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ABSTRACT

Results of surveys conducted to determine the present situation and trends in the use of computers in Japanese elementary and lower and upper secondary schools are summarized. Much of the data quoted comes from surveys by the International Association for the Evaluation of Educational Achievement and the Ministry of Education, Science, and Culture in Japan. The extent of the use of computers in elementary and secondary schools has been rather limited, although experimental projects on the use of computers for computer assisted instruction/learning in schools have been undertaken for more than 20 years. Most of these experiments have been conducted in university laboratories. Currently, more schools are being equipped with microcomputers for educational uses. The average number of software items possessed by public elementary schools in 1989 was 19.6; the respective figures for lower and upper public secondary schools were 27.5 and 78.5. These numbers represent appreciable increases over the previous year. Data are also available on the types and uses of software. Other data provide information concerning: (1) the integration of computer education into curricula; (2) computer literacy of and training for teachers and teachers' attitudes toward computers; and (3) problems associated with the introduction of computers into schools. The document concludes with a discussion of policy directions and measures taken by the Japanese government. Fifteen data tables are included. (TJH)

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The Use of Computers in Japanese Schools

*A paper prepared for the presentation
at the AERA 1990 Annual Meeting on April 17, 1990 at Boston*

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The Use of Computers in Japanese Schools

Introduction

The extent of the use of computers in education in Japan, particularly in elementary and secondary schools, has been rather limited, although experimental projects on the use of computers for CAI/CAL in schools have been undertaken for more than 20 years mainly by researchers and professors at universities. The low use rate is partly due to the fact that up to now in the official school curriculum, i.e. the Courses of Study issued by the Ministry of Education, computers have not been treated as a part of the teaching content except for the curriculum of vocational upper secondary schools, so only a limited number of schools have been using and giving instruction about computers.

With the rapid development and extensive use of computers in society and in business in particular, a need has come to be felt to introduce computers into education and to give instruction about computers as well as to make use of them for other than administrative purposes. Currently, an increasing number of schools are being equipped with microcomputers and they are trying to make use of computers for the improvement of instruction and to teach children about computers. Various surveys including the one coordinated by the International Association for the Evaluation of Educational Achievement (IEA) have been conducted to find out the present situation and trends in terms of the use of computers in elementary, and lower and upper secondary schools, and some of the results will be discussed in the following sections. The data quoted below without named sources are from the results of the national surveys conducted by the Ministry of Education, Science and Culture.

1) Availability of Micro-computers in Schools

As shown in Table 1, according to the national surveys conducted in all public schools by the Ministry of Education, Science and Culture, 0.6% of elementary schools, 3.1% of lower secondary schools and 56.4% of upper secondary schools had more than one microcomputer in 1983. In 1989, these figures increased to 21.0%, 44.8% and 96.3% respectively. This increase was achieved partly because of the measures taken by the Ministry of Education to facilitate the introduction of computers in view of the emerging need to prepare children for the forthcoming information-oriented society. The Ministry started to subsidize the purchase of computers by public schools in 1985. Subsequently, in line with this, local governments have also been encouraging the introduction and use of computers in schools through their subsidy systems. But as shown in Table 2, the introduction of computers into schools has not progressed to the extent it deserves, especially in terms of the number of computers installed in each elementary and lower secondary school. As of March 1989, the average number of computers in those schools that have computers is 3.0 computers per school for elementary schools, and 4.3 and 25.5 for lower and upper secondary schools respectively.

Table 1: Diffusion Rate of Computers in Public Schools

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
May 1, 1983	0.8%	3.1%	56.4%
Oct. 1, 1985	2.0	12.8	81.1
March 31, 1987	6.5	22.8	86.3
March 31, 1988	13.5 (3,337)	35.6 (3,748)	93.7 (3,925)
March 31, 1989	21.0 (5,172)	44.8 (4,740)	96.3 (4,035)

Note: The figures in parentheses are the number of schools with computers.

Table 2: Average Number of Microcomputers per School

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
March 31 1988	2.9 (9,523)	3.5 (13,199)	19.7 (77,420)
March 31 1989	3.0 (15,505)	4.3 (20,519)	25.5 (103,014)

Note: The figures in parentheses are the number of computers installed in schools.

More than eighty percent of computers installed in schools have been purchased by schools with the help of subsidies from both national and local governments as shown in Table 3.

Table 3: Methods of Procurement of Microcomputers (Year: 1989 and 1988)

	Elementary Schools		Lower Secondary Schools		Upper Secondary Schools	
	1989	1988	1989	1988	1989	1988
Purchase	81.4%	81.0%	83.8%	80.0%	80.4%	82.6%
Rental/Lease	11.4	9.6	9.2	8.1	17.1	13.4
Others (1)	7.2	9.4	7.0	11.9	2.6	4.0
Total number of computers in schools	(15,505)	(9,523)	(20,519)	(13,199)	(103,014)	(77,420)

(1) Donations/gifts, etc.

As of 1989, about 40% of computers installed in elementary schools are 8-bit machines, and about 20% each of those in lower and upper secondary schools are also 8-bit machines. However, the majority of computers installed in schools are 16-bit machines and there is an increasing tendency to install more 16-bit or even 32-bit machines in schools.

Table 4: Type of Computers in Schools (Year : 1989 and 1988)

	Elementary Schools		Lower Secondary Schools		Upper Secondary Schools	
	1989	1988	1989	1988	1989	1988
8-bit machine	39.9%	45.8%	19.4%	26.0%	22.5%	29.1%
16-bit machine	58.3	53.0	79.2	73.0	75.5	68.9
32-bit machine	1.3	0.5	1.0	0.3	1.1	0.6
Others	0.5	0.7	0.5	0.7	0.9	1.4
Total number of computers in schools	(15,505)	(9,523)	(20,519)	(13,199)	(103,014)	(77,420)

Regarding the location of computers (see Table 5), the survey showed that many schools keep their computers in the faculty rooms or teachers' rooms. However, there is a growing tendency to keep computers in computer laboratories, in special rooms reserved for the teaching of certain subjects, or in multi-purpose or audio-visual rooms. One of the major reasons for keeping computers in teachers' rooms apart from the security factor is that many schools which introduce computers for the first time tend to use them for administrative or management purposes in the beginning due to the availability of the number of computers as well as the number of teachers who can operate computers in the schools.

Table 5: Location of Computers in Schools (Year: 1989 and 1988)

	Elementary Schools		Lower Secondary Schools		Upper Secondary Schools	
	1989	1988	1989	1988	1989	1988
Computer Laboratories	9.4%	10.3%	16.5%	14.2%	49.3%	43.4%
Special Rooms (1)	10.9	10.2	12.2	12.3	48.2	42.1
Classrooms	5.9	6.1	1.6	2.3	2.3	1.6
Libraries	3.6	3.5	2.6	2.1	6.9	3.5
Teachers' Rooms	66.4	74.3	63.0	71.2	55.1	56.7
Others (2)	19.5	16.0	29.9	21.4	41.4	29.8

Note: Computers are kept in more than one place, so the total percentage exceeds 100%.

- (1) Such as special rooms for the teaching of science, industrial arts and home making, and audio-visual rooms.
- (2) Such as multi-purpose rooms and in-school broadcasting studios.

2) Software Development and Use

The average number of software items possessed by public elementary schools in 1989 was 19.6, and 27.5 and 78.5 for public lower and upper secondary schools respectively. The number of software possessed by schools has greatly increased from the previous year as shown in Table 6. However, many schools have multiple copies of the same software item, and the number of

different kinds of software, excluding multiple copies of the same kind of software, possessed by schools is 6.2, 7.1 and 14.4 per school for elementary, lower secondary and upper secondary schools respectively.

Table 6: Number of Software Items Possessed by Schools (Year: 1989 and 1988)

	Elementary Schools		Lower Secondary Schools		Upper Secondary Schools	
	1989	1988	1989	1988	1989	1988
Average number of software items per school	19.6	9.5	27.5	8.5	78.5	18.3
No. of schools with computers	5,172	3,337	4,740	3,748	4,035	3,925
No. of software items possessed	101,623	31,808	130,306	31,991	316,768	71,738

Of the software items possessed by schools in 1989, 73.9%, 59.7% and 68.9% of software were commercial software items purchased by elementary, lower secondary and upper secondary schools respectively. The remaining software was either developed by schoolteachers or jointly developed by teachers and local education centers.

Table 7: Sources/Development of Software used in Schools (Year: 1989 and 1988)

	Elementary Schools		Lower Secondary Schools		Upper Secondary Schools	
	1989	1988	1989	1988	1989	1988
Teacher made	15.0%	14.6%	23.1%	18.6%	21.4%	34.0%
Joint development (1)	6.4	6.0	14.6	5.1	2.5	4.3
Commercial	73.9	72.6	59.7	69.7	68.9	58.9
Others(2)	4.8	6.8	2.5	6.6	7.2	4.8
No. of software items possessed	101,623	31,808	130,306	31,991	316,768	71,738

- (1) Developed jointly by teachers and staff of local education centers, and by groups of teachers.
- (2) Exchange with other schools, gifts, etc.

About 70% of the software possessed by elementary schools and lower secondary schools is for use in connection with subject teaching, whereas about 54% of the software in upper secondary schools is for this purpose.

Table 8: Type of Software possessed by Schools (by Subject) (Year: 1989)

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
For subject teaching (No. of software items)	69.6% (70,685)	70.8% (92,043)	54.2% (171,641)
For administrative use, etc. (No. of software items)	30.4% (30,983)	29.4% (38,263)	45.8% (145,127)

Besides the software for use across subjects, software for Arithmetic, Science and Japanese Language is popular in elementary schools, software for Mathematics, Foreign Languages and Science in lower secondary schools, and software for vocational subjects, mathematics and science in upper secondary schools.

Table 9: Software for Subject Teaching in Schools (by Subject) (Year: 1989)

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
Japanese Language	8.8	2.6	1.2
Social Studies	4.9	5.1	0.9
Mathematics	52.5	29.2	10.3
Science	6.8	18.2	7.3
Music	3.5	0.3	0.1
Fine Arts	2.8	0.9	0.2
Industrial Arts	-	3.9	-
Homemaking	-	0.3	-
Homemaking/Home Economics	0.1	-	1.4
Physical Education	1.6	0.4	0.5
Foreign Languages	0.1	21.2	2.6
Moral Education	0.02	0.1	0.003
Special Activities (1)	2.7	2.8	1.3
Vocational Subjects	0.03	0.02	46.2
Across subjects (2)	16.2	15.1	28.1
(No. of software)	(70,685)	(92,043)	(171,641)

(1) Such as for club activities.

(2) Word Processing; Spreadsheets; Graphics; Database; etc.

Table 10: Software for Administrative Use in Schools (Year: 1989)

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
Courseware development	18.0	10.1	7.4
Management/Administration	39.4	43.9	22.4
Others(1)	44.6	46.0	70.2
(No. of software items)	(30,983)	(38,263)	(145,127)

(1) Operating systems; Word Processing; Spreadsheets; Graphics; Database; Communication tools, etc.

One of the interesting features of Japanese education is the development and the existence of an education industry. Textbooks are developed by private publishers, although they have to be approved by the Ministry of Education. Apart from textbooks, drills, worksheets, tests and supplementary instructional materials are also developed by private publishers and used in schools, and are also available in the market for home use. A number of educational magazines and periodicals for teachers, students and also for parents are published by private publishers and available in the market. The computer industry has also been growing and many private companies are paying attention to the field of education. Apart from manufacturers of computers, many companies are now developing and producing software for educational purposes and they are available in the market for schools as well as for home use.

An increasing quantity of commercial software is now available in the market, but evaluation of this is not yet systematically carried out. Although general guidelines for the development of software have been issued by the Ministry of Education in order to ensure the high quality of software, but the selection of, or the method adopted for the evaluation of, software is up to the user.

Some information on the content and evaluation results of new software is disseminated through monthly magazines and journals published by private publishers. A semi-governmental organization established in 1986 is engaged in collecting and evaluating software developed by teachers and schools as well as that used in pilot/experimental projects, and in making the results of the analysis available to users.

3) Curriculum

The Courses of Study for elementary, lower secondary and upper secondary schools have been revised almost every 10 years, and the most recent revision has just taken place. New Courses of Study will be put into practice from 1992 for elementary schools, from 1993 for lower secondary schools and from 1994 for upper secondary schools. In the new Courses of Study, computers are expected to be more positively used than now in the teaching of various subjects, and computer education will be covered by such subjects as industrial arts and homemaking in lower secondary schools, as well as such subjects as mathematics and science in both lower and upper secondary schools, as well as vocational subjects in vocational and technical upper

secondary schools.

According to the new Course of Study for elementary schools, it is expected that use will be made of computers for the improvement of teaching and learning, and that through the use of computers as an aid children will make themselves familiar with computers. But it is not expected that the functions and operation of computers will be taught at this level. In the Course of Study for lower secondary schools, it is expected that use will be made of particular characteristics and functions of computers such as simulation and information retrieval for instruction and that through such use of computers children's understanding of computers will be deepened and necessary skills will be developed. In the subject "Industrial Arts and Homemaking", there will be a requirement to teach the content of the foundation of information, especially computers, to both boys and girls. In upper secondary schools, in the teaching of each subject, proper attention has to be given to the emergence and development of an information-oriented society and the impact of computers on individuals and society. A new subject area called "Mathematics C" will be introduced to teach children about computers focusing on computer use.

4) Teachers

A suggested training program has been developed by the Media Committee of the Social Education Council, and the Ministry of Education as well as local (prefectural) governments have been providing interested teachers with opportunities for in-service education in the use of computers. In particular, prefectural boards of education make use of their education centers or establish information processing education centers to provide training opportunities for teachers. However, in-service teacher education provision varies from prefecture to prefecture. Teachers who wish to undergo training are provided with an opportunity for training on the basis of the availability of courses. Teachers interested in the use of computers may also find their own ways of getting trained at their own expense, as private companies provide teachers with opportunities for training on computers. Topics covered by training courses vary from course to course depending on the specific objectives/purposes and levels (beginner, intermediate, advanced, etc.) of courses, and the levels or backgrounds of participants. A training course normally covers general theory, and the operation, programming and application of computers. Pre-service teacher education programs with respect to computers also vary from institution to institution.

According to the survey conducted by the Ministry of Education last year, 7.6%, 14.5% and 30.2% of public elementary, lower secondary and upper secondary school teachers respectively responded that they can operate computers, and only 19.9%, 25.8% and 44.3% of these elementary, lower secondary and upper secondary school teachers respectively responded that they can teach about computers. So far, about 95,700 teachers have undergone some form of training in the use of computers, and a little over half of them (54%) received training organized by national and local government/prefectural education centers. Those teachers who are able to operate computers are teachers of mathematics and science in the case of lower secondary schools, and those of vocational subjects, mathematics, science in upper secondary schools.

Table 11: Percentage of Teachers who can operate Computers (Year: 1989)

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
Can operate computers (No. of teachers who can operate computers)	7.6% (32,612)	14.5% (38,898)	30.2% (61,774)
[Can teach about computers out of those who can operate computers]	[19.9%]	[25.8%]	[44.3%]
Japanese Language	-	7.7	6.8
Social Studies	-	9.7	6.9
Mathematics	-	22.1	18.6
Science	-	22.7	15.2
Music	-	3.2	0.8
Fine Arts	-	3.0	0.6
Industrial Arts	-	10.8	-
Homemaking	-	2.3	-
Home Economics	-	-	2.4
Physical Education	-	7.3	5.0
Foreign Languages	-	6.7	8.0
Vocational Subjects	-	4.3	36.8

Table 12: Forms of Training received by Teachers (Year: 1989)

	Elementary Schools	Lower Secondary Schools	Upper Secondary Schools
National/Local Governments	56.6%	50.9%	53.9%
University extension courses, etc.	4.9	6.4	5.2
Research Associations, etc.	13.3	13.5	14.1
Manufacturers/companies	16.3	16.8	20.2
Others (1)	8.8	12.3	6.6
(No. of teachers who received training)	(31,701)	(24,908)	(36,868)

(1) Self-study; In-school training; etc.

As for the opinions and attitudes of teachers toward computers, it was found from the data of the IEA Computers in Education study made in early 1989 that teachers are generally in favor of computers and have positive attitudes and opinions about the role of computers in society as well as in education. They tend to consider computers as a valuable tool to improve students' learning and enhance teaching effectiveness, and they are eager to learn more about computers as a teaching aid. However, due to the lack of systematic in-service teacher education programs on computers in the past, most teachers, especially those who are not using computers, consider that they do not know much about computers or their operation.

Table 13: Opinions/Attitudes of Existing Subject Teachers

Note: Elem.: Elementary school teachers (Total N = 1047; User: 438; Non-user: 609)

LS : Lower secondary school teachers (Total N = 992; User: 268; Non-user: 724)

US(G): General upper secondary school teachers (Total N = 1209; User: 353; Non-user: 856)

US(V): Vocational & Technical upper secondary school teachers (Total N = 954; User: 209; Non-user: 745)

DA: Disagree (strongly + slightly)

UC: Uncertain

AG: Agree (strongly + slightly)

		Total			User			Non-user		
		DA	UC	AG	DA	UC	AG	DA	UC	AG
1. Computers are valuable tools to improve the quality of a child's education.	Elem.	5.1%	33.5%	58.4%	2.5%	21.9%	74.4%	6.9%	41.9%	46.8%
	LS	5.4	40.7	49.8	1.1	32.5	65.3	7.0	43.8	44.1
	US(G)	8.5	41.0	47.2	5.6	30.6	61.1	9.7	45.3	41.4
	US(V)	8.6	43.4	44.5	8.1	32.5	56.5	8.7	46.4	41.1
2. Working with computers in class distorts the social climate.	Elem.	49.9	40.8	6.0	64.4	30.8	3.4	39.4	47.9	7.7
	LS	43.6	45.9	6.7	58.6	36.6	4.1	38.0	49.3	7.8
	US(G)	43.9	47.2	5.8	56.0	37.7	4.0	38.7	51.2	6.5
	US(V)	36.6	51.3	8.4	52.2	39.7	4.8	32.2	54.5	9.4
3. Computers have become too dominant over us.	Elem.	45.8	40.5	10.5	56.4	37.9	4.6	38.1	42.4	14.7
	LS	41.5	42.5	12.1	51.5	40.7	6.7	37.7	43.2	14.1
	US(G)	44.9	38.2	13.6	53.8	34.3	9.4	41.2	39.8	15.3
	US(V)	36.6	38.5	21.2	45.9	35.9	15.3	34.0	39.2	22.8
4. Advanced technical equipment has proved difficult for me to get along with.	Elem.	27.7	29.2	39.8	32.2	30.4	36.0	24.5	28.4	42.5
	LS	29.7	27.6	38.5	41.0	29.5	28.0	25.6	26.9	42.4
	US(G)	38.7	24.9	32.9	49.0	25.5	22.6	34.5	24.6	37.0
	US(V)	31.7	32.1	32.5	49.3	31.6	16.8	26.7	32.2	37.0
5. I try to keep myself informed about technological changes.	Elem.	9.1	27.0	60.4	6.4	27.2	65.1	11.2	26.9	57.0
	LS	10.6	29.4	55.6	5.6	20.9	71.6	12.4	32.6	49.6
	US(G)	8.6	20.1	67.5	4.8	13.9	78.2	10.1	22.7	63.1
	US(V)	9.0	28.4	58.7	4.8	16.7	75.6	10.2	31.7	53.9
6. Using computers in class leads to more productivity among students.	Elem.	1.9	21.5	73.5	0.4	8.9	89.5	3.0	30.5	61.9
	LS	2.6	29.9	63.3	1.5	15.3	82.1	3.0	35.4	56.2
	US(G)	3.9	39.7	53.1	2.8	28.0	66.3	4.2	44.5	47.7
	US(V)	3	44.1	48.3	1.5	21.5	73.7	4.3	50.5	41.1
7. Computers harm relations between people.	Elem.	52.1	39.0	5.9	68.5	27.4	3.0	40.3	47.3	7.8
	LS	47.4	40.6	7.8	56.3	38.1	4.9	44.0	41.6	8.9
	US(G)	51.0	41.1	4.6	56.3	35.1	5.6	48.8	43.6	4.1
	US(V)	43.2	47.2	5.6	55.5	36.8	3.8	39.9	50.1	6.2
8. Students are more attentive when computers are used in class.	Elem.	3.1	30.1	63.5	0.9	14.4	83.5	4.6	41.4	49.1
	LS	2.9	38.3	54.7	1.9	23.1	73.8	3.4	43.9	47.7
	US(G)	2.9	45.4	48.4	2.5	29.7	65.2	3.0	51.9	41.4
	US(V)	3.9	48.8	43.0	1.9	31.1	63.7	4.5	53.8	37.1

		Total			User			Non-user		
		DA	UC	AG	DA	UC	AG	DA	UC	AG
9. I could (can) well do without the aid of a computer in my class.	Elem.	3.5%	39.8%	53.5%	3.9%	49.8%	45.2%	3.2%	32.7%	59.4%
	LS	3.9	34.7	57.4	5.3	42.5	51.5	3.5	31.8	59.5
	US(G)	3.6	29.2	63.7	5.0	33.4	58.9	3.0	27.5	65.8
	US(V)	2.4	28.4	65.3	6.7	32.5	57.9	1.2	27.2	67.3
10. Computers help to teach more effectively.	Elem.	3.5	36.2	57.0	2.0	27.6	69.1	4.4	42.4	48.3
	LS	4.1	40.9	50.8	1.8	31.7	65.6	5.0	44.3	45.3
	US(G)	6.4	42.8	47.6	2.9	28.6	65.8	7.8	48.6	40.0
	US(V)	8.0	45.5	42.7	4.3	23.9	68.4	9.0	51.5	35.4
11. My way of teaching is positively affected when using a computer for teaching.	Elem.	11.9	67.8	16.8	8.6	69.6	20.5	14.1	66.5	14.1
	LS	12.3	67.9	13.4	8.9	72.4	18.0	13.5	68.9	11.7
	US(G)	14.4	68.0	14.2	10.2	62.6	24.0	16.0	70.2	10.1
	US(V)	17.4	67.1	11.2	12.0	62.7	21.1	18.9	68.3	8.4
12. I think I can (or could learn how to) write programs on the computer.	Elem.	18.0	18.4	60.3	12.5	14.6	71.7	21.8	21.2	52.0
	LS	21.5	16.7	57.5	10.4	14.6	74.2	25.6	17.5	51.3
	US(G)	17.5	12.3	66.8	7.7	9.9	80.2	21.6	13.3	61.3
	US(V)	17.8	16.6	61.5	7.7	11.0	78.0	20.6	18.1	56.9
13. I would like to take part in a computer course to learn more about computers.	Elem.	10.7	24.6	61.7	6.2	24.7	68.0	14.0	24.6	57.2
	LS	12.8	25.2	57.8	6.7	25.4	67.2	15.0	25.1	54.3
	US(G)	12.1	22.4	62.2	5.1	21.5	70.8	14.9	22.8	58.6
	US(V)	15.6	25.1	55.2	8.1	16.3	71.8	17.6	27.5	50.6
14. Social contacts are negatively affected by the use of computers.	Elem.	50.3	43.4	3.1	62.3	34.9	1.6	41.7	49.4	4.1
	LS	50.2	41.8	3.8	58.6	37.7	3.0	47.1	43.4	4.2
	US(G)	52.5	41.3	2.9	58.1	36.8	2.3	50.1	43.1	3.0
	US(V)	41.7	50.9	3.4	54.5	38.8	3.4	38.0	54.4	3.5
15. In-service training courses about computers should be made compulsory.	Elem.	19.7	37.5	39.7	13.3	36.8	48.9	24.3	38.1	33.2
	LS	21.3	39.5	35.0	19.4	32.5	47.4	22.0	42.1	30.4
	US(G)	25.3	38.4	32.9	20.7	37.1	39.0	27.3	38.9	30.2
	US(V)	28.4	38.8	29.1	22.9	34.9	39.3	29.9	39.9	26.3
16. I feel uneasy thinking of a future with computers and robots controlling me.	Elem.	38.0	34.4	24.6	44.3	35.8	18.8	33.5	33.3	28.8
	LS	37.2	32.0	26.7	47.3	29.9	22.1	33.5	32.7	28.3
	US(G)	41.7	30.9	23.8	46.7	28.9	21.0	39.6	31.8	25.0
	US(V)	32.0	34.8	29.3	42.1	34.9	20.6	29.1	34.8	31.8
17. Computers reduce humans to numbers.	Elem.	32.5	37.8	26.6	41.5	37.7	19.6	25.9	37.9	31.6
	LS	33.3	35.9	26.7	40.3	37.3	21.7	30.7	35.4	28.6
	US(G)	35.0	32.5	28.8	41.9	30.3	24.3	32.2	33.4	30.7
	US(V)	25.2	37.2	33.6	32.6	36.8	28.2	23.2	37.3	35.2
18. I would like to learn more about computers as teaching aids.	Elem.	4.3	12.4	80.4	2.1	8.2	88.3	5.8	15.4	74.6
	LS	5.2	17.7	73.0	2.6	12.7	84.0	6.2	19.6	68.9
	US(G)	7.6	14.2	74.9	4.8	9.1	83.6	8.8	16.4	71.4
	US(V)	8.4	19.4	68.4	2.8	13.4	80.4	10.0	21.1	65.1

		Total			User			Non-user		
		DA	UC	AG	DA	UC	AG	DA	UC	AG
19. Computers in schools enhance students' creativity.	Elem.	8.2%	51.9%	36.6%	5.0%	46.6%	47.3%	10.6%	55.7%	28.9%
	LS	7.2	54.8	34.1	3.0	49.6	46.7	8.9	56.8	29.4
	US(G)	9.3	56.2	31.1	6.5	49.0	41.3	10.4	59.2	26.8
	US(V)	10.2	56.8	29.1	5.7	50.7	40.7	11.4	58.5	25.8
20. The achievement of students can be increased when using computers for teaching.	Elem.	6.7	58.2	32.0	4.3	54.3	40.2	8.4	60.9	26.1
	LS	5.9	62.5	27.3	4.1	57.1	38.0	6.6	64.5	23.4
	US(G)	9.1	61.2	22.5	8.5	56.9	31.4	9.6	67.9	18.8
	US(V)	8.9	67.8	19.2	5.7	61.7	30.1	9.8	69.5	16.2
21. I don't mind learning about computers.	Elem.	10.7	18.8	67.4	8.9	17.1	72.8	12.0	20.0	63.6
	LS	12.5	19.0	64.6	7.5	14.6	77.3	14.4	20.6	59.9
	US(G)	6.7	10.6	79.4	2.8	5.7	88.4	8.3	12.6	75.7
	US(V)	10.5	16.0	69.5	3.8	5.3	87.6	12.4	19.1	64.5
22. A computer is not suited for teaching purposes.	Elem.	42.6	49.3	4.8	57.6	37.0	4.3	31.9	58.1	5.2
	LS	39.0	49.3	7.5	52.3	42.5	4.4	34.1	51.8	8.7
	US(G)	40.6	44.4	11.6	50.7	40.5	5.7	36.4	46.0	14.0
	US(V)	31.3	51.2	13.4	46.5	44.0	5.8	27.2	53.2	15.6
23. Computers are superfluous.	Elem.	68.1	25.2	2.8	77.8	18.0	2.1	61.1	30.4	3.3
	LS	65.9	25.9	3.8	78.7	18.7	1.8	61.2	28.6	4.6
	US(G)	71.8	20.3	3.7	81.6	13.3	1.7	67.9	23.2	4.5
	US(V)	62.5	25.9	4.5	78.5	18.2	0.0	61.5	28.1	5.7
24. The world would have been better off if computers had never been invented.	Elem.	73.6	21.9	1.3	81.7	16.0	1.2	67.6	26.1	1.3
	LS	68.6	25.6	1.9	79.9	18.7	0.8	64.4	28.2	2.4
	US(G)	72.1	23.1	1.1	75.4	20.4	0.9	70.7	24.2	1.2
	US(V)	65.3	27.6	3.0	75.2	19.1	2.4	62.5	29.9	3.2
25. Children should begin to use computers at an early age.	Elem.	13.4	34.8	48.8	10.5	32.4	56.0	15.5	36.5	43.7
	LS	12.9	38.9	44.0	11.2	35.1	53.0	13.5	40.3	40.8
	US(G)	14.2	38.4	44.0	13.1	34.0	49.9	14.8	40.2	41.6
	US(V)	13.6	40.4	42.3	16.3	29.7	51.2	12.9	43.4	39.7
26. Using a computer in a classroom makes a subject more interesting.	Elem.	4.8	36.9	55.2	2.5	26.0	70.3	6.4	44.7	44.4
	LS	5.6	42.7	47.5	3.4	35.8	60.1	6.5	45.3	42.8
	US(G)	7.6	46.7	42.2	5.1	34.6	57.2	8.8	51.6	36.0
	US(V)	8.3	51.4	36.2	6.7	40.7	49.8	8.9	54.4	32.3
27. It would take too much time to learn how to use a computer successfully.	Elem.	6.9	25.0	65.0	8.4	25.1	65.3	5.7	25.0	64.9
	LS	6.8	26.4	62.8	7.5	25.7	66.0	6.5	26.7	61.6
	US(G)	9.9	27.3	59.3	12.7	27.8	56.6	8.8	27.1	60.4
	US(V)	10.9	30.2	55.0	15.8	24.4	57.4	9.6	31.8	54.3
28. We will lose control over computers one day.	Elem.	37.5	47.2	12.3	43.4	46.6	8.9	33.1	47.6	14.6
	LS	40.5	44.5	10.9	46.3	42.5	10.1	38.3	45.2	11.2
	US(G)	47.0	38.9	10.5	54.4	34.6	7.9	43.9	40.7	11.6
	US(V)	37.2	43.1	15.6	45.4	38.3	12.9	34.9	44.4	16.4

		Total			User			Non-user		
		DA	UC	AG	DA	UC	AG	DA	UC	AG
29. I am afraid computers are too complicated for me to handle.	Elem.	22.8%	31.4%	42.6%	29.5%	33.6%	35.7%	17.9%	29.9%	47.6%
	LS	29.5	29.4	36.7	42.2	33.6	23.1	24.7	27.9	41.7
	US(G)	39.4	26.9	29.9	53.0	26.9	16.7	33.8	26.9	35.3
	US(V)	30.4	32.3	32.9	47.9	27.3	22.0	25.5	33.7	35.9
30. Computers can only be useful in a few subjects.	Elem.	37.8	41.2	17.8	51.3	32.6	14.8	28.0	47.3	19.9
	LS	40.3	40.1	16.3	60.1	29.9	9.3	33.0	43.9	17.6
	US(G)	45.6	32.5	18.3	57.8	26.9	12.2	40.5	34.8	21.0
	US(V)	37.5	39.6	19.0	51.2	32.5	12.4	33.7	41.6	20.8
31. The more use I make of computers in the class, the less time I would have to concentrate on the (content of the) curriculum.	Elem.	22.0	51.4	23.3	27.6	51.1	19.9	17.9	51.6	25.8
	LS	19.5	45.5	30.8	23.5	45.5	29.9	18.0	45.4	31.1
	US(G)	19.4	43.7	33.4	25.7	44.8	26.4	16.8	43.2	36.4
	US(V)	18.4	42.2	35.4	30.6	36.4	29.7	14.9	43.9	37.0
32. Students should be kept away from computers.	Elem.	82.5	13.0	1.2	91.1	6.8	0.7	76.4	17.4	1.5
	LS	78.9	15.4	1.4	85.9	11.9	1.4	76.3	16.7	1.4
	US(G)	84.3	10.8	1.5	89.0	7.4	0.9	82.4	12.3	1.8
	US(V)	80.5	14.3	1.2	86.6	9.1	1.5	78.7	15.7	1.2
33. Getting familiar with computers is a pure waste of time.	Elem.	78.8	15.7	2.2	86.5	11.0	1.2	73.2	19.0	3.0
	LS	72.3	21.3	2.3	80.6	16.0	2.6	69.2	23.2	2.2
	US(G)	78.5	15.0	3.1	82.4	11.9	2.5	76.9	16.2	3.2
	US(V)	71.8	21.5	2.9	79.9	13.4	3.8	69.5	23.8	2.7

Source: International Computers in Education study, sponsored by the International Association for the Evaluation of Educational Achievement (IEA). National Institute for Educational Research (NIER), Tokyo, unpublished data.

Table 14: Knowledge/Skills of Teachers

Note: Existing subject teachers

Elem.: Elementary school teachers (Total N = 1047; User: 438; Non-user: 609)

LS : Lower secondary school teachers (Total N = 992; User: 268; Non-user: 724)

US(G): General upper secondary school teachers (Total N = 1209; User: 353; Non-user: 856)

US(V): Vocational & Technical upper secondary school teachers (Total N = 954; User: 209; Non-user: 745)

Computer education teachers

LS : Lower secondary school teachers (N = 204)

US(G): General upper secondary school teachers (N = 207)

US(V): Vocational & Technical upper secondary school teachers (N = 294)

		Existing Subject Teachers			Computer Education Teachers
		Total	User	Non-user	
I know ...					
1. several advantages of computer use for instruction.	Elem.		62.7%	87.0%	N.A.
	LS		55.0	81.0	87.3%
	US(G)		60.8	76.2	85.5
	US(V)		56.9	80.9	89.1

		Existing Subject Teachers			Computer Education Teachers
		Total	User	Non-user	
2. the difference between a word processor and a desktop publishing system.	Elem.	38.3%	43.6%	34.5%	N.A.
	LS	36.8	55.6	29.8	58.3%
	US(G)	42.8	55.8	37.4	61.4
	US(V)	39.3	56.5	34.5	64.6
3. criteria to judge the quality of a printer.	Elem.	36.5	41.3	33.0	N.A.
	LS	40.8	62.3	32.9	71.6
	US(G)	51.2	68.0	44.3	75.8
	US(V)	44.2	66.5	38.0	77.2
4. the trends in hardware development over the past 20 years.	Elem.	20.9	25.6	17.6	N.A.
	LS	25.4	38.4	20.6	58.8
	US(G)	39.3	55.0	32.8	69.6
	US(V)	33.3	49.8	28.7	75.9
5. what 'file extensions' are.	Elem.	23.5	27.4	20.7	N.A.
	LS	25.9	41.4	20.2	54.4
	US(G)	34.2	49.9	27.8	59.9
	US(V)	30.3	45.9	25.9	67.0
6. what a 'loop' means in programming.	Elem.	26.0	39.3	16.4	N.A.
	LS	34.5	60.1	25.0	75.5
	US(G)	53.2	74.2	44.5	88.4
	US(V)	46.6	77.0	38.1	93.2
7. what a 'relational database' is like.	Elem.	16.7	24.7	11.0	N.A.
	LS	20.0	38.1	13.3	53.4
	US(G)	32.8	54.4	23.9	66.2
	US(V)	22.9	45.5	16.5	62.6
8. what a 'bit' is defined as.	Elem.	53.5	67.8	43.2	N.A.
	LS	52.6	75.4	44.2	85.2
	US(G)	69.6	85.6	63.1	95.2
	US(V)	66.0	87.1	60.1	96.3
9. the difference between 'RAM' and 'ROM'.	Elem.	31.6	44.1	22.7	N.A.
	LS	34.6	59.3	25.4	74.0
	US(G)	52.3	75.1	42.9	89.4
	US(V)	43.5	71.8	35.6	93.5
<u>I can write a program for ...</u>					
1. adding up numbers.	Elem.	35.1	52.1	22.8	N.A.
	LS	45.3	70.9	35.8	86.3
	US(G)	63.5	83.3	55.4	95.2
	US(V)	57.7	88.0	49.1	98.0
2. using arrays.	Elem.	18.8	26.0	13.6	N.A.
	LS	29.7	53.0	21.1	71.1
	US(G)	48.3	70.3	39.3	89.4
	US(V)	44.0	76.1	35.0	93.9

		Existing Subject Teachers			Computer Education Teachers
		Total	User	Non-user	
3. storing data on a disk drive.	Elem.	27.7%	40.9%	18.2%	N.A.
	LS	31.8	55.6	22.9	76.5%
	US(G)	49.8	72.0	40.7	91.3
	US(V)	43.2	78.5	33.3	91.5
4. sorting data into a certain sequence.	Elem.	20.8	29.0	14.9	N.A.
	LS	31.3	51.5	23.8	72.1
	US(G)	47.3	67.4	39.0	85.0
	US(V)	40.1	72.2	31.1	89.5
5. printing the complete ASCII character set.	Elem.	9.7	14.2	6.6	N.A.
	LS	15.9	31.7	10.1	47.5
	US(G)	29.8	49.9	21.5	57.0
	US(V)	21.2	45.0	14.5	61.9
I am capable of ...					
1. exchanging data between different types of computers.	Elem.	7.1	13.2	2.6	N.A.
	LS	10.7	25.0	5.4	30.9
	US(G)	15.5	27.5	10.5	41.1
	US(V)	11.4	27.8	6.8	42.9
2. copying files from one disk to another.	Elem.	52.9	76.5	36.0	N.A.
	LS	51.1	84.7	38.7	92.6
	US(G)	64.9	87.8	55.5	95.2
	US(V)	54.8	87.6	45.6	96.9
3. editing documents with a word processor.	Elem.	73.8	85.2	65.7	N.A.
	LS	72.9	96.6	64.1	94.6
	US(G)	80.5	92.6	75.5	97.6
	US(V)	74.2	92.3	69.1	97.6
4. loading a data set from a disk drive.	Elem.	45.1	66.7	29.6	N.A.
	LS	49.1	82.1	36.9	89.7
	US(G)	62.4	82.4	54.2	96.6
	US(V)	52.1	85.6	42.7	94.2
5. creating a data-base-file.	Elem.	27.8	42.0	17.6	N.A.
	LS	32.3	59.7	22.1	65.7
	US(G)	43.8	65.7	34.7	78.7
	US(V)	34.6	62.7	26.7	72.4
6. evaluating the usefulness of software for my lessons.	Elem.	19.9	36.1	8.2	N.A.
	LS	18.6	41.4	10.2	51.5
	US(G)	26.2	44.5	18.7	57.5
	US(V)	23.6	47.4	16.9	54.8
7. adapting instructional software to my needs.	Elem.	16.5	32.4	5.1	N.A.
	LS	15.3	41.0	5.8	53.9
	US(G)	22.7	43.6	14.1	66.7
	US(V)	20.4	51.7	11.7	62.6

		Existing Subject Teachers			Computer Education Teachers
		Total	User	Non-user	
8. writing courseware for my own lessons.	Elem.	18.3%	39.0%	3.4%	N.A.
	LS	16.6	47.0	5.4	54.9%
	US(G)	13.0	28.6	6.5	47.3
	US(V)	11.6	32.5	5.8	43.9

Source: International Computers in Education study, sponsored by the International Association for the Evaluation of Educational Achievement (IEA). National Institute for Educational Research (NIER), Tokyo, unpublished data.

5) Problems

Since the introduction of computers into schools has only just started, there are a number of problems yet to be solved before full and effective making use of computers in education as well as providing education about computers. Some of the pertinent problems observed by teachers in the school are centered around problems of software, the training of teachers and financial provisions. According to the data collected for the IEA Computers in Education study, several problems are commonly rated by many computer coordinators in elementary, lower secondary and upper secondary schools as those which are seriously affecting their school's ability to use computers effectively

Table 15: Serious Problems Affecting the Use of Computers in Schools

Problem	Elementary	Lower Secondary	Upper Secondary	
			General	Voc/Tech.
not enough software for instructional purposes available	93.0%	95.2%	88.4%	87.5%
lack of information about software or its quality	73.2	76.7	72.3	74.5
teachers lack knowledge/skills about using computers for instructional purposes	85.5	81.9	77.1	69.8
insufficient training opportunities for teachers	87.3	85.6	83.5	76.6
inadequate financial support	72.8	75.6	81.9	78.5
not enough time to develop lessons in which computers are used	83.8	85.3	88.7	85.7

N: (228) (270) (310) (321)

Source: International Computers in Education study, sponsored by the International Association for the Evaluation of Educational Achievement (IEA). National Institute for Educational Research (NIER), Tokyo, unpublished data.

6) Policy Directions and Measures taken by the Government

A large number of experimental or pilot projects on computer education have been or are being undertaken by various groups. Such projects are undertaken by schools themselves, by or on the initiative of education centers or educational research institutes, and by universities. However, the overall responsibility for the implementation of the use of computers in education rests with the Ministry of Education and local (prefectural, municipal) boards

of education, especially in the case of public schools.

It was pointed out in the recommendations and proposals made by various councils and committees of the Ministry of Education in the early 1980s that there was a need for school education to properly respond to the rapid transition of society as it moves toward a highly information-oriented/-based society. Some of the important policy directions incorporated in these recommendations are:

- development of the ability to utilize and handle information through school education and life long education;
- application of new information technology and media to education;
- development of human resources which will be able to lead in the information-oriented society;
- promotion of the use of information technology in educational policy administration and the development of various databases.

In particular, it was emphasized the development of an ability to utilize information or so-called information literacy and it was defined as the basic capability of each individual to actively make use of information and information media. It was also conceived that such ability or information literacy is composed of or fostered by the following:

- Development of the ability to judge, select, reorganize and process information as well as to create new information, and the development of communication skills;
- Appreciation of the characteristics of information and an information-oriented society and the impact of information on such society and human beings;
- Recognition of the significance of information and the development of a sense of responsibility for information; and
- Understanding of the foundation of information science and the characteristics of information media, especially computers, and the acquisition of their manipulative skills.

As already referred to under the section on the curriculum, in the report of the expert meeting organized by the Ministry of Education to discuss the basic principles for introducing computers into schools, the following was proposed: "In elementary schools, the use of computers should aim at the improvement of learning and teaching methods, and in principle, children should be brought in contact with computers, get accustomed to and become familiar with them through the use of computers as a teaching aid, but instruction only for the purpose of understanding of the functions and operation of computers should not be provided at this level". The new Courses of Study are also expected to facilitate the use of computers and the teaching about computers in secondary schools.

A special subsidy system for the procurement of computers by public schools was launched in 1985 by the Ministry of Education, and the introduction of computers has been promoted under this system since then. In line with the enforcement of new Courses of Study, it is planned to install computers in all public schools by 1994.

In 1986, eight schools were designated by the Ministry of Education to undertake experiments on computer education, and since then two dozen schools have been designated to carry out experimental studies every year. Also, the Center for Educational Computing (CEC) was established in 1986 jointly by the Ministry of International Trade and Industry and the Ministry of Education to undertake research studies concerning computers in education and to design computer hardware suitable exclusively for educational purposes in order to promote computer education and the use of computers in education.