Development of Educational Technology
Contributing to Educational Reform

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This paper summarises research trends of the 10 years following the establishment of JET and the Seven Article Declaration on Educational Technology from the 10th Anniversary JET Annual Conference. It goes on to describe the meaning of information in society, the change of the dominant communication methods from receiving to sending in learning, the need for citizens with creative capabilities, and the forms of information literacy required for living in an advanced information communication society. In this context, the paper demonstrates how the progress of educational computing and multimedia use in Japanese schools has been effectively supported by governmental policies. Finally, strategies for developing multimedia personnel and the significance of information technology are discussed.

Key words: educational technology, multimedia, computer, educational policy, informatics education

1. EDUCATIONAL TECHNOLOGY OF TODAY

1.1 Ten Year History of the Japanese Society for Educational Technology

The Japan Society for Educational Technology (JET) held its Tenth Annual Conference in 1994. The tenth conference was held as a national joint convention of the Association of Educational Technology Societies (AETS). If we compare this conference with the first joint one, held in 1985, there clearly has been remarkable progress made in the past decade. In 1985, a 372-page volume of proceedings was published, a single panel discussion was held and three themes were addressed through 18 presentations. The level of activity was far greater in 1994, with a two volume set of proceedings totaling 1,111 pages, two symposia, three autonomous symposia, two forums, ten presentations in English, and eight themes addressed through 107 presentations. The number of general papers increased from 149 to 311. There was a significant change in the nature of the themes as well. The theme of the 1985 panel discussion, “Educational method in information age,” was oriented towards teaching, whereas the themes in the 1994 discussions were “How can educational technology contribute to the new scholastic ability viewpoint” and “The learning environment in the information age.” These clearly were oriented towards learning. Although the three themes from 1985, teacher education, software development, and informatics education, were also included in 1994, the basic approach and treatment of these themes had changed substantially. Teacher education was treated in relation to the new scholastic ability viewpoint, software development expanded to media and multimedia, and informatics education focused on the scholastic ability to be engendered. In addition to these themes, the participants of the conference explored a number of very difficult themes intended to be instrumental in solving such profound practical problems as, the establishment of interactive learning environments and other types of learning environments, a system for facilitating natural language education, and methods for the evaluation of interest, motivation, and attitudes.
1.2 Seven-Article Declaration of Educational Technology

The JET's (Japan Society for Educational Technology) Tenth Annual Conference held in Gifu University coincided with the Fourth National Convention of the AETS (Association of Educational Technology Societies), a gathering of some of the most prominent organizations involved in educational technology, including the CAI society (currently Japanese Society for Information and Systems in Education), the newly consolidated Japan Association for the Study of Audiovisual and Broadcast Education, the Association of National University Education Practice Research Centers, the Technical Committee for Educational Technology Research of the Institute of Electronics, Information and Communication Engineers. As mentioned, research results on a wide variety of themes including media utilization, computer utilization, informatics education, classwork study, and teacher education were reported and enthusiastically discussed. The central subjects were educational reform under the new scholastic ability viewpoint and utilization of multimedia. The following "Seven-Article Declaration of Educational Technology" was adopted unanimously at the general meeting of the conference.

Seven-Article Declaration of Educational Technology Resolution made at the general meeting at the Tenth Annual JET Conference (Japan Society for Educational Technology), October 8, 1994.
1. We promote basic studies to improve human learning activities.
2. We promote the development of curricula and studies on teaching methods based on the new scholastic ability viewpoint.
3. We actively pursue the improvement of educational practices which utilize educational technology.
4. We promote informatics education oriented towards the future.
5. We promote the development of advanced information technology and research on its utilization for education.
6. We encourage research and development to help implement governmental policies promoting utilization of information technology in the educational field.
7. We promote international exchange and electronic dissemination of its results throughout the world.

Following are brief explanations of the above articles:
1. We promote basic studies to improve human learning activities.

This article refers to our intent to promote basic studies conducted by JET and related societies to improve the human learning process, learning-assistance methods, and communication activities.
2. We promote the development of curricula and studies on teaching methods based on the new scholastic ability viewpoint.

In this article, we declare that we develop systematic and cross-sectional curricula based on the new scholastic ability viewpoint and improve teaching methods based on them. This takes the next Standard Course of Study into consideration.
3. We actively pursue the improvement of educational practices which utilize educational technology.

Here we declare that we enhance educational practices by effectively taking advantage of the results of research and development for educational reform in areas of educational technology related to teaching techniques, classwork design, lesson procedures, methods of development of teaching materials, composition and utilization of media, learning-aids, and evaluation methods.
4. We promote informatics education oriented towards the future.

This refers to our intent to develop informatics education curricula for common education programs for primary, middle, and high school, and university, and to establish this new curricula as the core of the general science and technology education in the next
5. We promote the development of advanced information technology and research on its utilization for education. This refers to our intention to promote research on adequate utilization of advanced information technologies in human communication, networks, and multimedia in the field of education. We endeavour to disseminate the technology, taking sufficient care not to overly disturb the field of education.

6. We encourage research and development to help implement governmental policies promoting utilization of information technology in the educational field. This refers to our intent to cooperate in the enforcement of governmental policies promoting educational technology and utilization of information technology for education. We also wish to promote research and development to provide guidance to administration aimed at the improvement of education.

7. We promote international exchange and electronic dissemination of results throughout the world. This refers to our intent to promote international exchange through academic writing, international conferences, training, networks, and so forth, and transmitting the results internationally.

In establishing the foregoing articles as our most important resolutions, we resolved to adequately utilize a variety of research subsidies; to increase our membership from academic societies, educational circles and industrial circles; and to devote ourselves to research and development contributing to Japanese educational reform.

There has been steady progress in research and development in each subject. As society adopts more advanced forms of information and communication, the most rapidly progressing domains of educational technology have been informatics education, educational use of advanced information technology, and cooperation with governmental policy on the educational use of information technology.

2. THE ADVENT OF AN ADVANCED INFORMATION COMMUNICATION SOCIETY

2.1 Advanced Information Communication Society

Today's society is said to have entered into the age of a new social revolution, i.e., an "information revolution" comparable in scale to the civil revolution and industrial revolution. The "Basic policy for the promotion of the advanced information communication society," an article issued by the Headquarters for the Promotion of the Advanced Information and Communication Society, an organization headed by the prime minister, defines today's society as "a society based on a new socioeconomic system that realizes the unrestricted creation, distribution, and sharing of information and knowledge produced from human intellectual activity; and that harmonizes the life, culture, industry, economy, nature, and environment as a whole." Education is naturally geared into this system.

2.2 The Meaning of Information in Social Life

The advent of the advanced information communication society, a historical phenomenon propelled by scientific and technological progress, will engender a radical change in the course of our civilization's development in the coming years. Specifically, the form of information exchange linking people will be reversed. As words provide the basis for the exchange of information, they are of vital importance for life in human society. Words convey the outbreak of danger, lessons, the art of living, and so forth. In addition, words, of course, are essential means for thinking. In many cases, information flows from those who know something or who have authority, to those who do not. Even after written language was invented and recorded on stone or bamboo, the contents were mostly accounts of the lives of great people or the lessons they left for posterity. The receiver of the information mostly read and interpreted the meaning of the written words. The communication in words imparted in the Analects of Confucius, Scriptures, stories, songs, and proverbs were a truly effective
means to convey knowledge and authority. People interpreted the meanings of texts, mulled over them, and dispersed them through education. With the birth of the printing machine, written materials were mass produced, and the content of written texts became more closely associated with authority and knowledge. Even today, an author is viewed as an authority in possession of intellectual content to impart to others.

Conversely, those commonly regarded as ordinary people read the information as "receivers" or learners and utilized it in their lives. Opportunities for ordinary people to send written information outward was through correspondence or diaries, and before literacy education prevailed, even these forms of writing were the privilege of only the educated. Today still, people primarily learn of the world and its wisdom from the media such as books, newspapers, or magazines.

In the age of radio, the message senders were men of wisdom and authority, and it was an important task for ordinary people as learners to take in information conducive to their own lives. In the age of television as well, the participation of ordinary people was infrequent in the earlier stages of the medium, and appearance on the media represented authority. This inclination still persists: to appear in some types of programs evokes an impression of authority. The same thing applies to movies, but since very few people have the resources to create a movie, the authority is much larger. Ordinary people, again, are just observers, and merely watch the movies and feel the meaning of life. In conventional distance education, learners were just receivers who read and understood the information sent from media such as books, radio, or TV. If they were in a position to send information, it was a compulsory report at best.

Recently, however, a great change has emerged in the world of the ordinary people who have been used to merely receiving and reading images and spoken and written words as expressions of authority.

2.3 Information Receivers Turn into Information Senders

New tools for expression such as cameras, VCRs, word processors, and computers have appeared and spread. As a result, the world restricted to receiving information has now evolved into a world encompassing capabilities to send information. Ordinary people can easily transmit words, voice, sound, still images, and moving video images. Today, business people habitually create and transmit information with multimedia tools and word processors, and little children can draw pictures on their computers that win competitions in contests with middle school students or older competitors. In one instance, a first-grader in primary school created a multimedia work, recorded it on a floppy disc, entered a contest, and won the Minister of Education's prize. There is even a boy now in primary school who makes "multimedia poems."

Originally, when people drew pictures, sang songs, and played musical instruments, they were transmitting messages in the same way that they communicated spoken words. Often, it was a process which required considerable time and effort.

With a computer, however, people can draw pictures or compose music easily. Moreover, the works they create can be modified or duplicated at any time, and mistakes can be instantly undone with the click of a mouse. Real painting or music scores are difficult to erase, so it's hard to realize a drastic new idea.

Also with the prevalence of word processors, an "information-sending" society is rapidly approaching. In the past, ordinary individuals could only express information to those close by. Today, if a school is linked to a network, one individual can disseminate a message all over the world. In this way, written media as a source of information expanded to multimedia. We can selectively receive information from media through reliable databases, and now we can send multimedia information. In a sense, we are in the midst of a great turn in the history of civilization.

In the 21st century, selection, understanding, utilization, creation and transmission of information using multimedia will become quite natural. The transmission of information media integrating characters, images, videos, voices and sounds over networks will be as commonplace as the telephone today. Although text information will continue to
play the most important role in communication of multimedia information, the reading of written texts alone will be insufficient. Communication with graphics, pictures, photographs, tables, and moving video will be quite important both in learning environments and everyday life.

Therefore, the learners in the coming advanced information communication society will have to possess not only the skills of reading, writing and understanding information through media such as radio or TV, but also the skills to retrieve and utilize multimedia information, and to create and transmit multimedia work by themselves.

What we must bear in mind is that in receiving information from media, we must not allow ourselves to be misled by excessive amounts of information. We need to be equipped with the ability to distinguish and identify genuine information, as well as the ability to identify biased information and maintain a grasp of actual realities without relying too much on the mediated representations of realities imparted in the form of information. Also, we have to choose real information by ourselves. In sending information, we should not invade the privacy of other people. We should not use or create biased or erroneous information, and we must respect the intellectual property rights of information produced by others. To act responsibly, learners will need to truly understand the importance of information for life in society.

3. NEW TYPES OF PERSONNEL DESIRED IN MODERN SOCIETY

3.1 The Ideal Personnel Types

With the rapid changes in our society, the science, technology, knowledge, and skill obtained in school education will soon lag behind the actual levels of progress in the world. In order to catch up with the social change, particularly for actively constructing society, lifelong learning will be essential. In relation to this, a Subcommittee on Educational Contents in the Central Council for Education proposed the term “self-education ability” in its interim report (October, 1983). The elements of this ability include: study motivation, study method, and a spirit of inquiry into life. Since this, many schools have been actively researching how to stimulate the motivation and ability for self-education.

However, considerable challenges face children wishing to obtain an ability for self-education. They must set up a personalized target, select the educational content, establish a study process, and study and evaluate progress independently. Consequently, a review of one’s educational goals, content, and study process is essential, and improvements must be made if necessary. Additionally, since the study content must be constantly renewed, the self-study method is far beyond children’s control. Thus, in many cases, in the school educational stage, teachers prepare the educational goal or content while the order of study and study method are left to the pupil, and the pupil’s so called “self-learning ability” is thus cultivated.

Persons in the upcoming age will need to be competent in independently utilizing the outcomes of technology in modern society. It will become particularly important to equip students with the skill for the use of technology as an effective means for self-education or self-study.

Economic organizations are hoping that educational circles will turn out personnel well prepared for the new age. The special committee for education of The Japan Federation of Employers’ Association (Nikkeiren) proposed a report titled “University education and industry for the new age” (1995.4.24). At the beginning of this report, five desirable characteristics for people in the new age are defined:

1) persons of rich character and vision;
2) persons with originality and creativity;
3) persons with the ability to identify and solve problems;
4) persons who can adapt to globalization;
5) persons with the ability to lead others.

Another paper published by the Federation of Economic Organization (Keidanren, March, 1996) entitled “For the development of creative personnel-desired educational reform and business involvement” also suggests that “The ideal personnel for the future society of this country will be active, highly responsible, and creative.”

The Committee “Vision for the 21st century” of the Japan Teachers Union submitted
its final report on April 12, 1995. This report proposes a series of traits, not unlike those cited above, desirable in the children to inhabit the 21st century. They include:

- the ability to adapt to social changes in active and creative ways;
- the ability to live as a global citizen while fostering local and traditional culture;
- the ability to form new civil communities in cooperation with others while also preserving, if not fostering, the independence of the individuals living within those communities.

This aspect coincides with the direction that the Standard Course of Study stresses: development of the willingness to study by oneself and the ability to adapt to social change, perfection of teaching of basic contents, enrichment of education for cultivating ones' individuality. It also corresponds to the aspects of the Students' Record of Scholastic Attainment, which place great emphasis on:

- interest, willingness, and a positive attitude toward subjects;
- ability of logical thinking and judgement; and
- self-expression.

Above all, it values the ability to actively build up modern society. This new direction is a reflection of what is now expected of Japanese Industry. After straining itself to catch up with the advanced nations of the west in scientific and technological development, it is now expected, at the advent of the new century, to contribute more actively to the world through leadership and originality.

Passive groups of personnel engaged simply in processing the orders passed down from superiors have proven ill-equipped to adapt to the upheaval of advanced information society and will be unable to actively construct society. Thus, Japan, a country resolutely working to became one of the world's scientific and academic leaders in the 21st century, will have to revise its models for ideal personnel types, and to strenuously cultivate ideal new personnel.

3.2 Six Qualifications Required for Information-Oriented Persons

Faced with the advanced information communication society, the next generation, the executors of society in the 21st century, will need to equip themselves with the following six qualifications in order to positively utilize, create, and transmit information:

1. Information literacy;
2. full awareness of the value of information;
3. an information-oriented sensitivity;
4. respect for the information ethics;
5. mastery of information skills; and
6. an ability to participate in an information network.

"Information literacy" means an understanding of the mechanism, role and theory of information technology.

"Awareness of the value of information" means a recognition of the importance of information, as well as the adverse effects it precipitates in daily life. An awareness and understanding of both the bright and dark sides of information, as well as an ability to discriminate the authenticity of information, will be essential.

To have an "information-oriented sensitivity" means to have rich appreciation of truth, virtue and beauty; namely to appreciate and feel the delicacy and complexity of certain types of information such as, for instance, the beauty of flowers, the preciousness of humanity, and the glory of love.

With a respect for the "information ethics," one will refrain from making ill use of information technology. This entails respect for intellectual property rights and the privacy of others, and a refusal to disseminate bogus or biased information which is potentially confusing to society; in other words, the establishment of a morality.

Mastery of "information skills" is the skill to use information technology.

Participation in an "information network" involves the exchange information and assistance and cooperation with many people through information networks in business and in everyday life.

An information-oriented person in the future has to be equipped with, not only the skills to use a computer alone, but also a good balance of above six qualifications.

4. EDUCATIONAL COMPUTING IN JAPAN

4.1 The History of Educational Computing in Japan Started around 1985

The move was initiated by the Subcommittee of Educational Broadcasting of Social Education Council (SEC). In March 1984,
the subcommittee published the “Standard Teacher Training Curriculum for the Educational Use of Microcomputers,” and in 1985, it incorporated this curriculum in its “The Report on the Use of Microcomputers in Education.” These reports marked the first efforts to publicize the basic policy for the use of computers in general school education and in social education as educational administration. Subsequently, the subcommittee (later called the “Subcommittee of Educational Media within the SEC,” and then, the “Subcommittee of Educational Media in the Subcommittee Social Education within the Lifelong Learning Council”) published four additional reports in succession: “The Report on the Guidelines for Developing Educational Software,” “Lifelong Learning and New Media,” “The Standard In-service Teacher Training Curriculum on Audio-visual Educational Media,” and “The Report on Audio-visual Education Using New Educational Media.” The subcommittee has always played a leading role in the field of “informatization” of education. Concurrently the National Council on Educational Reform was established in 1984. The Council’s first report, published in April 1985, pointed out that coping with the information society was one of the eight most important goals of the nation’s educational reform. In a second report published in April 1986, the Council expressed three principles for informatization and the need to cultivate the ability to utilize information. In its third report, published in April 1987, the Council introduced the concept of the “intelligent school,” and in its final report, published in August of the same year, it emphasized that informatization and internationalization were the most important tasks facing education. One of the most important and urgent tasks presented in the most recent report, a task which has been receiving an increasing amount of attention, is how to cope with the informatization. This has significant meaning.

The second report defines the following three principles for informatization:

1. to promote with alacrity the cultivation of information literacy;
2. to utilize the potential of information technology in all educational institutions; and
3. to reduce the negative effects of informa-

tion and increase its benefits (shadow and light).

These principles with the term information literacy, have had a great deal of influence on the development of educational informatics. Information literacy is defined as fundamental qualification of individuals to select and utilize information and informational media.

The Task Force on Elementary and Secondary School in the Information Society (Task Force) has also supported development of educational informatics in Japan. In its first report, published in August 1985, The Task Force introduced the following basic policies:

—In primary schools, basically familiarize students with computers through their use as tools.

—In middle school, help students acquire computer awareness and literacy by making more frequent use of computer capabilities such as simulation and information retrieval. In the future, study the introduction of informatics as part of related subjects in the curricula as the need arises.

—In high school, for the time being, give special consideration to the progress of the information society and to the effects of computers on individuals and society in lessons on related subjects. In the future, study the establishment of an independent optional subject dealing with informatics.

The Curriculum Council reiterated the importance of educational informatics in a report published in December 1987, entitled “On the Improvement of Curriculum in Kindergarten, Primary, Middle and High School (Reply).”

In an earlier report on discussions in November 1987, the Council pointed out that: ‘Future school education needs to place an emphasis on cultivating students’ motivation to learn and their ability to cope with changes of society as a basis for life-long education. In light of this, the basic objectives of school education should be to equip students with abilities of thinking, judgment, and expression by adequately developing their knowledge and skills in accordance with their development stage. While emphasizing their capacities for logical thinking, imagination, and intuition, those faculties that contribute to the creation of new ideas, we need to make marked efforts to cultivate their fundamental abilities to cope with progress in science and
technology and the development of informatization. Also, in view of establishing the basis for life-long learning, we need to equip them with the motivation to set their own goals and decide what and how to study on their own.”

The underlined portion was not included in the Council’s interim report in October 1986. During the year the importance of measures to cope with informatization must be strongly recognized.

Then, a few months later, the Council cited in its December 1987 report the need “to consider education for informatics literacy according to the development stage of students.” This had become a basic policy in the present Course of Study, and the Course of Study published in March 1989 stressed computer education and educational use of computers. In publishing its Course of Study, the Council also took into consideration the Task Force’s report on information literacy. According to the report, information literacy is divided into four elements:

1. Cultivation of abilities for judgment, selection, arrangement, and processing of information, as well as abilities for creation and communication of new information;
2. Understanding of the characteristics of informatization and the effects of informatization on society and people;
3. Knowledge of the importance of information and responsibility for information; and
4. Understanding of fundamentals of information science and the characteristics of information tools (especially computers), and development of operating skills.

The report takes the viewpoint that it will be necessary to cultivate not only the operating skills, but also fundamental competence necessary for judging, selecting, processing, creating, and transmitting new computer information; as well as the ability to understand the importance of information for society, the importance of intellectual property rights, and responsibility for information.

This report has influenced the Course of Study, which emphasized educational computing. The Course of Study presented in March 1989 recommended the use of computers as tools for education in the following courses.

Middle School: Technology and Home Economics for “Fundamentals of Informatics”

High School: Home Economics for living skills, etc. of Mathematics “C”

In addition, the efficient use of computers in science courses in middle school and high school was recommended.

The various measures taken for promotion of educational computing have included:

- study on the use of computers in pilot schools;
- research and development of educational software;
- research and development of new educational equipment and educational methods (promoted for a five-year period from 1985);
- assistance in the use of necessary equipment;
- improvement of school facilities and study spaces; and
- the publication of “A guide to educational informatics” and “Practice examples.”

Today’s informatics education is not limited merely to teaching operating skills. In addition, it seeks to foster an understanding of the importance, meaning, responsibility and influence of information in society, as well as the abilities to judge, select, edit, process, create, and transmit information. Thus, content cultivating information literacy is mainly delivered in courses on the “fundamentals of informatics,” but is also incorporated in all other subjects to a certain degree as well. In the near future, more advanced subjects such as information science will be established even in general high school course curricula. Until this is implemented, it is hoped that advanced educational informatics is positively included in individual local curricula in many regions as subjects outside the standard Course of Study.

4.2 The New Scholastic Ability Viewpoint

In the Course of Study Article 1 in Chapter 1 general rule, general policy of curriculum development, it states that “To achieve favourable progress in educational activity in schools, teachers must endeavour to cultivate students’ motivation to study by themselves, as well as their ability to actively adapt to social change. At the same time teachers must thoroughly teach the basics and fundamentals of subject content and encourage
development of individuality.” On this basis, the Students' Record of Scholastic Attainment specifies “interest, motivation, attitude, the thinking abilities, judgment, self-expression, etc.” as the content of scholastic record of each subject. For instance, in Social Studies courses in middle school, it specifies “interest, motivation, and attitude toward social phenomenon; social thinking and judgment; skill of utilizing data; and expression, knowledge and understanding of social phenomena.” In Mathematics, it specifies “interest, motivation, and attitude toward Mathematics; mathematical thinking; mathematical expression and treatment; and knowledge and understanding of quantities and figures.” In Science, it specifies “interest, motivation, and attitude toward natural phenomenon; scientific thinking; skills and expression of observation and experimentation; and knowledge and understanding of natural phenomena.” According to the Students' Record of Scholastic Attainment, “social thinking and judgment” refer to the ability to find themes inherent in social phenomena, delve into them from various points of view, judge them objectively, and cope properly with attendant social change. “Mathematical expression and treatment” refer to mastery of mathematical expression, treatment of quantities and figures, and methods of inference. “Scientific thinking” refers to the ability to find themes inherent in natural objects and phenomena through observation and experiments, and to think positively, logically, analytically, and comprehensively to solve problems. “Skills and expression of observation and experimentation” refer to mastery of basic observation and experimentation, methods to scientifically research natural phenomena, and the proper expression of the process and results. “Scholastic ability” specified above appears to be the ability to actively study and tackle nature, and to conceive, judge, and express it.

4.3 Change of the Scholastic Ability Viewpoint

The antecedent of the above perspective is the assumption, stemming from cognitive science, that cognition takes on a constructivism-like aspect. Human cognition is not generated only from receiving information from the outside world; it is generated through the receiver's positive reconstruction of the meaning of the received information. This assumption differs markedly from the earlier view of behaviourism rooted in behavioural sciences. Specifically, it is the assumption that if an educational content is analyzed, sequenced, and taught in proper order, it is automatically learnt by the receiver. In many CAI systems, techniques for drill and practice and for tutorials were vigorously researched and developed. This was effective to some extent in promoting the mastery of basic knowledge and skill, which is something to note. But from a constructivist viewpoint, learners ideally need to independently act, think, judge, and express in order to deepen their learning. Just as the world has witnessed a veritable eruption of data, the new scholastic ability viewpoint was accepted in the educational world and computers were adopted as tools for self-expression, problem solving, the discovery of theories, and exploration of nature.

If computers, their peripheral devices, and networks are all in place, then multimedia can be introduced for education. As a tool for self-expression, a computer provides a vast scope of applications encompassing everything from document production with wordprocessing software, to creation of tables and graphs with spreadsheet software, drawing and design with graphics software, and composition with music software. A computer is also a helpful tool for PC network communication. As a tool for problem solving, it can be used for data retrieval from databases. As a tool for discovering rules, it can be used for drawing graphs of formulae, simulating natural laws and social phenomena so that the changes accompanying adjustments of parameters can be examined. As a tool for measuring natural phenomena, a computer can observe changes through sensors for temperature, humidity, air pressure, wind pressure, wind speed, wind direction and light. Such computer applications are contributing significantly to children’s education.

These years, such usage has been attracting attention. Many practical cases are introduced not only in “Samples and hints for the practical use of computers,” a booklet edited by the Education Informatics Research Group in the Ministry of Education, but also
in the report by the Information and Research Center for Educational Software on research assigned by the Ministry of Education, as well as the other study reports on the use of educational software. Also, educational research entrusted to the Japanese Association for the Promotion of Educational Technology by the Ministry of Education dealt with educational software manuals corresponding to the new scholastic ability viewpoint in each subject.

In the past, the scholastic abilities formed through computer experience were generally storage of knowledge and retrieval ability. Today, in addition to these, the application-oriented scholastic ability used for observing natural phenomena and performing experiments, and the creative scholastic abilities used for independently thinking, judging, expressing, and creating are also formed.

5. SMOOTHING THE WAY TO ENHANCE THE ENVIRONMENT FOR MULTIMEDIA EDUCATION

5.1 The First Year of Multimedia

1994 is regarded as the first year that multimedia spread into every corner. The Ministry of Posts and Telecommunications, the Ministry of International Trade and Industry (MITI), the Ministry of Education, Science, Sports and Culture and other ministries pursuing a multimedia environment, vied in establishing policies to promote multimedia. Industrial circles and mass media embraced the move to multimedia as a major issue and made a great fuss about it. Nevertheless, this movement did not directly set the course for the first year of multimedia education.

In today's multimedia, characters, charts, pictures, sounds and moving videos are treated as a unified system, exchanged as digital information over an information network, and, at each terminal they reach, searched, edited, created, and transmitted through interactive operation.

This form of multimedia has started to develop but does not yet abound everywhere. Most schools, for example, are only supplied with a limited number of telephone lines, multimedia-compliant computers, and peripheral devices, and the realization of such a high multimedia capacity is still regarded as a dream. It is equally certain that every step in the development of multimedia, is leading, ultimately, to the realization of this dream.

By 1995, ten years had already lapsed since the debut of educational computing in Japan. During that period, we saw tremendous progress in the spread and utilization of computers in the educational field.

As of March 31, 1996, the rate of the spread of computers into schools was 84.7% in primary schools, 99.7% in middle schools, and 100% in high schools. When these rates are compared with those from the first year of educational computing in 1985, i.e., 2.0%, 12.8%, and 81.1%, respectively, the progress in primary and middle schools is clearly remarkable.

Hardware appears to have spread steadily. In comparison with the 22 units per public primary school and 42 units per middle school specified in the New Educational Computer Extension Program, the achievement ratio is still only 17% in primary schools and 18.1% in middle schools and 43.5% in high schools. Moreover, around 35% of computers introduced in primary and middle schools throughout the country are still 8-bit or 16-bit machines, and in many cases even the 32-bit machines in use are not Windows-compliant. This hardware is already unable to support much of the excellent software for Windows. High schools, where computers were immediately introduced, have particularly serious limitations in hardware capacity: 40% of computers in high schools are 8-bit or 16-bit machines. Further, since 65 to 75% of these have been purchased, replacement remains still today a difficult prospect. Again, this underscores the need to further accelerate the introduction of computers to schools.

5.2 Coverage of Multimedia in Newspapers

The total number of articles appearing in the Asahi, Mainichi and Yomiuri newspapers covering personal computers or computers and education averaged about 200 per year from 1987 to 1990. In the next years, this figure then took a dramatic rise, climbing up to 366 in 1991, 431 in 1992, 495 in 1993, and 563 in 1994. The changes in these 4 or 5 years were remarkable.

In looking only at multimedia, the number of articles which covered both multimedia
and education until 1989 was very close to zero. Articles on topics in these areas first began to increase in about 1992, and climbed up to an annual total of 164 in 1994. This figure reiterates that 1994 truly was the first year of multimedia. Incidentally, the total was 157 in 1995. As for Internet and education, the first article to be published appeared as late as 1993, but the subsequent increase was rapid, with the total reaching 28 in 1994, and then jumping up to 146 in 1995. While multimedia-related articles are decreasing, the Internet is likely to attract increasing attention in the days to come. Over the same years, to my regret, only a small number of articles including the term "educational technology" were published, and the articles that did contain this term in most cases covered subjects like "the Society for Educational Technology," "the Educational Technology Center," and "Majors in educational technology." This term has not attracted attention of public at large.

5.3 Governmental Policies on Multimedia

We are gradually entering into an age where everyone has good command of computers and will be able to use them everywhere. Workstations, downsizing to personal computers, networking by personal computer communication, and multimedia represent the age. Soon, everyone will communicate with each other using computers in schools, offices, and the home. The use of computers has substantially propagated in offices recently, but they are still not found in some companies, and in some plants they are used only for shop floor operations. The level of computerization in administration, in public facilities, and in the planning and management departments in private enterprises still lags far behind that in advanced foreign countries.

With regard to this, in June 1993, the Subcommittee of Information Industry of Industrial Structure Council within MITI compiled an analysis of the current status of computerization and a proposal for its further promotion. In addition, in keeping with the NII in the US, MITI announced an "Advanced informatization program" in June 1994 in an attempt to join forces with other ministries to promote informatization in society at large. As for education, in implementing the program, MITI anticipates that: As multimedia's capacities for transmission of pictures, sounds, characters, etc., through networks increases, utilization of libraries and databases throughout the world, real-time observation of various phenomena in every part of the world, and joint learning with foreign schools will all become possible. The program is an attempt to proceed with concrete measures in conjunction with the Ministry of Education. The measures include:

- development of advanced software in the newly established Centers for the development and utilization of educational software;
- creation of database of software;
- provision of a technological network environment linking about 100 primary and secondary schools; and
- establishment of a multimedia-oriented human resource training center.

The Subcommittee of Educational Media of Social Education Division in the Lifelong Learning Council within the Ministry of Education initiated the promotion of multimedia education. In the second chapter of "The implementation of audio-visual education using new educational media," an article published in March 1992, the subcommittee proposed the themes of educational use of multimedia and its propagation. The educational characteristics of multimedia were enumerated in the chapter as follows:

- integration of characteristics of conventional educational media;
- utilization of a variety of media organically setting the relation between them;
- ease of familiarization to little children;
- adaptation to individual learners; and
- possible use for remote education.

As possible fields of use, it cited eight items, including:

- cultivation of the ability to utilize information;
- taking advantage of its capacity to store various image materials and its interactive information retrieval function;
- creation of original educational material by editing image materials;
- presentation of educational material using image materials on electronic media and search function;
- virtual museums using creative functions.
to present scenes combining images, sound and databases organically; and —supply of information with images and characters through screen selection.

As subjects related to propagation, it pointed out: further improvement of equipment; promotion of practical research of educational usage, and development of multimedia education material; promotion of joint use of image materials, etc.; expansion of opportunities of teacher training on multimedia utilization; smooth settlement of copyright issues; development of machines that enable easy creation of original multimedia education materials; propagation of software to create multimedia education materials; and enhancement of compatibility of multimedia education materials.

Subsequently, in 1994, the Ministry of Education established its Multimedia Planning Policy Office and implemented discussion for promoting an educational policy adapting to multimedia development. In January 1995, the ministry published a report arranging comprehensive educational measures on multimedia education and proposed a basic set of principles upon which base the measures and concrete strategies to be taken in multimedia education.

On the part of the Ministry of Posts and Telecommunications, the Association for Advanced Telecommunications published a report entitled the “Discussion for education using new media.” The report pointed out the desirability of adequate teaching of educational informatics including communication and broadcasting in school education. In view of the movement of informatization of education toward network utilization, the report also proposed the promotion of measures utilizing communication/broadcasting networks. In addition, the “International Communication Foundation” investigated the current status of international remote education and conducted trials in entrusted research. In May, 1994, the Telecommunications Council published a report which presented the Japanese Information Superhighway concept, estimating that the market to be created as a result would reach 123 trillion yen.

5.4 Governmental Policies and the 15th Central Council for Education

After the appointment of committee members on April 10, 1995, the 15th Central Council for Education was presented with a list of questions by the Minister of Education on April 26, 1995, centering around the following three topics:

—The ideal state of education, and the respective roles and collaboration of schools, households and local communities;
—The education to cope with ability and aptitude of each student, and improvement of connection between schools; and
—The ideal way to accommodate societal changes such as internationalization, informatization, progress of science and technology, etc.

The ideal method for education in the multimedia age is included in the third topic. Although Japanese education has so far proven effective, it has turned out not to be fully effective in keeping up with the swift changes society has recently been undergoing. The reform of education to cope with environmental issues, progress of science and technology, internationalization, etc., is greatly desired.

On February 21, 1995, the Headquarter for the Promotion of the Advanced Information Communication Society headed by the Prime Minister set out a “Basic policy for promotion of the advanced information communication society.” Based on this, the Ministry of Education published in August a “Guideline to informatization in education, science, culture, and sports.” The guideline proposed the following concrete measures:

Primary and secondary school education:
—Programs to improve computer and related equipment, and promotion of intelligent school facilities
—Diffusion of software and research and development of good software
—in-service teacher training and teacher education to equip teachers with basic knowledge and skills related to utilization of computers
—research on methods of education using advanced communication networks based on technologies such as fiber optics
—establishment of a general educational information center equipped with a national center function providing general
information on education and culture
Higher education:
- improvement of information facilities and improvement of network environments, including intra-school LANs and utilization of a communication satellite
- improvement of educational and research organizations for graduate schools, faculties, and departments
- improvement and extension of the University of the Air throughout the country
- R&D and promotion of new educational methods and educational forms utilizing communication satellites, fiber optics;
- multimedia-support to private universities and specialized colleges; and supply of information on university/college life and admission information using advanced communication networks
Social education:
- improvement of supply of information for life-long education
- informatization of libraries and museums
- R&D for learning methods using new media
- supply of a variety of learning opportunities in local communities
- enhancement of the qualifications of leaders in social education
Science:
- Enhancement and speed-up of scientific information network and expansion of international connectivity
- improvement of intra-school LAN such as introduction of ATM network system
- improvement of scientific information databases
- research and development of new systems such as electronic library system
- expansion of the National Center for Science Information, etc., that play a central role for promotion of science information distribution
Culture:
- improvement of information system providing information related to possession of cultural assets and art objects, and improvement of cultural administration of local government and art groups
- development of information and materials for Japanese language study using an advanced information communication network to support Japanese language learners within and outside of Japan.

Sports:
- improvement of the information system providing information on local sports activities
- promotion of research and development on scientific training methods using multimedia, and establishment of a national center dealing with information on sports science
- promotion of research on training methods and teacher education using communication media.

As listed above, promotion of the utilization of multimedia has become a national policy in education, science, culture, and sports.

5.5 Development of Software
In 1994, the Ministry of Education was allocated a budget of 250 million yen for research and development of educational software. Out of the 98 projects which applied, ten were adopted. The rich variety of multimedia educational materials under development included a "Research and learn picture book—Cans and the Environment"; a multimedia study-support software package for local communities, "MY TOWN"; "Travel of water", a life experience simulation—"My town"; Time travel in Kyoto with "GPS"; and space exploration. Projects on network-related software included a collaborative study support system for subject study and a dialog-type English conversation hearing system. These products have been completed, and most are now on the market. "My town" won the grand prize and "Travel of water" won the prize for excellence in a software contest.

In 1995, the budget was increased to 425 million yen, and a total of 17 projects were adopted. These included a multimedia experience study, "Arithmetic theme park"; the support tools and educational material for a remote joint study (joint observation of acid rain) on WAN; groupware related to international economy, "Multimedia science observation note"; town design simulation software "CITY HALL," and others.

In 1996, 20 teams obtained subsidies. Further back, in a study project commissioned by the Ministry of Education, the Japan Audio Visual Education Association developed a hypermedia educational material called
"Science Hyper Media." In addition to this, the Japanese Study Material Research Institute has been continuing research on the efficient use of a multimedia database.

Turning to MITI-related research and development of system technology, the Software Technology Research Foundation published a report on the concept of a new computer-aided educational system which employs materials for English language lessons with a game-like feeling. The foundation also developed a system-supported debate, a contest in which the affirmative and negative side of a proposition counter each other's arguments. The Center for Educational Computing also has been proceeding with research and development of various educational software using multimedia technology; expert systems, and simulation. The specific applications developed include simulation of collaborative and disintegrated type business, "Econo-discovery"; an intellectual adventure application introducing the world of sound, "Sound adventure"; and energy and environment education software.

The Ministry of Education has also been sponsoring the study of an educational software information service. Governmental budget of a little less than 2 billion yen was newly allocated for the establishment of an educational software library center in 1995, and about 200 million yen has been allocated for the study and development of usage for multimedia of advanced information communication facilities in schools in remote rural areas.

"Educational use of multimedia—a guide to the use of computer in audio-visual education—for primary and middle school," published by the Ministry of Education in August 1994, introduces examples of computer use in local community observation studies, creation and utilization of databases, learning by reference, self-expression, intensive reading, moral education, orientation, and so on. These examples are a clear indication of the steady improvement of the multimedia learning environment.

5.6 Utilization of Network

In a project consigned by the Mechanical Social System Foundation to develop a multimedia learning environment more compatible for a more sensitive society, the Software Technology Research Foundation is trying to develop an environment which facilitates the use of multimedia educational materials, retrieval and arrangement of information in databases, creation of presentation materials, and teleconference transmission in remote places. When these capabilities further advance to the stage where the information travels through Internet or high-speed broadband backbone networks, the world of diversified multimedia education will develop further.

Vying with the NII in the US to promote the informatization of society, MITI, in cooperation with related ministries, announced in June 1994 the implementation of the advanced informatization program. Under the program's so-called "100 school networking project," the Information Processing Promotion Agency publicly invited schools to participate in a 100-pilot-school program with the Center for Educational Computing, and 1,543 schools applied. Schools selected comprised 30 A-Group schools, i.e., schools with advanced policies, skilled teachers with good performance records; and 70 B-Group schools, i.e., schools that can actively establish plans and participate in the network project. In addition to these 102 schools, two American schools (one added to each group), and a number of specially designated schools and hospitals were also added, bringing the total up to 111.

The information collected by these schools included messages from the US president, data on earthquakes, video from the weather satellite "Himawari," and information on admission into schools of higher grade.

As for transmission of information, some schools are sending information on work of art and music, local contamination status, and natural monuments within and outside the country.

Different types of information are exchanged between the schools. Students communicate with the middle schools they graduated from or exchange messages about manners and customs, seasonal and natural matters such as cherry blossoms, and original pictures and music. The programs planned for joint study include: a joint study on rainfall levels, air pollution, water pollution, water shortage, the altitude of the sun, flying in the route of the hooded crane, greeting
words, dialects, manners and customs, local products, commodity prices, and cooperative creation of relay-style novels and scripts. As for network conference, discussion between foreign schools are planned around fashion, culture and customs. At present, videoconferences between schools and joint research on subjects such as acid rain and the germination of pumpkin seeds have been started.

In 1996, NTT launched its “Konet Plan,” a consortium to provide 1,014 schools with a network environment supporting e-mail exchange, collection of information, WWW home page design and transmission. This marks the true arrival of the multimedia age in school. However, not every school in Japan will enjoy the benefit. Basically, in regular classes, pupils must get accustomed to media mix, that is, a combination of various media, and be able to actively and intelligently use a variety of educational materials, OHPs, broadcasts, printed materials, models, and actual things. Multimedia can only be put to effective use after students have obtained these types of experiences. Unless pupils have adequate abilities to gather, store, retrieve, create, and express information freely and independently without the provision of an actual computer in the classroom, simply bringing in a computer and connecting it to a network will not ensure effective use of multimedia networks. It is important to combine new media with conventional ones.

In the budget request of 1996, ten model communities have been selected for designation projects for continuation of the vitalization of school libraries which started in 1995. In this project, various information software and tools in schools will be reviewed, and practical study to promote networking between school libraries and public libraries will be performed.

Even now, library information on published materials can be retrieved from some university libraries through the Internet. In a move to build up a network of national and public libraries, plans were made in 1995 to establish an electronic pilot library in the Information Infrastructure Center at Keio University’s Fujisawa Campus. The entire network of library catalogs can be accessed in this new system, and the following library materials will soon be linked: 7,100 rare books archived in the National Diet Library; 11 categories (1,236 pieces) of rare books, national trea-suries, important cultural properties; 21,000 copies (six million pages) of publications in Meiji era; 3,000 copies (750,000 pages) of publications published around the time of World War II; 24 categories (one million pages) of domestic magazines; 260 volumes (6,000 pages) of research documents for Diet sessions; 7,000 constitutional documents; and 18 categories (1.6 million pages) of documents from publishers archived in the National Diet Library and Toyo Bunko—the branch of the National Diet (at the time of September, 1995). There will soon come a day when every school in Japan will be able to retrieve information from this library network.

6. CULTIVATION OF PERSONNEL FOR MULTIMEDIA USE

6.1 Cultivation of Engineers Processing Advanced Information

As multimedia research and development continues to intensify, those personnel engaged in software development will require more education. In order to enhance engineers’ competence in coping with the structural changes of the information industry. The Task Force for Personnel Training to the Sub-committee of the Information Industry of Industrial Structure Council within MITI proposed in May 1993 typification of advanced information-processing engineers and establishment of respective training curricula and qualification test systems. According to the proposal, 13 curricula for advanced information engineers, two general curricula, and two curricula for users will be established.

The following job types are specified within these curricula: system analyst, project manager, application engineer, production engineer, technical specialist, system operation and management engineer, development engineer, and system administrator. In addition, Education Engineer has been added as a job type, and creation of educational curricula and questions for qualification test were planned. Standard training curricula was formed and textbooks were issued. Recently an information-processing engineer qualification test system based on the above job types has been reviewed. Six tests were conducted
in fall 1994, five in spring 1995, and an additional 3 up to now, making a total of 12 types of tests. These tests put an emphasis on evaluating practical capability. In the future, the execution of the remaining three tests is to be studied. It is worth noting that the category of Educational Engineer has been added. It is also important to note that educational technology fully utilizing informatics technology has been authorized publicly.

In addition to special knowledge in a specific field information processing, educational engineers are required to have abilities to:
1) develop education plans for others;
2) equip others with educational knowledge and techniques;
3) prepare presentations and reports using technical writing skills;
4) develop high-quality educational materials including multimedia tools.

6.2 Cultivation of Multimedia-Software-Related Staff

The Multimedia Software Promotion Association organized the Special Committee for Multimedia Software Staff Development in 1992. In the committee’s report on “Research on multimedia software staff development,” it pointed out the urgent need to cultivate human resources for the development of multimedia software. In light of this, the Association established the “Study Committee for Development Vision” in 1993 and conducted “Research on multimedia staff development vision.” This committee proposed:
1) that two types of human resources, i.e., software creators and information provider/communication experts, are required to support multimedia information society;
2) that development of human resources is required to cover three levels, i.e., expansion of ordinary computer users, development of “power users,” and recruitment and training of experts; and
3) that resourcing the professionals and systematizing certification and qualification of skills is important to achieve these ends.

One of the required resources, the multimedia software creator, creates software in the fields of art, entertainment, and documentary. The other requirement, the information provider/communication expert, provides accurate information in an understandable format, prepares a system for its utilization, and offers various services.

Comprehensive multimedia training was launched in 1993 with 700 participants. The training consists of 7 courses, i.e., producer, director, scriptwriter, image creator, sound creator, CG creator, and multimedia engineer. Four basic lessons, one special lesson, and 14 practical lessons are offered.

In addition, 2,25 billion yen has been budgeted for the construction of a Multimedia Support Staff Development Center in Maruko, Nagano prefecture. The new center is expected to contribute to the creation of multimedia software, development of supportive tools, and training of professional creators.

6.3 Qualification Test

The aforementioned Multimedia Software Promotion Association established an “Expert Development Committee” in 1994 and conducted a study on a “Multimedia Software Creator Qualification System.” Referring to personnel who have ability to create multimedia contents as “multimedia software creators,” the study investigates the establishment of a qualification test for setting evaluation criteria, the provision of an educational model, increase of potential human resources, and enhancement of their motivation to step up and improve the staff development method.

Based on this study, the Association structured a qualification test qualifying persons capable of creating simple multimedia software as “third grade”; persons who have mastered knowledge, skills and techniques related to multimedia creation systematically as “second grade”; and persons who have a record of performance in multimedia software creation as “first grade.” It divided the second and first grades into a “planning/composition division” and “creation division,” the former being comprised of a producer, director and scriptwriter, and the latter covering specialized fields such as images, CG, sounds and music. The third-grade test is carried out on a mark sheet basis, and description and skill sections are included in the second-
grade and first-grade tests, which are comprised, respectively, of a thesis, interview, and record of performance evaluation.

In line with this, trial examination questions were prepared and trial examination was performed for the third grade in 1995. The difficulties of questions, test hours, passing marks, etc., are analyzed and studied, and concrete measures for the execution are publicized. The "Guidebook on Multimedia Software Creator Qualification System," published in September 1995, describes the areas and contents covered by the test.

All users, particularly teachers, are expected to evolve into power multimedia users, adept at retrieving world information quickly through Internet and transmitting local information within and outside the country. Just as the enlightenment of the Meiji era emanated from its schools, schools of the 21st century will flourish as the centers of local communities.

7. DEVELOPMENT OF CURRICULUM FOR MULTIMEDIA EDUCATION

7.1 Establishment of Expression and Communication Course as a School Subject

In light of the above, development of curriculum for multimedia education is an urgent necessity for the basic education of all who are to live in the 21st century. This curriculum has to be continuous from kindergarten through to primary school, middle school, high school and university. The distribution of study hours shall be greater in the lower grades and decrease gradually as pupils ascend the stages of their development.

The curricula should not be narrowed down to the use of merely computers and networks. Rather, an emphasis must be placed on the cultivation of broader abilities for expression or communication through language, sound, music, still images, moving video, performance, the natural environment, artificial environment, etc., in performing various activities such as reading, appreciation, writing, discussion, presentation, art appreciation, painting, sculpture, handicrafts, architecture, music appreciation, music arrangement, music composition, drawing, graphics, making maps, making graphs, cooking and serving food, dress design, flower arrangement, interior decoration, perfumery, drama, dancing, body language, broadcast learning, video creation, etc.

Furthermore the curricula will have to be comprehensive and incorporate the study about various media, means, systems, and functions of the technologies that support such activities, as well as:

- study of their effects on politics, economy, and society, and their role and importance in social life;
- study of their utilization for the improvement of living;
- study of their utilization for the improvement of study;
- development of the ability to select accurate, fair, and unbiased information through media;
- development of ethics to supply such information; and
- development of an attitude respecting the intellectual rights of others.

Thus, this is almost the establishment of a new Expression and Communication course.

7.2 Measures in Transition Period

It will be difficult to introduce such revolutionary, comprehensive curricula for multimedia education into the next Course of Study. However its development has to be undertaken before the establishment of the next Course of Study. The curricula can be incorporated into traditional subjects as comprehensive study even if an Expression and Communication course is not introduced as an independent subject.

More specifically, it is recommended to create a curriculum of informatics education that is continuous all the way from primary through high school by including information-related subjects and information-related basic subjects from vocational high schools collectively such as "Fundamentals of Informatics" in Technology and Home Economics subjects in middle school; "Distribution of Information" in courses in the 5th grade of primary school; and Physics IA, Mathematics "A," "B," "C," Politics and Economy and Modern society in high school.

In the past, the Ministry of Education has subsidized several research programs for science study such as research on educational informatics in foreign countries, analysis of current curricula, and newly proposed curricula for informatics education (Goto,
Hayashi, Nishinosono, Okamoto and Sakamoto).

In preparation for organization of next Course of Study, the Science Education Research Committee in the fourth section of the Science Council of Japan, has been studying a tentative plan for curricula for science and technology education from various perspectives since 1993. Study results, some of which are proposals for educational informatics curriculum, were published in June 1996.

Also, in 1995, representatives from ten groups in the Association of Educational Technology Societies (AETS) formed the Committee of the Informatics Education Project to study informatics education curricula that are continuous all the way from primary to middle and high school. The association published a special study report on educational informatics called “Proposal for Course of Study on continuous educational informatics throughout primary, middle and high school” (Okamoto et al.).

The 15th Central Council for Education issued a report emphasising active promotion of educational informatics in July 1996. The report recommends the following forms of activity:
— the systematic implementation of informatics education;
— qualitative improvement of school education through the use of information communication networks;
— the construction of “New School” coping with advanced information communication society;
— overcoming the less-desirable components of informatization;
— enhancing balanced human beings; and
— the cultivation of information ethics in children.

8. THE EFFECT OF EDUCATIONAL USE OF INFORMATION TECHNOLOGY

8.1 Systems Function

As mentioned above, educational technology has been proceeding with conventional study on improvement of education. Above all, the progress in the field of effective use of information technology has been remarkable and has had a vast effect on education.

For one thing, information technology works both as an equalizer and an amplifier. As information technology enables everybody to obtain information from every part of the world, it functionally realizes equal educational opportunities, and in that sense, serves as an equalizer. Moreover, it increases the volume of information to be collected and saves time, and in that sense, it serves as an amplifier. However different levels of skill in using information technology might result in gaps in the information collection or learning progress in education.

Secondly, information technology contributes to generalization as well as specialization.

Information technology enables all the people to share contents of information, thus contributing to generalization of common education. Moreover, it facilitates the systematic collection of specialized information contributing to specialization of education.

Thirdly, information technology contributes to both diversification and individualization. Thanks to information technologies, education is diversified and individualized, and can facilitate the collection of a variety of types of information from law, economy, art, literature, science, medical science, and art. By learning selectively, students can develop their own individuality.

8.2 Utilization of Information

The advanced information technology is also effective in view of utilization of information. Firstly, as each information source provides unique and distinctive information, we can collect broader information than that previously available, and we can utilize local cultural information or specialized information supplied by schools and educational institutions.

Secondly it is an approach to excellence. A lot of excellent information is available, so if we are selective enough, we can approach excellence.

Thirdly it eliminates redundant activities. As we can gather broad information, we can eliminate production of duplicate information. Information can be produced even in distributed cooperative efforts.

Fourthly, it is helpful in publicizing schools' outcomes and activities.

Each institution, organization and individual can publicize its distinctive features
worldwide on its own home page. This is expected to be far more effective than distributing brochures within limited areas.

8.3 Development of Mental Faculties

Utilization of information technology contributes to cognitive development.

First, the power of probing, expressing, and transmitting information is formed through the repeated experiences of collection, selection, editing, creation, and transmission of information.

Second, Information Literacy is developed. Through the rich experiences of information handling, the six qualifications of an information-oriented person can be formed.

8.4 Contribution to Internationalization

With the culmination of advanced information communication society, distinctive network education systems can emerge. When all education-related facilities are connected through networks and provide unique information in the forms of databases, home pages or direct transmission throughout the world, the whole world will be built into a single-network educational information system. Systems for admission, graduation or qualification acquisition will be more flexible, and a society where people can learn freely will be realized.

It is an urgent necessity that we establish effective curricula for advanced information communication technology, and that we develop all citizens' abilities to utilize multimedia or Internet information as a source of basic education. Educational Technology centering around the Seven-Article of Educational Technology can contribute to many areas.

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