a discussion in the Central Council for Education at MEXT. The roots of this reform originate from a policy recommendation by the Education Rebuilding Implementation Council in 2014, promoted by Prime Minister Abe in the previous year. The Council issued the report “Integrated Reforms in High School and University Education and University Entrance Examination Aimed at Realizing a High School and University Articulation System Appropriate for a New Era,” outlining the major pillars of the university selection process reform.

The new university entrance selection process aims to evaluate prospective entrants in a multifaceted and holistic manner to promote the acceptance of students from a diverse range of backgrounds. In particular, since the goal is to align reforms in entrance exams with reforms in education and the curriculum, Council members support multifaceted and holistic selection processes that reflect the three aspects of scholastic ability based on the admission policies promoted by individual universities: proficiency, drive, and suitability [Minister of Education, Culture, Sports, Science and Technology, 2015]:

> Fostering descriptive expression for university entrance exams creates an environment where learners can concentrate on acquiring language skills that incorporate thinking, expression, judgment, and so on. Such an environment is realized comprehensively in high school with the exploration of subjects using improved language-based competencies. This requires a focus on logical thinking, problem solving, and the application of these abilities in social and public studies which are helpful in defining problems that require solutions. Mathematics, being fundamental to logical thinking, and the national language, which is essential in the development of communication ability, are critical in this learning process. [Suzuki, 2017]

## 8.6 Pressing Needs for Distance Learning in K-12 Education

To ensure that the textbooks are objective, impartial, and incorporate adequate educational principles, MEXT examines textbooks using textbook examination standards based on deliberations of the Textbook Approval and Research Council. The examination standards include General Rules, which outline the basic policy for screening, common conditions applicable to all subjects, and subject-specific conditions. These conditions are arranged from the following three viewpoints: "scope and degree of difficulty," "selection/treatment and organization/amount," and "accuracy, orthography and expression" (as per the overview of the General Rules and common conditions).

In contrast, for language competencies such as logical communication, teaching materials are updated constantly. This requires teachers to adapt to the latest changes, which is a challenge due to the short period of time teachers must catch up with these programs. Teachers of K-12 schools in Japan are required to prepare lesson materials, while at the same time, on weekdays, they need to deal with individual students and parents. During holidays, teachers are required to be the coaches or advisers of sports and cultural clubs, called Bukatsu. A government survey indicated that the average working hours of teachers of K-12 schools exceeded 11 hours per weekday. The work overload of teachers is becoming a serious social problem [The Ministry of Education, Culture, Sports, Science and Technology, 2018].

Ari Nito, visiting researcher at Keio University Research Institute at SFC, declares, "If the university takes on new forms of education in developing language competencies, it will ease the workload of teachers in K-12 education in Japan. Teachers in K-12 education are not good at designing new subjects because many of the subjects taught in K-12 education are developed in accordance with textbook

standards and the Courses of Study that come with government verification. In that sense, inter-organizational cooperation would be a rational way of addressing quality issues in subjects requiring language skills" (personal communication, Ari Nito, May 1, 2020).

There are three critical needs with respect to distance learning in Japan: (1) new educational subjects (stressing logical communication and English conversation), (2) educational opportunities for all (whether living on remote islands or in underpopulated areas), and (3) individual needs of students (due to illness, accessibility, or refusal to attend school). In Japan, "losing a school," the closure of schools resulting from lack of students in the community, is a critical social problem in local communities that faces the aging problem. The disappearance of schools is normally followed by an economic downturn in the community. Once schools close, younger families do not move in, and this depresses economic activity in the community.

For example, Nagasaki prefecture has 971 small islands, more than any other prefecture in Japan. Yet, it is suffering from a population decline which causes many small communities to "lose their school." The combination of distance learning and face-to-face learning for K-12 education is expected to be a way to ameliorate the problem.

Virtually the entire population has broadband high-speed Internet access in Japan, with close to 100% coverage of homes (5595 million homes nationwide) [Ministry of Internal Affairs and Communications, 2018]. However, many schools might still experience difficulty connecting with each other via the Internet even if teachers agree to distance learning, and even where the connection is feasible, latency and packet loss make distance learning impossible.

## 8.7 Emergence of a New ICT Policy in Education

As discussed, distance learning is common in university education but had not been allowed for K-12 education in Japan. It was through the engagement of Keio University in the revision of educational ICT policies that distance learning in K-12 education became a possibility. A research consortium at Keio University carried out an empirical study with industries and local governments, including Microsoft, INTEC (a Japanese ICT company), V-Cube (the biggest video conference service provider in the Japanese market), Dai Nippon Printing (a Japanese giant in the printing industry), Nagasaki Prefecture, and Takaoka City, to identify the impacts and problems of implementing distance learning in K-12 education. The initial phases of the study were:

✓ Keio commencement of empirical research at high schools (April 2012)
✓ A round table at Keio University (October 2013)
✓ A presentation to Council for Regulatory Reform, Cabinet Office (December 2013)
✓ MEXT launch of a task force to drive distance learning (July 2014)

The study at Keio University facilitated discussions at many institutions such as the National Diet, the Council for Regulatory Reform, and the Taskforce Committee at MEXT. In March 2015, Keio University hosted an international round table to discuss the future shape of distance learning in K-12 education in Japan. Panelists were united behind the need for distance learning:

✓ "People wish to see educational innovation based on the power of ICT. Distance learning is a landmark," said the leader of Parliament, Toshiaki Endo (personal communication, Toshiaki Endo, March second, 2015).
✓ "Microsoft, through our corporate mission of enabling people and businesses throughout the world to realize their full potential, has long believed in educational transformation," said Jean-Philippe Courtois, CEO of Microsoft International. (personal communication, Philippe Courtois, March second, 2015).
✓ "Distance learning provides quality education by overwhelming regional differences," noted Professor Jiro Kokuryo, Vice President of Keio University (personal communication, Jiro Kokuryo, March second, 2015).

In April 2015, Japan announced that every Japanese high school could launch distance learning for daily lectures. Since this policy reform, every high school student in Japan can take 36 of 74 credits necessary for graduation by distance learning. In general, distance learning systems are categorized in four dimensions across two axes: 1) differences between synchronous and archived and 2) differences between individuals and groups. The research consortium at Keio University is recommending a group-type/synchronous interactive communication model (top right in Fig. 8.2), while an individual study/synchronous model is recommended in cases of diseases and emergencies such as the Covid-19 pandemic (top left on Fig. 8.2), backed by the empirical study and MEXT guidelines.

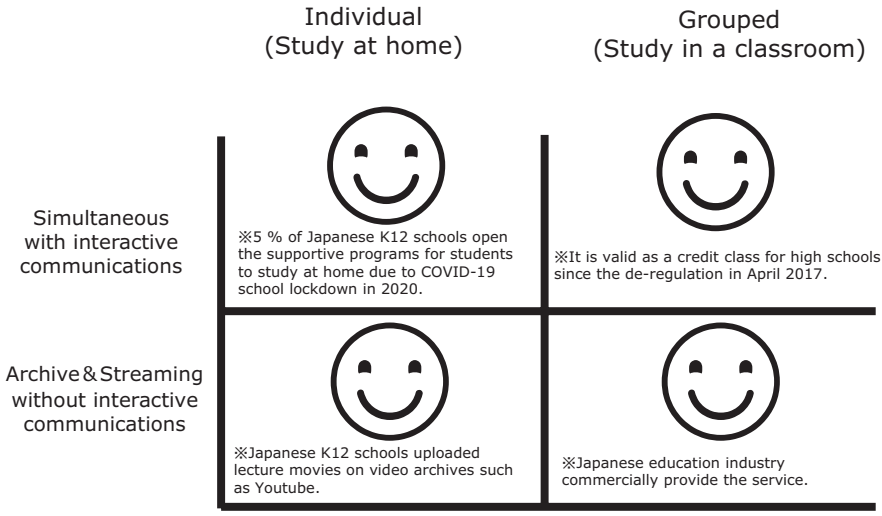


**Fig. 8.2** Structure of distance learning

In April 2015, MEXT provided guidelines to ensure the quality of school education in distance learning at high schools [The Ministry of Education, Culture, Sports, Science and Technology, 2015].

First, in high school distance learning, the guidelines stipulated that the communication between teachers and students would be synchronous and the number of students in the classroom could not exceed 40. This number, as applied in the guidelines for distance learning, rests on the same standard as in a face-to-face class. The model in which one teacher is teaching 100 students, as seen in university classes and cram school lectures, was prohibited.

Secondly, the guidelines stipulated special provisions for students who are absent from high school for a considerable period due to medical treatment of an illness or disability.

Thirdly, the guidelines defined the qualifications for teachers in charge of distance learning. A teacher must be licensed to be authorized to teach remotely, and regardless of whether there is a license for the subject, must be present to look after study activities in the class. For example, a university lecturer could conduct distance learning in a high school with a special license issued by the Local Educational Administration Committee and the principal of a private school.

In the process of developing the pilot cases, the research team at Keio university discovered a problem in the education network guidelines issued by MEXT. To gather all packets of schools at one gateway at the local educational administration office, the guidelines enforced the use of a dedicated line in every school instead of using public cloud services via the Internet. As a result, when a school accesses a distance learning service, the packets become congested at a gateway in the educational administration office before reaching the Internet. The gateway becomes overloaded and cannot scale to meet the rapidly increasing demands for higher capacity and data speeds. The schools who planned for distance learning ended up struggling with high cost and low speed of data services.

In December 2019, 3 months prior to the day when the Japanese government announced the lockdown of schools because of the Covid-19 pandemic, the new education network policy paved the way for every lecturer and student to be able to participate in distance learning via the public cloud services over the Internet. The new policy mandated that the combination of cloud service, authentication, and encryption ensure the protection of student data, while unbundling security and network design.

## 8.8 Distance Learning for Education Continuity during the Covid-19 Pandemic

As discussed, teachers of K-12 schools in Japan are suffering from work overload on weekdays, due to lecture and material preparation, individual instruction to students, and communication with parents, among other responsibilities. In addition, on holidays teachers advise sports and cultural clubs, called *Bukatsu*. Overwork of

teachers has become a social problem. Extra arrangements, such as the countermeasures during the Covid-19 pandemic, have added even more to the current overload of work.

Only 5% of Japanese K-12 schools managed to open supportive programs for students studying at home due to the school lockdown during Covid-19 pandemic [Ministry of Education, Culture, Sports, Science, and Technology, 2020]. Obviously, there is a growing need for educational ICT, especially for support in distance learning.

## 8.9 The "Nagasaki-Takaoka Model": A Prototype of Distance Learning in K-12 Education

### *8.9.1 Requirements of the "Nagasaki-Takaoka Model"*

Supervised by the research consortium at Keio University and with strong support and subsidies from the Japanese government, high schools in Nagasaki prefecture and junior high schools in Takaoka City (Toyama Prefecture) are implementing a distance learning prototype which can serve as a model for other Japanese cities. The details are as follows:

✓ In Nagasaki Prefecture, Shimabara High School is providing classes in logical communication in line with language competencies from the MEXT Courses of Study. In Shimabara High School, Skype for Business (currently Microsoft Teams) with Internet access has provided secure and smooth interaction between the lecturer and the classroom 850 kilometers away from the lecture room. Just as in traditional classes, students can raise questions while seeing the teacher's face and can participate in the class with assurance that their personal data is protected from inappropriate use.

✓ In Takaoka City, every junior high school is providing classes in language skills and support programs for home study in response to the education interruption caused by Covid-19. In schools, V-CUBE is used to ensure smooth interaction between classroom members and the lecturer at a distant place. In this case, too, classes are perfectly interactive.

Let us summarize the requirements of the "Nagasaki-Takaoka Model" for the distance learning system:

- Open network access to enable "access anytime and anywhere" so that students and lecturers can open a remote class on demand.
- Quality of system and operation target set to about 60% of that of face-to-face lessons.
- Data security implemented not based on closed system interface but in comprehensive ways referring to international standards and disallowing vendor lockdown.

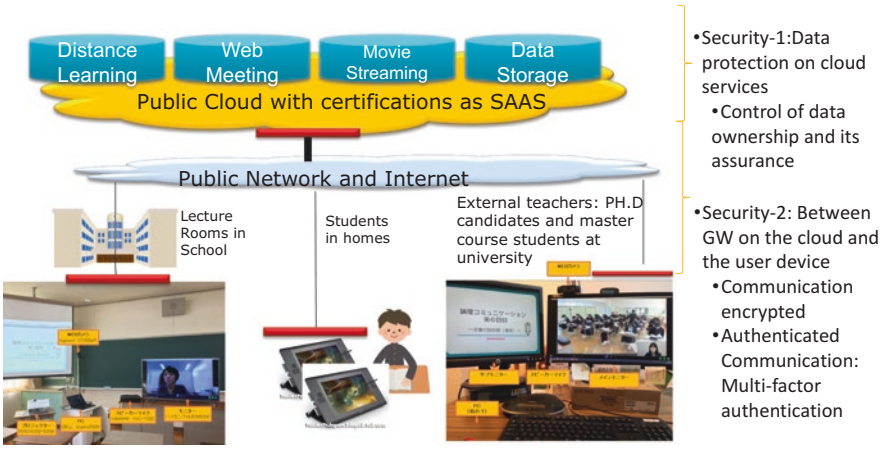


**Fig. 8.3** Distance learning system in the Nagasaki-Takaoka Model

- A method of communication to transfer data following end-to-end encryption. If third parties like ISP and cloud service players enable monitor, watch, and analyze data, the system can decouple security and network in design.
- International certifications like ISO/IEC 27001 and 27017 together with service contracts with cloud service providers to ensure data protection and privacy (Fig. 8.3).

The Nagasaki-Takaoka Model targeted the quality of distance learning lessons at about 60% of that of face-to-face lessons. As shown in Table 8.1, the Keio empirical study showed that the average satisfaction rate for teachers in the school was 72%. Students, too, indicated satisfaction at well over 60% of the target rate.

### *8.9.2 Implementation of the "Nagasaki-Takaoka Model"*

In June 2020, the Keio University Research Institute at SFC and Takaoka City announced a comprehensive partnership to develop a Global Innovation and Gateway for All program (GIGA), in which MEXT promotes new educational ICT policies with supplementary budgets for 1700 municipalities nationwide, exceeding \500 billion ($5 billion) in all. Currently, in Takaoka City, all junior high schools are equipped with an environment where remote classes can be conducted under the supervision of Keio University. The partnership plans to handle Covid-19 risk management and serve as proof of concept by being the national leader of the GIGA School Program founded on three pillars:

1. Distance learning enabled anytime and anywhere.
2. High-quality access via public networks and the Internet environment for public cloud services.
3. Educational ICT models that can be used economically, technically, and independently (Fig. 8.4).

**Table 8.1** Student and teacher satisfaction with distance learning

| | Students' answers [%] N = 87 | Teachers' answers [%] N = 7 |
|---|---|---|
| Objection to language skills classes | 1 | – |
| Minor complaints about language skills classes | 2 | – |
| Little satisfaction with language skills classes | 17 | – |
| Satisfaction with language skills classes | 79 | – |
| Same satisfaction as for face to face | – | 0 |
| Over 80% satisfaction compared to the face to face | – | 29 |
| Over 60% satisfaction compared to the face to face | – | 43 |
| Less than 60% satisfaction compared to the face to face | – | 28 |

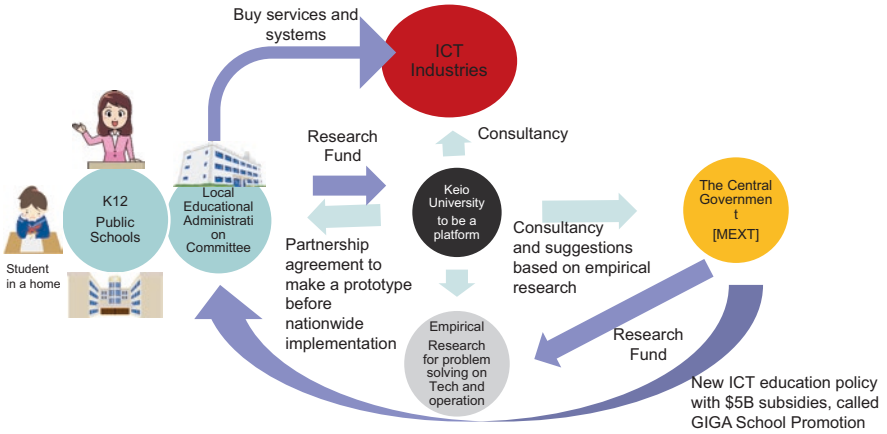


**Fig. 8.4** The relationship among stakeholders in research at Keio University

## 8.10 Conclusion

Kazuya Kometani, Chairman of the Educational Administration Committee of Takaoka City, observes: "The Covid-19 crisis has impacted K-12 education continuity. The need for distance learning will rocket as it reaches every student and lecturer" (personal communication, Kazuya Kometani, April 20, 2020).

Distance learning is the enabler of quality education beyond local boundaries. With today's Covid-19 quarantine and social distancing guidelines in place, the "Nagasaki-Takaoka Model" is expected to transform classrooms using video conferencing. The "Nagasaki-Takaoka Model," in which data trust is ensured on the open network aims to be the reference model for distance learning in K-12 education in Japan. The MEXT GIGA program supports the model by giving every

student and lecturer tablets with a wide range of digital education tools. Those tablets allow writing on the screen with a digital pen, taking photos with a high-definition camera, and using cloud services on demand. The new tablets – which come with their own full-sized keyboard – were introduced in all Japanese cities by March 2021. In Takaoka City, distance learning is becoming more common in every junior high school.

ICT adoption in education and distance learning delivers satisfaction while also raising concerns between teachers. The major concerns are affordable Internet access and education fairness, data management of education records, lack of trust in user authentication, and bullying cases enabled by ICT.

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**Jiro Kokuryo** is Professor and Vice-President, Keio University. As Keio University's Vice-President for International Collaboration, Professor Jiro Kokuryo plays a key role in developing the university's international strategy and raising its profile abroad. He is concurrently a Professor at the Faculty of Policy Management, where he served as Dean from 2009 to 2013. Vice-President Kokuryo's research and teaching interests are focused on developing business and social models that maximize the benefits of information technologies to society. Vice-President Kokuryo graduated from the University of Tokyo in 1982. While an employee of Nippon Telegraph and Telephone Corporation between 1982 and 1993, he obtained a Master of Business Administration (MBA) in 1988 and Doctor of Business Administration (DBA) in 1992, both from Harvard Business School.

**Jun Murai** is Distinguished Professor, Co-Director, Cyber Civilization Research Center Global Research Institute, Keio University. Dr. Murai received his PhD in Computer Science, Keio University in 1987, majored in Computer Science, Computer Network and Computer Communication. He developed the Japan University UNIX Network (JUNET) in 1984, established WIDE Project in 1988, aiming to research and develop the computer networks. He is a member of the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters), a member of the Cyber Security Policy Council, National center of Incident readiness and Strategy for Cybersecurity (NISC), Cabinet Secretariat, chairs and serves on many other governmental committees, and is active in numerous international scientific associations. He is known as the "Internet samurai" and, in Japan, has also been called "the father of the Internet in Japan." He was inducted into the 2013 Internet Hall of Fame (Pioneer)/2011 IEEE Internet Award/2005 Jonathan B. Postel Service Award.

**David Farber** is Distinguished Professor, Co-Director, Cyber Civilization Research Center Global Research Institute, Keio University. Before joining Keio, Dr. Farber was the Distinguished Career Professor of Computer Science and Public Policy at the School of Computer Science (SCS) at Carnegie Mellon University with secondary appointments at the Heinz School and EPP prior to his retirement. He is now the Adjunct Professor of Internet Studies in SCS and Adjunct Professor in EPP. From 2000 to 2001, he served as Chief Technologist for the Federal Communications Commission. He was awarded the Sigcomm Award for lifelong contributions to communications and Philadelphia's John Scott award for Contributions to Humanity as well as an Honorary Doctorate from Stevens and a Pioneer of the Internet Society Hall of Fame.

**Keiko Okawa** is Professor in Keio University, Japan. Dr. Okawa received master's degree in Engineering in 1985 and PhD in Media and Governance in 2001, both from Keio University. In 12 years of computer industry experience, Dr. Okawa oversaw research on "the internet and higher education" at United Nations University, Institute of Advanced Studies in 1996 and Keio University Shonan Fujisawa Campus from 1997. As the director of the SOI Asia Project, which is Asian wide top university alliance for the Internet education, she also has initiated the Global Education Project in collaboration with UNESCO and partner schools and universities throughout Asia.

**Kan Suzuki** is Professor in Keio University, Japan. Before joining Keio, Mr. Suzuki was the member of the House of Councilors in the Diet, serving as State Minister of Ministry of Education, Culture, Sports, Science, and Technology (MEXT), Japanese Government. In February 2015, Mr. Suzuki was appointed to the chief advisor to Minister of MEXT in charge of reform of high school and university articulation system.