Current Situation and Issues Related to ICT Utilization in Primary and Secondary Education

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The development of information and communications technology (ICT) has brought about significant changes in society. As society changes, education must also change. Since the 1980s, Japan's government has been promoting the use of information technology in education. In particular, policies related to ICT in education have been accelerating since the Liberal Democratic Party (LDP) regained control from the Democratic Party in 2012. Fujitsu has participated in the government's demonstration projects and has been providing and gathering technologies and know-how aimed at making innovative use of ICT in education and learning. There are still many issues that need to be resolved regarding the use of ICT in education, including safeguarding personal data, protecting copyrights, and alleviating the cost burden. Fujitsu is using its technologies and know-how to help revolutionize education by working with teachers and administrators to resolve these issues one at a time and to create new learning concepts. This paper describes the government's policy for the introduction of ICT in education and the efforts that Fujitsu is making in this regard.

1. Introduction

Modern society has changed significantly due to the development of information and communications technology (ICT). For example, the way we work today is different from the way we worked before the spread of the Internet and e-mail during the 1990s. It is likely that further developments in ICT will continue to accelerate changes in society in the future.[1)]

As society changes, today's children may end up working in professions that do not yet exist. As new professions arise, many existing professions will change or even disappear.[2)] A survey has shown that Internet technology creates 2.6 new jobs for every traditional job that it makes obsolete.[3)]

Children are thus growing up in a society where changes happen very quickly and will have to learn how to instigate such changes themselves. The leaders of change must be diversely talented and creative. How can this sort of talent be cultivated? Perhaps we will have to use ICT to bring about a revolution in education in the same way as in society.

In this paper, we present an overview of previous government initiatives to promote the use of ICT in education, and we discuss the trends of future policies. We also introduce the efforts being made by Fujitsu in this regard.

2. Previous government initiatives

The importance of introducing ICT into education was first pointed out in June 1985 in the first report of the National Council on Educational Reform, which was set up by the second Nakasone cabinet. Since then, it has been promoted in accordance with national government strategies related to telecommunications, such as the "e-Japan Strategy."[4)]

In April 2011, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) published "The Vision for ICT in Education." It was aimed at providing Japan's children with the basic skills needed to create the world of the 21st century amid international competition and called for efforts to be made in the building of schools and learning environments suitable for the 21st century. The objectives were to promote both mass classroom learning (multiple students taught at the same time), individualized learning (tailored to the abilities and characteristics of each individual child),

and collaborative learning (where children teach each other cooperatively). This can be achieved by such methods as[4)]

1) Information education (cultivating children's information literacy)
2) Utilization of ICT in course instruction (developing digital textbooks and teaching materials, providing a computer terminal for each child, setting up network environments such as wireless LANs, etc.)
3) Introduction of ICT for school administrative work

As specific approaches for implementing these activities, the government carried out teaching trials using ICT environments equipped with tablet PCs, electronic blackboards, wireless LANs and the like, in partnership with MEXT and the Ministry of Internal Affairs and Communications(MIC). MEXT was primarily concerned with software, and verified the effectiveness and impact of ICT with regard to teaching methods, the development of digital textbooks and teaching materials, and the teaching of regular subjects. Meanwhile, MIC was primarily concerned with hardware and verified the technical criteria for the construction, operation, and use of ICT environments. Both ministries conducted trials at a total of 20 demonstration schools throughout Japan (10 primary schools, 8 junior high schools, and 2 schools for special needs education) in two separate programs: the "Learning Innovation Project" (MEXT, 2011–2013 academic years), and the "Future School Project" (MIC, 2010–2013 academic years). These trials produced three results in particular.[5)]

1) Stimulation of children's communication and improvement in their motivation to learn
2) Improved leadership of ICT utilization among teachers
3) Promotion of local government initiatives referencing the guidelines drawn up for this project (in Arakawa city, Osaka city, Saga prefecture, and Nagasaki prefecture)

3. Future policy trends

In the second Abe Cabinet, which came about when the Democratic Party was ousted by the Liberal Democratic Party (LDP) in 2012, education reform was chosen as the most important issue along with economic recovery, and the introduction of ICT into education was identified as a key part of this reform.

First, the LDP's achievements are summarized below.

In April 2013, the LDP's education reform executive headquarters drew up recommendations for the cultivation of human resources capable of playing an active role in global developments. These included proposals such as providing every student with a tablet PC and called for the development of advanced education systems to be implemented in roughly 100 regional centers by 2015.[6)] Furthermore, in the LDP's parliamentary group for the promotion of ICT in education, a resolution was passed relating to the use of ICT in education, and it was asserted that the government and people should unite to strengthen their efforts.[7)]

In June 2013, there were four cabinet resolutions associated with the introduction of ICT in education: Japan Revitalization Strategy ("Japan is Back"),[8)] Declaration to be the World's Most Advanced IT Nation,[9)] Basic Policies for Economic and Fiscal Management and Reform,[10)] and the "Second Basic Plan for the Promotion of Education".[11)] The introduction of information technology in education was mentioned in each of these resolutions. These resolutions are summarized in **Table 1**. The government's aim is to introduce ICT into school education during the 2010s and to build a teaching and learning environment that connects seamlessly between homes and schools. They are also calling for innovative teaching methods, such as collaborative and interactive systems to be implemented through improved teaching methods and systems based on the active use of ICT.

As described above, the policy of introducing ICT into education is gaining momentum. However, the autumn review of government business (November 2013) questioned the verification of benefits from previous initiatives and the investigation of procedures and timing for nationwide deployment and called for more effective and concrete measures to be implemented in the annual budget for FY 2014.[12)] In addition to presenting a major course of action and accelerating the implementation of policies, it also demanded the implementation of practical, cost-effective policies.

4. Policies of related ministries

The FY 2014 annual budget passed by the cabinet in December 2013 was drawn up to put these government policies into practice. MIC was allocated ¥620

Table 1
Overview of government policy on information technology(IT) in education adopted by Cabinet in June 2013.

Title (Common name in parentheses)	Summary
Japan Revitalization Strategy : Japan is Back	Cultivate and secure a supply of high-level IT personnel as a source of industrial competitiveness • Acquire 21st century skills using IT • Organize and promote measures for full-scale deployment of education with one terminal per child before the end of the 2010s • Promote efforts to improve the development of digital teaching materials and the leadership potential of educational staff • Promote new learning support innovations such as interactive education and global-scale remote education • Develop an ongoing program to give personnel practical IT skills with the cooperation of industry, government, and academia in FY 2014.
Declaration to be the World's Most Advanced IT Nation	Use information technology for school facilities • Improve the academic skills and IT literacy of children and others by promoting IT in education from the primary education stage to the education environment itself, including high-speed broadband connections to schools, distribution of one information terminal per child, development of wireless LAN environments and electronic blackboards, and the use of digital textbooks and teaching materials • Build an IT user guidance model, and improve the use of IT leadership • During the 2010s, IT education environments will be realized in all elementary schools, junior high schools, high schools, and special needs schools, and a teaching and learning environment will be built to provide seamless connections between home and school.
Basic Policies for Economic and Fiscal Management and Reform	Rebuild education • Cultivate skills for a robust society, such as the teaching of English, numeracy, ICT, and morals • Strengthen special needs education
Second Basic Plan for the Promotion of Education	Promote new ways of learning through the use of ICT, through • Promote cooperative and interactive teaching innovations through improvement of teaching methods and leadership systems through the active use of ICT and the like • Promote the provision of ICT environments in schools by local public bodies through the widespread dissemination of experimental research results

million for the use of ICT in education, and MEXT was allocated ¥442 million for the promotion of learning using ICT.[13), 14)]

4.1 Policies of MIC

In a broad breakdown of the budget for MIC, ¥550 million was earmarked for the demonstration of an advanced education system. To promote the nationwide deployment of ICT in education, this project provides a technical standard for a leading-edge low-cost deployment model that can be used from diverse terminals. This project aims to keep the cost of introducing ICT down to a level at which it is possible for this technology to spread. There have also been discussions about the provision of a platform for the implementation of a teaching and learning cloud environment that connects seamlessly to schools and homes at the same time to facilitate innovative learning methods.[13)] For the implementation of an advanced model, verification trials are being conducted in cooperation with MEXT at approximately 12 schools in three regions over a three-year period. One of the main features of this project is its use of cloud technology, enabling the model to be accessed cooperatively via diverse terminals at home and at school.

1) Cloud computing

It is important to use cloud computing in order to achieve widespread use of ICT in education. The provision of services from the cloud eliminates the time and money that has hitherto had to be spent installing and operating servers in schools. The cloud also makes it easy to access the system from outside the school premises. This makes it possible for people to access services from home.

2) Cooperation between homes and schools

Learning in schools can be aided by learning support in homes and communities, which could help to provide children with more well-rounded learning

opportunities.[4] Cooperation between schools and homes is also an important element of "flipped learning," which started to spread widely in the US around 2009–2010. The idea of flipped learning is that students receive tutoring at home and spend their school time doing applied learning that would normally have been given as homework. It is attracting attention as a new style of learning for which the efficacy has been backed up by studies conducted in the US.[2]

3) Accessibility from diverse terminals

Making systems and services available for use on any device running any OS enables them to be purchased in a more competitive market. In a healthy competitive market, as soon as prices have dropped to a reasonable level, users are able to choose from a wider range of terminals and operating systems and are able to choose different systems and services. This free choice promotes innovation by providing incentives for the development and provision of new products by communication terminal manufacturers and service providers. In the future, it may even be possible to reduce public expenditure related to device procurement by implementing a "Bring Your Own Device" (BYOD) service model where students bring their own devices to school. However, there are many issues related to the operational and system design aspects of BYOD services, such as reducing the burdens imposed on households.

4.2 Policies of MEXT

With a view to constructing an advanced education system (budget: ¥122 million), the MEXT project is studying education systems in partnership with the MIC project. The project for the promotion of education using ICT (budget: ¥288 million) also includes plans to clarify the effects of ICT on education, improve the level of ICT leadership among teachers, and standardize digital materials.[14]

Through these efforts, by clarifying the effects of ICT, making use of digital teaching materials, and cooperating with businesses, MEXT is pushing forward with new forms of learning that adapt to the ICT environments provided by education committees and to the ICT usage leadership abilities of teachers. MEXT is also promoting innovation in education to ensure the cultivation of academic ability.

In parallel with the above mentioned advanced experimental initiatives, MEXT is raising the use of tax revenue allocated to local governments as a step towards achieving nationwide deployment. For the 2014 fiscal year, ¥167.8 billion has been budgeted for measures to promote the use of ICT in education. However, until FY 2013, not enough of the revenue allocated to local governments had been set aside for introducing ICT into education. As mentioned above, some local governments are implementing independent initiatives with reference to the guidelines for the Innovation in Learning and Future School Project programs. However, some regions are more active than others. According to a MEXT survey of ICT leadership among teachers, the percentage of teachers who received ICT leadership training during 2012–13 ranged from as high as 98.2% in some regions to as little as 9.0% in others.[15] Depending on the policies of each regional government, the state of involvement in these initiatives can vary widely. For these measures to continue spreading, it is essential that many local governments implement active measures based on the results of verification initiatives, such as promoting budget allocations that ensure the availability of tax revenues allocated to local governments, providing terminals, electronic blackboards, and environmental facilities such as wireless LANs, deploying ICT support staff, and providing learning software.

5. Fujitsu's efforts

Fujitsu is participating in the Future School Project (MIC) and the Innovation in Learning Project (MEXT) and is involved in such activities as supporting the construction, use, and operation of ICT environments, extraction of issues to be addressed, and verification work.[16] We are also cooperating with the Japan Association for Promotion of Educational Technology, which is doing research for MIC on the use of state-of-the-art ICT in education.[17] Through these efforts, Fujitsu is using its technology to contribute to the introduction of ICT in education and is accumulating useful know-how and knowledge in this field.

We have also been conducting joint research with the Nara University of Education on an ICT-based teacher training curriculum development project. At primary and junior high schools affiliated with the university, tablet devices, software, and other resources provided by Fujitsu are being used with the aim of

collecting application examples, identifying points requiring improvement, and contributing to the improvement in ICT leadership among teachers through the training and cultivation of teachers with advanced ICT skills.[18)]

Through school demonstrations and the like, we have found that ICT is an effective tool for[19)]

- Training
- Thinking (investigation, trial-and-error)
- Expressing
- Sharing (comparing)
- Archiving (storing)

Innovation in education and learning varies depending on how ICT is used as a tool for these purposes. When bringing ICT into the conventional learning model, the effect is not sufficient because of treating ICT merely as a replacement for paper and pencil. Instead, we should aim for new forms of education and learning that have not been possible in the past but can now be implemented through the use of ICT.

Borderless teaching is another possibility offered by ICT in education. We should be using ICT to eliminate the constraints of curriculum and age and remove the walls of the classroom so that people can learn in accordance with their own desires and passions in order to create education and learning methods that offer unlimited possibilities.[20)] In this education model, the desires and passions of learners are formed by intrinsic motivation rather than extrinsic motivation. With learning and teaching methods that harmonize well with the intelligence and aptitude of each child, it should be possible to instill a sense of self-efficacy and create voluntary motivation.[21)] With ICT, it is possible to offer education that is personalized for each child, changing conventional education based on simultaneous learning into diverse learning adapted to each individual.

Using ICT to store and analyze learning records makes it possible to ascertain the learning situation of each child and provide detailed guidance tailored to the child's understanding and pace of learning. Using ICT also facilitates the preparation of evaluation materials and the like.[22)] However, there are still many issues to be addressed in the introduction of ICT into education. The use of ICT in education is still at the demonstration stage. For it to become widespread, it is necessary to accumulate further knowledge and expertise. It is also necessary to address needs related to terminal equipment, such as batteries that last longer and can be recharged faster, and to establish stable, optimal authentication methods for wireless LAN networks and the like. The protection of personal information and copyrights must also be ensured. At Fujitsu, we will continue using our skills and know-how to help resolve issues in education one at a time.

6. Conclusion

We described the current situation and challenges related to ICT use in primary and secondary education. We believe that under the government's policy of promoting ICT in education, we will eventually see full-scale deployment after the current demonstration phase. Fujitsu will continue to participate in the investigation, creation, and testing of new learning concepts in the educational field.

References

1) Lynda Gratton: The Shift: The Future of Work Is Already Here, HarperCollins Publisher (2011).
2) Yuhei Yamauchi: The Classroom after 10 Years, first edition. Nikkei BP, Tokyo, 2013 (in Japanese).
3) Matthieu Pélissié du Rausas et al.: Internet matters: The Net's sweeping impact on growth, jobs, and prosperity. McKinsey Global Institute, 2011. *http://www.mckinsey.com/insights/high_tech_telecoms_internet/internet_matters*
4) Ministry of Education, Culture, Sports, Science and Technology: An IT vision of education, 2011 (in Japanese). *http://www.mext.go.jp/b_menu/houdou/23/04/__icsFiles/afieldfile/2011/04/28/1305484_01_1.pdf*
5) Ministry of Internal Affairs and Communications: Guidelines for promoting ICT use in education (handbook), 2013 (in Japanese). *http://www.soumu.go.jp/main_content/000218507.pdf*
6) Liberal Democratic Party Headquarters for Revitalizing Education: Global Human Resource Development Committee recommendations that contribute to the growth strategy, 2013 (in Japanese). *https://www.jimin.jp/policy/policy_topics/pdf/pdf112_1.pdf*
7) Liberal Democratic Parliamentary Group for the Promotion of Information Technology in Education: Resolution on the introduction of ICT into education, 2013 (in Japanese). *http://www.furuya-keiji.jp/blog/wp-content/uploads/2013/05/決議案.pdf*
8) Japan Economic Recovery Headquarters: Japan is Back:

A strategy for the revitalization of Japan, 2013 (in Japanese).
http://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/saikou_jpn.pdf

9) IT Strategic Headquarters: Manifesto for the Creation of a World-Leading IT Country, 2013 (in Japanese).
http://www.kantei.go.jp/jp/singi/it2/kettei/pdf/20130614/siryou1.pdf
10) Council on Economic and Fiscal Policy: Basic Policy for Economic and Fiscal Administration and Reform –Economic growth and an end to deflation, 2013 (in Japanese).
http://www.kantei.go.jp/jp/kakugikettei/2013/__icsFiles/afieldfile/2013/06/20/20130614-05.pdf
11) Ministry of Education, Culture, Sports, Science and Technology: Second Stage Basic Plan for Education Promotion, 2013 (in Japanese).
http://www.mext.go.jp/a_menu/keikaku/detail/__icsFiles/afieldfile/2013/06/14/1336379_02_1.pdf
12) Council for administrative reform (Autumn review): Promotion of ICT usage in teaching and learning, 2013 (in Japanese).
http://www.cas.go.jp/jp/seisaku/gyoukaku/h25_fall/pdf/kekka(kyouiku).pdf
13) Ministry of Internal Affairs and Communications: Draft budget summary for FY 2014. 2013 (in Japanese).
http://www.soumu.go.jp/main_content/000266451.pdf
14) MEXT Lifelong Learning Policy Bureau: Description of FY 2014 budget (draft), 2014 (in Japanese).
http://www.mext.go.jp/component/b_menu/other/__icsFiles/afieldfile/2014/01/09/1343218_13_1.pdf
15) MEXT Lifelong Learning Policy Bureau, Information Education Department: FY 2012 survey on the state of information technology use in school education (educational ICT usage leadership), 2013 (in Japanese).
http://www.mext.go.jp/a_menu/shotou/zyouhou/1339524.htm
16) Y. Sato: The effects of ICT on communication in education. FRI Consulting Forefront. Vol. 6, pp. 61–67 (2014) (in Japanese).
http://jp.fujitsu.com/group/fri/downloads/service/case/rep_vol6/rep10.pdf
17) Ministry of Internal Affairs and Communications: Choosing contractor partners for a survey study of leading-edge ICT utilization in the education field, FY 2013 (in Japanese).
http://www.soumu.go.jp/menu_news/s-news/01ryutsu05_02000038.html
18) Nara University of Education: Agreement with Fujitsu Ltd. regarding Curriculum Development for Teacher Training using a Tablet PC, 2013 (in Japanese).
http://www.nara-edu.ac.jp/nakki/blog/2013/08/tablet_pc.html
19) Y. Muramatsu: Current status and issues of ICT environments that support education—from a case study at a trial school using one terminal per student. Workshop 1, 37th National Convention of the Japanese Society for Information and Systems in Education, 2012 (in Japanese).
20) M. Umeda et al.: Learning on the Web—The knowledge revolution in open picture learning, first edition. Chikuma Shobo, Tokyo, 2010 (in Japanese).
21) C. Christensen et al.: Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns. McGraw-Hill, 2008.
22) Ashiro Primary School, Higashi-Miyoshi town, Tokushima prefecture: The future school miracle at Ashiro primary school, first edition. Kyoikudojinsha, 2013 (in Japanese).

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