KGRI
Keio University Global Research Institute

KGRI Working Papers

No.2

Distance learning with trust over open network policy: Nagasaki-Takaoka Model as a case study on distance learning for K12 education in Japan

Version1.0

December 2020

Masaki UMEJIMA(i), Cherry H.Y. WONG(i), Jiro KOKURYO(i), Jun MURAI(i), David FARBER(i), Keiko OKAWA(ii), Naoto MASHITA(iii), Rena RYUJI(vi), and Kan SUZUKI(v)

(i) Keio University, Cyber Civilization Research Center (CCRC)

(ii) Keio University, Graduate school of Media Design

(iii)V-Cube Corporation

(iv)Microsoft Corporation

(v) Keio University, Research Institute at SFC (SFC)

Keio University Global Research Institute

Distance learning with trust over open network policy: Nagasaki-Takaoka Model as a case study on distance learning for K12 education in Japan
Version1.0

Masaki UMEJIMA, Cherry H.Y. WONG, Jiro KOKURYO, Jun MURAI, David FARBER, Keiko Okawa, Naoto MASHITA, Rena RYUJI, and Kan SUZUKI
Keio University
V-CUBE Corporation
Microsoft Corporation

Abstract: COVID-19 crisis is ascending the needs of distance learning. Keio University has been engaging in the revision of educational ICT policies in Japan for many years, however Japanese school network guideline by Ministry of Education, Culture, Sports, Science, and Technology, Japanese Government (hereinafter refer to MEXT) regulated every school to depend on a dedicated line for many years. In December 2019, the new educational network guideline announced by MEXT paved the way that every school launches distance learning class on public cloud service through the internet access via a public network. The new guideline mandated that the combination of cloud service, authentication, and encryption ensures to protect student data, unbundling the security and the network design. “Nagasaki-Takaoka Model” in which data trust is ensured on the open network has aimed to be the reference model of distance learning for K12 education in Japan. In December 2020. Takaoka City is ready to start distance learning in every elementary school and junior high school.

1 Background

1.1 The cooperation between University and K12 education

In June 2020, Keio University Research Institute at SFC and Takaoka City announced the comprehensive partnership to address Global Innovation and Gateway for All (GIGA) program in which MEXT promotes new educational ICT policies with supplementary budgets for 1,700 municipalities nationwide, exceeding ¥500 billion ($5 billion). Currently, in Takaoka City, all junior high schools are equipped with an environment where remote classes can be conducted, together with the supervision of Keio University. The partnership plans to handle COVID-19 risk management and demonstrate as the national leader of GIGA school program with the following three pillars:
(1) Realization of distance learning at anytime and anywhere.
(2) Realization of high-quality access via public networks and the Internet environment for public cloud services
(3) Realization of educational ICT models that can be used economically, technically, and independently

Figure 1 Distance learning in a junior high school in Takaoka

1.2 Keio University

Keio University was established in 1858 by Yukichi Fukuzawa as a small school of Western learning, Keio has a history as Japan’s very first private higher education institution. Over 150 years since its founding, Keio has fostered

founder's motto of Jitsugaku, as it were, empirical science to transform Japan as a modern nation through contributions to education, research, and medicine. Jitsugaku is the 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 as a comprehensive university to promote multidisciplinary research under the three initiatives of Longevity, Security, and Creativity.

Akira Haseyama, President in Keio University declared the principle of how Keio contribute to solving the problems occurred by 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 evolved into one of Japan's leading comprehensive universities through the cooperation of benefactors who share in its philosophy. Whenever the university faces a crisis, the overwhelming support we receive through the power of Shachu Kyoryoku (the entire Keio community coming together and collaborating), fueled by our students, alumni, and faculty and staff members, enables us to prevail [Haseyama, 2020].

Shonan Fujisawa Campus (SFC) of Keio University is the pioneer of project-based learning. Since their early years at the university, students join seminars to work on advanced research themes and issues while acquiring the ability to shape the future. The Curriculum in SFC has been designed to motivate students finding a problem worthy of solution. SFC holds these project-based learning classes online.

1.3 Roots of the history of distance learning in Japan: Pioneering by universities

In December 1997, Japanese universities started distance learning in response to the report "Handling of distance learning according to university establishment standards" in University Education Council of MEXT. Practices at the universities have fostered know-hows backed by successful cases that the Internet realized the interoperable communication among universities. Adopting the Internet for communication has allowed more exchanges on course contents among teachers in different universities.

In 1996, one year prior to the government the de-regulation, Keio University, led by Prof. Jun Murai (he is well-known as the member of the internet hall of fame), launched the academic alliance for running SOI Asia in which higher educational institutions jointly operated the high speed internet backed by the satellite telecommunication, working together with 28 leading universities in 14 Asian countries. The SOI Asia Project was launched in 2001 as a platform for inter-university education programs among universities throughout Asia, with the purpose of establishing a wide area Internet education platform utilizing satellite technologies, collaborating with AI3 project (Asian Internet Interconnection Initiatives project).

For example, an entrepreneurship class in SFC in Keio University is managed by three faculty staffs in two universities, targeting the startups business in ASEAN market.

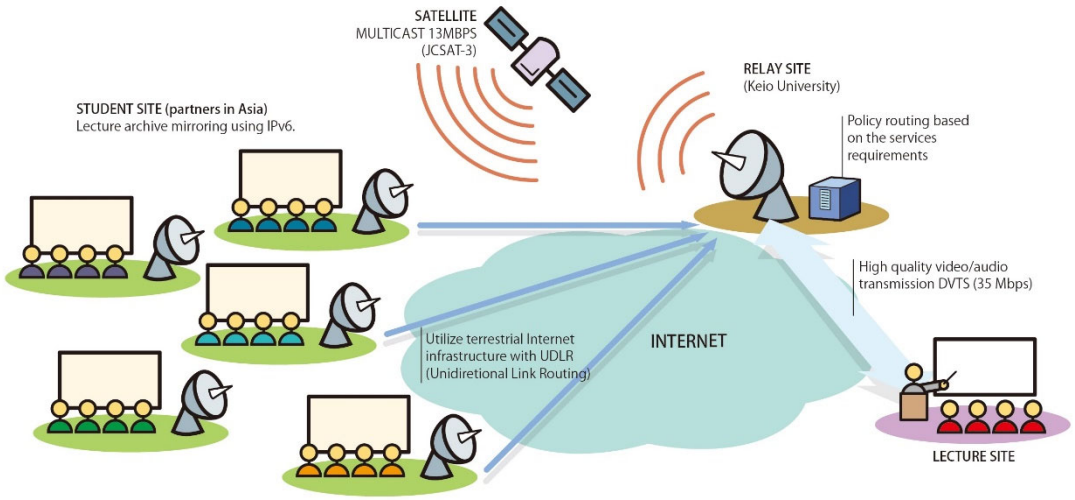

Figure 2 SOI Asia Platform

Figure 3 Distance learning in Keio University

2 K12 education system and the reform in Japan

2.1 The principles and the reform of high school and university articulation system

"The Courses of Study emphasize language activities. However, the current university examination does not assess language activity. As a result, in high school, language activity learning is removed." Kan Suzuki, The former Deputy Minister of MEXT, Professor in Keio University, says [Suzuki, 2017].

K 12 education system in Japan primarily consists of six-year elementary schools, three-year lower secondary schools (junior high schools) and three-year high schools, continuing to junior colleges or university. Compulsory education lasts for 9 years through elementary and junior high school with the objectives of building the foundation for all education. Equity in education is the important principle for public education through elementary and junior high school. Equity in education has two dimensions. The first is fairness, which basically means making sure 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, in other words ensuring a basic minimum standard of education for all – for example that everyone should be able to read– write and do simple arithmetic. The two dimensions are closely intertwined: tackling school failure helps to overcome the effects of social deprivation which often causes school failure [The Public Affairs Division, Public Affairs and Communications, OECD, 2008].

The MEXT determines the Courses of Study as broad standards for all schools, from kindergarten through upper secondary schools, to organize their programs in order to ensure a fixed standard of education throughout the country. The Courses of Study have generally been revised once every ten years and the latest revise was carried out in 2017-2018. The new Courses of Study 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 requirements by the course study for a junior-high school are: (1) Each school should be committed to enhancing education to enable students to solidly acquire basic and fundamental knowledge and skills, to foster students' ability to think, make judgements, and express themselves that are necessary to solve problems using acquired knowledge and skills, to cultivate an attitude of proactive learning to develop students' individuality, and to encourage working together with diverse people. (2) Each school should enhance its students' activities that create the foundation of learning, such as language activities and other activities, giving consideration to the developmental stages of the students, in cooperation with students' families at the same time, with consideration given to help students establish good study habits [Ministry of Education, Culture, Sports, Science and Technology, 2017].

However, a present high school and university articulation system, such as the National Center Test for university admissions, tends to favor the rote memorization and recall of information, 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.

The reform of university entrance test system targeting 2020 academic year began with the discussion in Central Council for education in MEXT. It was accelerated when the Education Rebuilding Implementation Council made a policy recommendation, promoted by Prime Minister Abe in 2013. In 2014, 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 entrant selection process aims to evaluate the proficiency, drive, and suitability, etc. of prospective entrants in a multifaceted and holistic manner in order to promote the acceptance of students from a diverse range of backgrounds. In particular, in order to promote reforms in entrance tests in line with reforms in education and the curriculum reform, multifaceted and holistic selection processes that reflected the three aspects of scholastic ability and which were based in the admission policy is promoted in individual universities [Minister of Education, Culture, Sports, Science and Technology, 2015].

> *“Evaluating language activities in K12 education, descriptive expressions for university entrance exams, creates the environment where learners can concentrate on studying language activities that consist of thinking, expression, judgment, etc. For example, in the time of comprehensive learning in junior high school and the time of exploring study in high school, increased language activities and fostered logical thinking ability and problem solving ability, harmonying with other subjects such as social and public study that is helpful in finding problems to be solved, mathematics that is fundamental of logical thinking ability, and class of the national language to develop verbal communication ability.” Kan Suzuki says* [Suzuki, 2017].

2.2 Interruption of the reform of high school and university articulation system

In the reform plan, grading of the written portions were to be commissioned to a subsidiary of the correspondence education firm Benesse Holdings, Inc. For example, it required some 10,000 people to grade all test answers of approximately 500,000 exam-takers in about 20 days, meanwhile concerns were raised over the possible errors or disparities in grading due to the hiring of part-timers.

Eventually, the high school and university articulation system reform due to start in the 2020 academic year was postponed as per the announcement by the Minster of Education Koichi Hagiuda in December 2019. Both the introduction of private English tests and written portions of Japanese and Mathematics exams were the major pillars of university entrance exam reforms [The Mainichi, 2019].

2.3 Needs towards distance learning in K12 education

To ensure that the textbooks are objective, impartial and incorporate adequate educational considerations, MEXT examines textbooks under textbook examination standards, following deliberations within 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" (refer to the overview of the General Rules and common conditions).

In contrast, for language activities such as logical communication, teaching materials are updated constantly, which require teachers to adapt to the changes. The new teaching fields are not something teachers can catch up immediately in a short time. Teachers of K12 schools in Japan are required to prepare lecture documents, while at the same time, to deal with students and parents on weekdays. 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 K12 schools exceeded 11 hours on weekdays. The over workload of teachers is getting serious as a social problem [The Ministry of Education, Culture, Sports, Science and Technology, 2018].

> *“If university takes over the new education in line with the language activity, it will ease the teachers on K12 education in Japan. They are not good at designing the new subject because many of the subjects taught in K12 education are in accordance with the textbooks and the Courses of Study with government verification. The inter-organizational cooperation is a rational way to address the quality language activity”. Ari Nito, visiting researcher in Keio University Research Institute at SFC and lecturer in Nagasaki Prefectural high Schools,*

says

2.4 The reform of adopting distance learning to K12 education

As we discussed, distance learning was common in university education but was not allowed for K12 education in Japan. Keio University has engaged in the revision of educational ICT policies to pave the way of distance learning in K12 education. A research consortium in Keio University carried out the empirical study with industries and local governments, e.g. Microsoft, INTEC (Japanese ICT company), V-Cube (the biggest video conference service provider in Japanese market), Dai Nippon Printing(Japanese giant on printing industry), Nagasaki Prefecture, and Takaoka City, to identify the impacts and problems in case of implementing distance learning for K12 education. The study experiences at the initial phase are:

- ✓ 2012 April: Keio started empirical research at high schools
- ✓ 2013 Oct.: A roundtable at Keio University
- ✓ 2013 Dec.: Presentation at IT regulation reform committee, Cabinet Office
- ✓ 2014 July: MEXT launched a task force to drive distance learning

The study in Keio University facilitated discussions at many institutions such as the National Diet, Council for Regulatory Reform in Cabinet House, and the Taskforce Committee at MEXT. In March 2015, Keio University hosted the international roundtable to discuss the future figure of distance learning for K12 education in Japan. Some messages addressed by the panelists were:

- ✓ “People wish to take educational innovation by the power of ICT. Distance learning is a landmark” Toshiaki Endo, the leader of Parliament said.
- ✓ “Microsoft, through our corporate mission of enabling people and businesses throughout the world to realize their full potential, has long believed in educational transformation”, Jean-Philippe Courtois, CEO of Microsoft International.
- ✓ “Distance learning provides quality education by overwhelming the regional differences” Prof. Jiro Kokuryo, Vice President of Keio University.

Figure 4 The roundtable to discuss the future vision of distance learning in Keio University

In April 2015, Japan announced that every Japanese high school could launch distant learning for daily lectures. Since this deregulation, every high school student in Japan can take 36 credits of 74 credits by distant learning that are necessary for graduation. In general, distance learning systems are categorized in 4 dimensions by 2 axes: 1) differences between simultaneousness and archives and 2) differences between individuals and groups. The research consortium in Keio University is recommending a group-type/simultaneous interactive communication model,(top right on figure 4), while individual study/simultaneous model is recommended in the cases of diseases and emergency such as COVID-19 Pandemic (top left on figure 4), backed by the empirical study and the guideline of MEXT.

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

Firstly, in high school distance learning, the guideline stipulated that the communication between teachers and students was simultaneous and the number of students in the classroom cannot exceed 40. This number applied in the guidelines for distance learning is the same standards as a face-to-face class. The model in which one teacher teaching 100 students as seen in university classes and cram school lectures was prohibited.

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

Thirdly, the guideline defined the qualifications of teachers in charge of distance learning: (1), a teacher who teaches a subject in a distant place are required for the licenses to teach the subject; (2) a teacher (regardless of whether there is a license for the subject) attended a class to look after study activities in the class. For example, a university teacher could conduct distance learning for a high school with a special license issued by Local Educational Administration Committee and a school master in a private school.

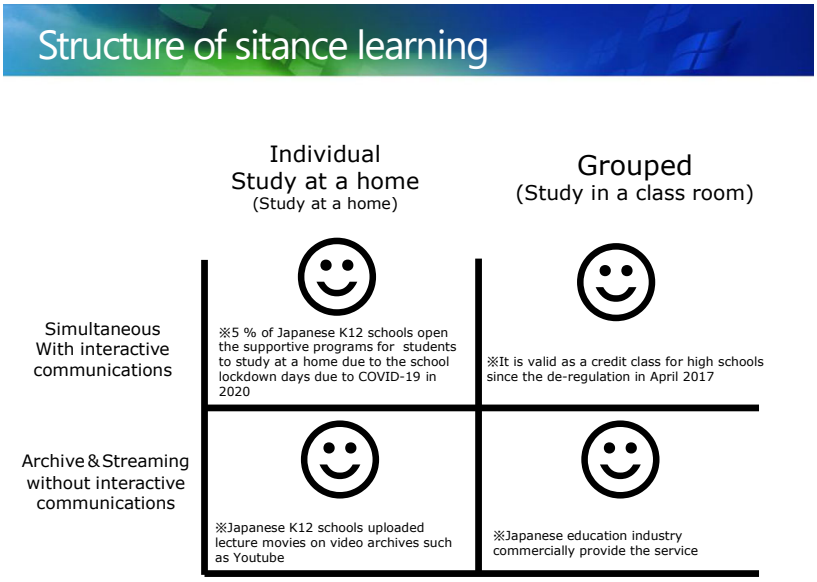

Figure 5 Structure of distance learning

2.5 Distance learning for education continuity in COVID-19 disaster

As we discussed, teachers of K12 schools in Japan are suffering from overloaded works on weekdays: lecture and document preparations, instruction to students individually, and communication with parents, etc. On holidays, the teacher is necessary to be advisers of sports and cultural clubs, called Bukatsu. Over workload of teachers has become a social problem. Extra arrangements, such as the countermeasures during the COVID-19 Pandemic, have added to the current overloaded works.

There is a growing need for educational ICT, especially in distance learning. In contrast, in terms of implementation, only 5% of Japanese K12 schools open the 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].

3 Problem identification: how to ease distance learning for teachers

Same as during the deregulation announced in April 2015, the research consortium in Keio University started to develop pilot cases at some high schools and junior high schools, involving MEXT as the regulator, and prefectural and municipal educational administration committees as the owner of schools. In the cases, feasibility study is conducted to measure educational merits and identifies problems on technology and operation aspects.

Distance learning in Japan has the following three needs: (1) new educational subjects (logical communication, English conversation), (2) educational opportunities for all (whether living in remote islands or underpopulated areas), and (3) individual needs (illness, accessibility, refusal to attend school). In Japan, “losing a school” is a critical social problem in the local community that faces an ageing problem. Disappearing of a school is the starting of the downturn in a community (no school, no child, and no economic activity).

For example, Nagasaki prefecture has 971 small islands, which is the biggest number in Japan. Yet, it is suffering from a population decline which causes to “losing a school” as a landmark in a small community. The combination of distance learning and face-to-face learning for K12 education is expected to be a way to solve the problem.

In Japan, all homes in Japan are technically available for the broadband high-speed Internet access, reaching 100% as coverage rate (the nationwide 5,595millions home) [Ministry of Internal Affairs and Communications,

2018]. However, in many schools, even if teachers agree, the schools might experience difficulty in connecting with each other via the Internet, and if the connection happened, latency and plenty of packet loss make distance learning impossible for schools.

In the process to develop pilot cases, Keio university found a problem within the former education network guideline issued by MEXT. The guideline enforced in every school to use the dedicated line, to gather all packets of schools at one gateway at the local educational administration office, instead of using public cloud services via the Internet. For instance, when a school access a distance learning service, the packets got congested at a gateway in the educational administration before outreaching to the Internet. The gateway was overloaded and could not scale to meet the rapidly increasing demands for higher capacity and data speeds. The schools who planned for distance learning had long struggled with the high cost and low speed of data services.

In December 2019, prior three months to the day when Japanese government announce the lockdown of schools caused by COVID-19 Pandemic, the new education network policy paved the way that every lecturer and student carried out distance learning over the pubic cloud services over the internet access.

In response to the deregulation, the Japanese government launched GIGA program for every K12 student to own a tablet with USD 5 billion subsidies, enabling brand new kinds of app-driven services like video conference, data sharing, and AI workbook.

4 “Nagasaki-Takaoka Model”: a prototype of distance learning for K12 education

4.1 Requirements to “Nagasaki-Takaoka Model”

With the supervision by the research consortium in Keio University and strong supports with subsidies by the Japanese government, high schools in Nagasaki prefecture and junior high schools in Takaoka city are implementing distance learning to be a prototype and a reference model for other Japanese cities. The details are:

- ✓ In Nagasaki prefecture, Shimabara high school is providing the logical communication classes in line with language activities that indicated in the Courses of Study in MEXT. In Shimabara high school, Skype for Business (Current Microsoft Teams) with Internet access has provided secured and smooth interaction between the classroom receivable and the lecturer at the distant place located 850 Km east away from the lecture room. As same as other regular lectures, students can raise questions with seeing teacher’s face and can participate in the class without concerning the commercial use of personal data.
- ✓ In Takaoka City, every junior high school is providing the logical communication classes and support program for home study as a countermeasure to the education interruption caused by COVID-19. In schools, V-CUBE are used to ensure the interaction smoothly between the classroom receivable and the lecturer at the distant place. As same as the other regular lectures, students can raise questions with seeing teacher’s face and can participate in the class without concerning the commercial use of personal data.

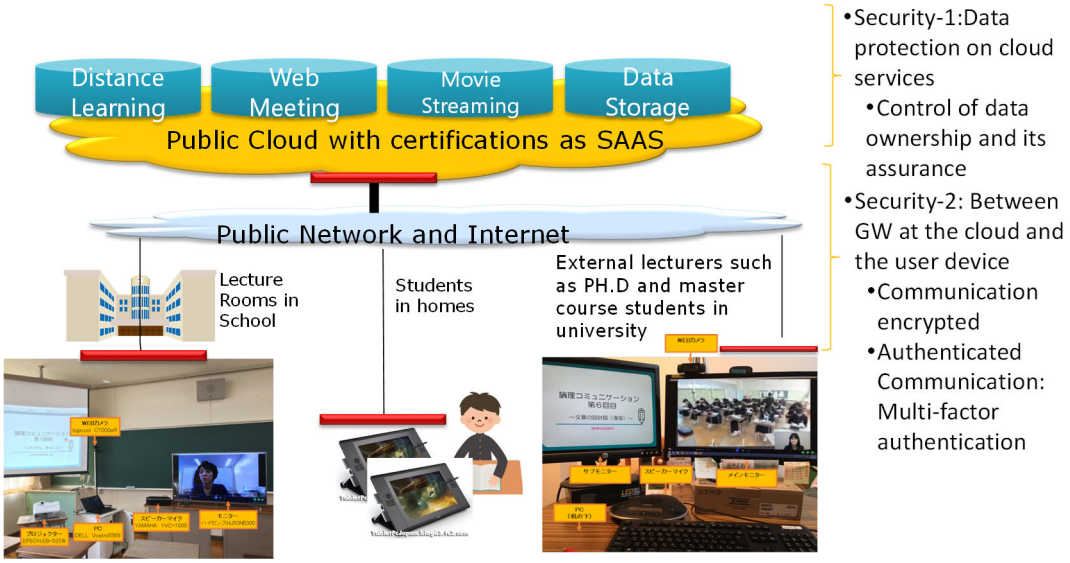

Figure 6 System configuration for distance learning

The requirements in “Nagasaki-Takaoka Model” are:

① A distance learning system allows the open network access, including the internet, to enable “accessing at anytime and anywhere” so that students and lecturers can open a remote class on demand.

② Distance learning both in the system and operation target quality of about 60% compared with face-to-face lessons.

③ Data security is implemented not by a closed system interface but by comprehensive ways, referring to international standards, not allowing a vendor lockdown.

④ A principle of communication to transfer data follows the end-to-end encryption policy. If the third parties like ISP and cloud service players enable interfere, monitor, watch, analyze, and use data, the countermeasures are in-design.

⑤ Data protection and privacy should be ensured by international certifications like ISO/IEC 27001 and 27017 together with the service contract with the cloud service providers. The details of security requirements are shown in the table1:

Table 1 Security requirements to Cloud Services in Nagasaki-Takaoka Model

No	Requirement	Implementation example
1	Servicers have the third-party authentication that an organization manages the security of assets in an information security management system (ISMS).	ISO/IEC27001
2	Servicers have the third-party authentication that information security control is applicable to the cloud services.	ISO/IEC27017 Information disclosure authentication for safety and trust service on ASP・SaaS(Japan Domestic)
3	Data integrity: Data integrity must be ensured by a backup operation and recovery solutions.	By contracts with the service providers
4	Privacy Protection: When analyzing student data to improve a teaching and learning process. Privacy protection must be implemented within the stakeholders like students, parents, and teachers.	ISO/IEC27018 By contracts with the service providers
5	Secured Communication: A handset is capable of 1) carrying out authenticated and encrypted communication with the public cloud servers and 2) updating a web browser and OS with the function of countermeasures to external attacks	Multi-factor authentication Encryptions: AES128, SSL

The equipment configuration in the lecture room is shown in Table 2. As for the PC for distance education, you can use it if you have a normal PC equipped with the school.

Table 2 The equipment configuration in the lecture room in Nagasaki-Takaoka Model

	Item	Example	Volume
1	Video Conference Software	Skype, Skype for Business (Current Microsoft Teams), V-Cube, and so on	1

2	PC or Tablet for common use	OS: After Windows 8 CPU: over 1Ghz with single core Storage: over 64GB Momory: over 4GB Interface; USB, VGA port[Recommend] and HDMI port[Recommend]	1
3	Speaker Mic	YAMAHA　YVC-1000	1
4	USB Camera	logicool webcam C930eR	1
5	Camera stand for common use	Sanwa DG-CAM21	1
6	Projector for common use	Epson EB-W05	1
7	Display for common use	Untcad LCM5502S	1
8	Others	Cables [HDMI, Ethernet]	1
		Screen	1
		Table Tap	1
		PC Shelf [if necessary], e.g. Hayami PH-815 PHP-8101L	1

As shown in figure , the important for distance learning in K 12 education is that students can see teacher's face and white board with presentation with high definition.

Figure 7 Lecture room's view【Left】Teacher room view in a distant place【Right】

4.2 Implementation of "Nagasaki-Takaoka Model"

Nagasaki-Takaoka Model is implementing the new education like language ability for daily K12 education. In addition, the model is getting awareness for a school to start distance learning in encounter with the crisis situation caused by Covid-19. For example, Logical Communication is the new subject in line with language ability, backed by the basic research began in 2003 at the SFC Research Institute at Keio University. The research results on the teaching techniques that are published as books, PDFs on MEXT website, and video streaming and measurement techniques that SFC Forum has taken over as a logical communication assessment test. Logical Communication is the method to write and present one's opinion logically without depending on the majority by "text blueprints" with five steps and nine rules. Learners who are not good at writing sentences, who feel that they are not good at communicating their thoughts collectively, and even those who are good at writing sentences, can acquire a new way

of expression.

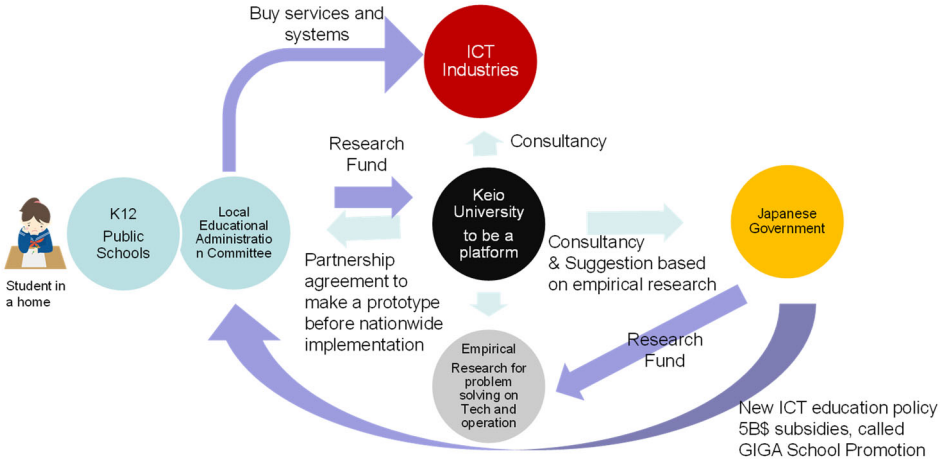

Figure 8 The relationship among stakeholders on the research in Keio University

The logical communication education began in 2013 at comprehensive learning classes at six high schools and the test takers in high schools and junior high schools nationwide exceeded 25,000 in 2019 academic year.

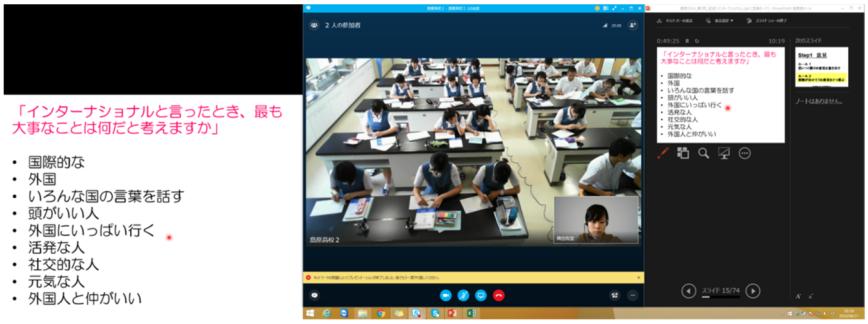

Figure 9 Teacher's view at the remote class of logical communication

Figure 10 Student's view in a lecture room at the remote class of logical communication

4.3 Evaluation of "Nagasaki-Takaoka Model"

4.3.1 High speed network access by the internet via public network

With aiming at enabling accessing the distance learning system at anytime and anywhere, "Nagasaki-Takaoka Model" adopted public cloud services. In the model, it is necessary to be fixed that shaky networks caused poor audio quality and latency. Schools are facing even higher capacity needs for education continuity by implementing real-time distance learnings. As shown in Table 2, the empirical study in junior high schools in Takaoka in 2020 showed that the internet access via public network satisfied the requirement of "Nagasaki-Takaoka Model", enabling distance learning with a quality audio and a high definition movie.

Table 3 High speed network access to enable distance learning

No	School Name	Lecture Room			Speed Test（Mbps）by Wi-Fi Access # Bold by Ethernet access					
					Before a class		During a class（High at BE）		During a class（Low at BE）	
					DL	**UL**	**DL**	**UL**	**DL**	**UL**
1	Fushiki	A	B		**51**	**74**	Not Measured			
2	Nansei	A	B		18	12	24	29	17	16
3	Koryo	A	B		**61**	**73**	27	23	21	17
4	Takaoka-Seibu	A	B		10	25	15	34	2	10
5	Kuniyoshi	A			**74**	**67**	20	24	11	13
6	Toide	A	B		**77**	**72**	33	49	32	46
7	Yoshino	A	B	C	**96**	**68**	Not Measured			
8	Shikino	A	B	C	39	52	40	50	12	16
9	Fukuoka	A	B		31	27	26	28	23	18
10	Nakata	A			**68**	**68**	**54**	**70**	**42**	**73**
11	Goi	A	B		15	34	27	50	6	21
12	Makino	A			13	35	21	38	17	21

4.3.2 Users satisfaction

The requirement to Nagasaki-Takaoka Model has targeted the quality of about 60% compared with face-to-face lessons. As shown in the Table 3, the empirical study in junior high school in Takaoka in 2019 showed satisfaction rate by the teachers in the school was 72% in average. In addition, the students who take Logical Communication classes showed high satisfaction to the classes.

Table 4 Students' and teachers' satisfaction to distance learning

	Students' answers [%] N=87	Teachers' answers [%] N=7
Complaint to the Logical Communication Classes	1	-
A little complaint to the Logical Communication Classes	2	-
A little satisfaction to the Logical Communication Classes	17	-
Satisfaction to the Logical Communication Classes	79	-
Same satisfaction as the face to face	-	0
Over 80 % satisfaction to the face to face	-	29
Over 60 % satisfaction to the face to face	-	43
Less 60 % satisfaction to the face to face	-	28

4.3.3 Cost evaluation

Regarding cost evaluation on the model, the empirical study in partnering with Ministry of Internal Affairs and Communications newly build 21 distance learning lecture rooms in 12 junior high schools and deliver over 300 lectures, descending initial and operation cost. “Nagasaki-Takaoka Model” was implemented by less than 1 million¥, including lecturer and education material fees for one year. The cost structure is shown on Figure 9. The important is for the lecturers in charge of daily education can use enough budgets for pure education purposes, e.g. inviting external lectures and procuring education material to analyze students’ learning performance. In the empirical study, 27% of the budgets were used for that purpose. The details are shown in the figure 9.

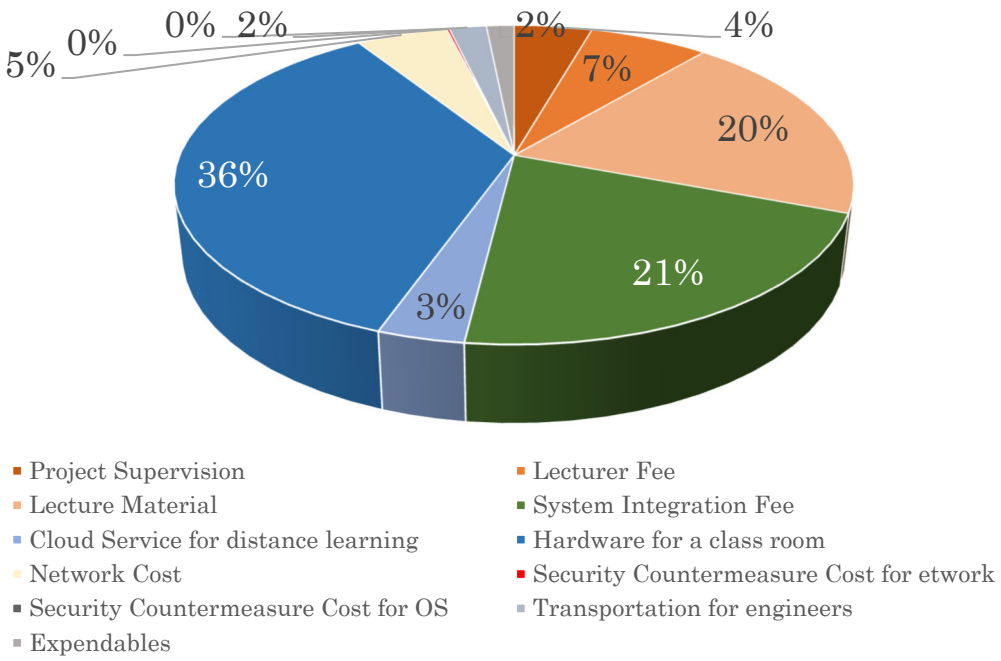

Figure 11 The cost structure to open distance learning for K12 education

5 Conclusion

“COVID-19 crisis has influenced education continuity on K12 education. the need for distance learning will rocket up when it reaches every student and lecturer” Kazuya Kometani, chairman of Educational Administration Committee, Takaoka City

Distance learning is the enabler of delivering quality education beyond the geographical difference. With today’s COVID-19 quarantine and social distancing guidelines taken in place, “Nagasaki-Takaoka Model” is expected to transform classrooms through the use of video conferencing by bringing the high-speed network access by the internet via public network and decoupling security and network in-design. In December 2019, the new educational network guideline announced by MEXT paved the way that every school launches distance learning class on public cloud service through the internet access via a public network. The new guideline mandated that the combination of cloud service, authentication, and encryption ensures to protect student data, unbundling the security and the network design. “Nagasaki-Takaoka Model” in which data trust is ensured on the open network has aimed to be the reference model of distance learning for K12 education in Japan. MEXT’s GIGA program supported 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 the digital pen, taking photos by a high-definition camera, and using plenty of cloud services on demand. Takaoka City is ready to start distance learning in every elementary school and junior high school in December 2020. The new tablets–which come with their own full-sized keyboard–will be introduced in all Japanese cities by March 2021.

6 Consideration

In Japan, K 12 education get ready to use ICT with the preparation of hardware and high-speed internet access. For example, AI can predict, to a certain degree, what quiz we should do to next based on a good learner's previous choices. On the other hand, ICT adoption on education such distance learning and AI will deliver the satisfaction but raise the concerns between teachers. The major concerns are:

6.1 Affordable internet access and education fairness

Equity in education is the important principle of public education in Japan with two dimensions: fairness and inclusion. Japan has succeeded in providing most Japanese with access to broadband connections. In Japan, all homes in Japan are technically available for the broadband high-speed Internet access, reaching 100% as coverage rate (the nationwide 5,595millions home) [Ministry of Internal Affairs and Communications, 2018]. Yet our finding through the implementation of Nagasaki-Takaoka model was that Approx. 10 % students in a class of a junior high school did not have a network access to take distance learning in a home, which was caused by personal and social circumstances.

6.2 Data management of education records

This concern happens in many countries, not only in Japan. The Student Privacy Policy Office, U.S. Department of Education defined that "Education records" are records that are directly related to a student and that are maintained by an educational agency or institution or a party acting for or on behalf of the agency or institution. These records include but are not limited to grades, transcripts, class lists, student course schedules, health records (at the K-12 level), student financial information (at the postsecondary level), and student discipline files. The information may be recorded in many ways, including, but not limited to, handwriting, print, computer media, videotape, audiotape, film, microfilm, microfiche, and e-mail.

6.3 Lack of trust to user authentication

In 2019, Zoom emerged as an indispensable video conferencing tool for remote study during the COVID-19 pandemic. But a growing number of "Zoom-bombing" causing warnings from authorities like FBI National Cyber Security Center in Japanese Government. People participating in meetings and lessons via video conference platforms can find their screens hijacked by malicious actors who can put words and images on the screen and in the chat box or create havoc with the audio. Better security such as passwords as suggested by ZOOM are necessary in all applications. In addition, there is a discussion between authentication models: government centric VS private centric. Some government applications require users to verify their identities. It means that users must prove themselves. By doing this procedure, the applications make sure that only the right people get access to sensitive information. In U.S., users only need to verify their identity once for their login.gov account (after users verify their identity with login.gov for one government application, they don't need to do it again for other government applications).
On the other hand, Japanese government centric authentication service is in propose for the Social Security and Tax Number System which is addressing to improve administrative efficiency, enhance public convenience, and realize a fairer and more just society. Since January 2016,"My Number" is required for administrative procedures related to social security, taxation, and disaster response. Japanese government is issuing "My Number Card" with "My number" and the electronic certificate at the request.
"My Number" is:
-A 12-digit number designated and notified to each and every resident in Japan
-Only used in administrative procedures in the areas of social security, taxation and disaster response stipulated by the My Number Act
"My Number Card" is:
-Individual can verify "My Number" and identification only with My Number Card.
-The IC chip contains an electronic feature for authenticating the card bearer (electronic certificate).
Electronic certificate on "My Number Card" is used for user identification and signature. In Japanese model, in addition to the government applications, private business applications can use this government centric certificate with the approvement by the Minister of Internal Affairs and Communication. In online banking and shopping, the model allows cheap and speedy identify verification at customer registration (account opening); much securer user verification at login compared to an ordinary ID/password system. Both government and private institutions is also encouraging people to use Multi-Factor Authentication (MFA) and move beyond passwords and use an added level of security such as mobile-based authentication. Two-factor authentication requires the user to have two types of credentials before being able to access an account. MFA is a process where a user is prompted during the sign-in

process for an additional form of identification, such as to enter a code on their cellphone or to provide a fingerprint scan.

Figure 12 My number card in Japan

6.4 Bullying cases caused by ICT

Japanese government survey mentioned that the number of bullying cases acknowledged at schools across Japan rose to 543,933 in 2019 academic year, an increase of 129,555 in one year. The survey was carried out on a total of 35,439 private and public elementary, junior high, and high schools, as well as special education facilities. There are 425,844 cases in elementary schools, up by 198,723, 97,704 cases in junior high schools, an increase of 17,280 in one year, and 17,709 in high schools, up by 2920. Bullying cases related to slander and abuse via PCs, Mobiles, and SNS are not many but getting worse. The report registered 16,334 bullying cases caused by PCs, Mobiles, and SNS, an increase of 3,702（29%） [Ministry of Education, Culture, Sports, Science, and Technology, 2019].

- Reference:

Haseyama, A. (2020). *Emergency Support for Students in Light of the COVID-19 Outbreak — A Message from the President to Keio Students.* Retrieved from Keio University Web site.

Minister of Education, Culture, Sports, Science and Technology. (2015, 1 16). *Plan for Implementing High School/University Articulation Reforms (Overview).* Retrieved from Ministry of Education, Culture, Sports, Science and Technology Web: https://www.mext.go.jp/en/news/topics/detail/__icsFiles/afieldfile/2015/04/16/1356120.pdf

Ministry of Education, Culture, Sports, Science and Technology. (2017). *National Curriculum Standards for the lower secondary school.* Retrieved from Ministry of Education, Culture, Sports, Science and Technology Web: https://www.mext.go.jp/component/english/__icsFiles/afieldfile/2020/02/27/20200227-mxt_kyoiku02-100002604_2.pdf

Ministry of Education, Culture, Sports, Science and Technology. (2018). *The techers' working environment survey.* Retrieved from Website for Ministry of Education, Culture, Sports, Science and Technology: https://www.mext.go.jp/component/a_menu/education/detail/__icsFiles/afieldfile/2018/09/27/1409224_004_3.pdf

Ministry of Education, Culture, Sports, Science, and Technology. (2019). *Survey on various problems in student guidance such as problem behavior and school refusal of children and students.* Tokyo: Ministry of Education, Culture, Sports, Science, and Technology.

Ministry of Education, Culture, Sports, Science, and Technology. (2020). *Survey on the learning instruction in public school due to temporary school closure to countermeasure COVID-19 infection.* Retrieved from Ministry of Education, Culture, Sports, Science, and Technology Website: https://www.mext.go.jp/content/20200421-mxt_kouhou01-000004520_4.pdf

Ministry of Internal Affairs and Communications, J. (2018). *WHITE PAPER Information and Communications in Japan in 2016.* Retrieved December 30, 2018, from https://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2018/2018-index.html

Suzuki, K. (2017). *Interview to Prof. Kan Suzuki.* Retrieved from EDUPEDIA: https://edupedia.jp/article/594b79b43614bd000060aa70

The Mainichi. (2019). New written Japanese, math portions for college entrance exams postponed. *New written Japanese, math portions for college entrance exams postponed*.

The Ministry of Education, Culture, Sports, Science and Technology. (2015, 4 24). *The guideline of distant learning for high school education* . Retrieved from The Ministry of Education, Culture, Sports, Science and Technology Website:

https://www.mext.go.jp/a_menu/shotou/kaikaku/1358056.htm

The Ministry of Education, Culture, Sports, Science and Technology. (2018). *The techers' working environment survey.* Retrieved from Website for Ministry of Education, Culture, Sports, Science and Technology: https://www.mext.go.jp/component/a_menu/education/detail/__icsFiles/afieldfile/2018/09/27/1409224_004_3.pdf

The Public Affairs Division, Public Affairs and Communications, OECD. (2008). *Ten Steps to Equity in Education.* Paris: OECD.