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ABSTRACT

In 1989, the International Association for the Evaluation of Educational Achievement (IEA) Computers in Education study collected data on computer use in elementary, and lower- and upper-secondary education in 22 countries. Although all data sets from the participating countries had not been received at the time of writing, this paper provides some preliminary results from 19 educational systems in 18 countries. Countries participating in the study include Belgium (Flemish and French school systems), Canada (British Columbia), China, France, West Germany, Greece, Hungary, India, Israel, Japan, Luxembourg, the Netherlands, New Zealand, Poland, Portugal, Slovenia, Switzerland, and the United States. The paper shows statistics related to: (1) the availability and the use of computer hardware, software, and peripherals; (2) the problems experienced in using computers in schools; and (3) the attitudes of administrators towards computers. The results show that drastic changes have taken place in the last few years in the number of schools equipped with computers, and the number of computers available in schools. It is noted that in most educational systems microcomputers are used by a limited number of teachers, and are used mainly for teaching students about computers. Major problems that appeared included a lack of teacher preparation time, the lack of sufficient computer software of high quality, and a lack of teacher education and training. It is suggested that the creation of short- and long-term implementation strategies could facilitate the integration of computers into existing subjects. (5 references) (DB)

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In 1989, the IEA Computers in Education study collected data on computer use in elementary, lower- and upper secondary education in 22 countries. Although all data sets from the participating countries have not yet been received, this paper contains some preliminary results from 19 educational systems (18 countries).*
The paper shows statistics related to the availability and the use of hard- and software, the problems experienced in using computers in schools and the attitudes towards computers of the principals in the sampled schools. The results show that in the past few years quite drastic changes took place in the number of schools equipped with computers and the number of computers available in schools. Despite this fact, in most educational systems computers still are used by a limited number of teachers, and mainly for teaching students about computers; the integration of computers in existing subjects is increasing quite slowly. The major problems that are experienced in schools deal with teacher time, the lack of sufficient software of high quality, and the training of teachers.

Introduction

The 1980's have shown a rapid increase of the informatization of most societies. The idea that computers are playing an important role in the live of every citizen is not longer discussed. The question how education should react to these developments and what role computers can and should play in schools is still an issue of major debates. Several theoretical perspectives on the role of computers in education are unfolded and many claims exist as to the potential power of computers as instructional aids.
Many countries have adopted policies for the systematic introduction of computers in education. However, the major question still is: how should new information technologies be introduced in education and to what degree are the expected effects of policies actually realized in educational practice.
The major goal of the Computers in Education study (Comped) of the International Association for the Evaluation of Educational Achievement (IEA) is to collect longitudinal and crossnational comparative data in order to contribute to the evaluation of policies on (the introduction of) computers in the countries that are participating in the project.
This paper will contain a summary of results collected in stage 1 of the study (see below) more fully des[illegible] Pelgrum & Plomp (1991) and provides some thoughts about implications for educatio[illegible].

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*The following acronyms will be used for the educational systems participating in this study: BFL:Belgium-Flemish, BFR:Belgium-French, CBC:Canada British Columbia, CHI:China, FRA:France, FRG:Federal Republic of Germany, GRE:Greece, HUN:Hungary, IND:India, ISR:Israel, JPN:Japan, LUX:Lu[illegible]mbourg, NET:Netherlands, NWZ:New Zealand, POL:Poland, POR:Portugal, SLO:Slovenia, SWI:Switzerland, USA:Un[illegible]es of America

Goals and design of the study

The major goals of the study are to describe and analyze crossnationally as well as longitudinally how computers are used in schools by teachers and students, and what cognition, skills and attitudes students have with respect to new information technologies.
The study consists of two stages. During stage 1 (1987-1990) data were collected in elementary, lower secondary and upper secondary schools at school and teacher level. In stage 2 (1991-1994) measures from stage 1 will be repeated and, in addition measures at student level will be taken.
The measures taken in stage 1 of the study were based on a conceptual framework characterizing the educational system in terms of levels of decision-making and identifying the factors contributing to effect changes. These factors were taken from literature on educational change (e.g.: Fullan, Miles, & Anderson, 1988) such as the quality, clarity and relevance of the objectives and the characteristics of the innovation (content, materials, instructional strategies); support and leadership; staff development; experiences with innovations; and the existence of evaluation and feedback. The framework reflects the hierarchical structure of most educational systems, but acknowledges that decisions which promote or inhibit the implementation of computer-related curricula are made at all levels, which may cause discrepancies between decisions and expectations that exist at different system levels. An identification of these discrepancies may in itself be an important starting point for improvement measures in education.
In stage 1, altogether, by means of questionnaires data were collected from about 60.000 respondents (principals, computer coordinators and teachers) from schools sampled in 19 educational systems. As not all samples are national representative, Appendix A contains a description of the population definitions used in each participating system. This Appendix also shows the number of cases for each category of respondents (Table A.1).

The availability of hardware

Figure 1 shows that, in 1989, in many educational systems computers were not yet available for all schools.
In **elementary education** the access to computers is low in Japan and Portugal (respectively 25% and 29%), moderate in Belgium-French (54%), Israel (62%), the Netherlands (53%), while a high degree of access at school level can be observed in British Columbia (99%), France (92%), New Zealand (78%) and the USA (100%).

In **lower secondary education** in Belgium-Flemish, Belgium-French, British Columbia, Federal Republic of Germany, France, Luxembourg, the Netherlands, New Zealand, Switzerland and the USA three quarters or more of the schools have access to and use computers for instructional purposes; Greece, Japan and Portugal show low or moderate access rates of respectively 5%, 36% and 53%.
Most **upper secondary** schools in the educational systems that participated in this study have computers, while access to computers is still low or moderate in Greece (4%), China (61%) and India (7%).
If computers are available in schools, they are used for instructional purposes by most schools.
Table 1 shows that the median number of computers in **elementary schools** varies between 2-5 in Belgium-French, France, the Netherlands and Portugal, 10 in Japan and respectively, 17, 18 and 16 in British Columbia, Israel and the USA.
In most countries **elementary schools** started quite recently with the introduction of computers (typically more than 50% of the schools started after 1986) with the exception of British Columbia and the USA where the median starting year was 1983.

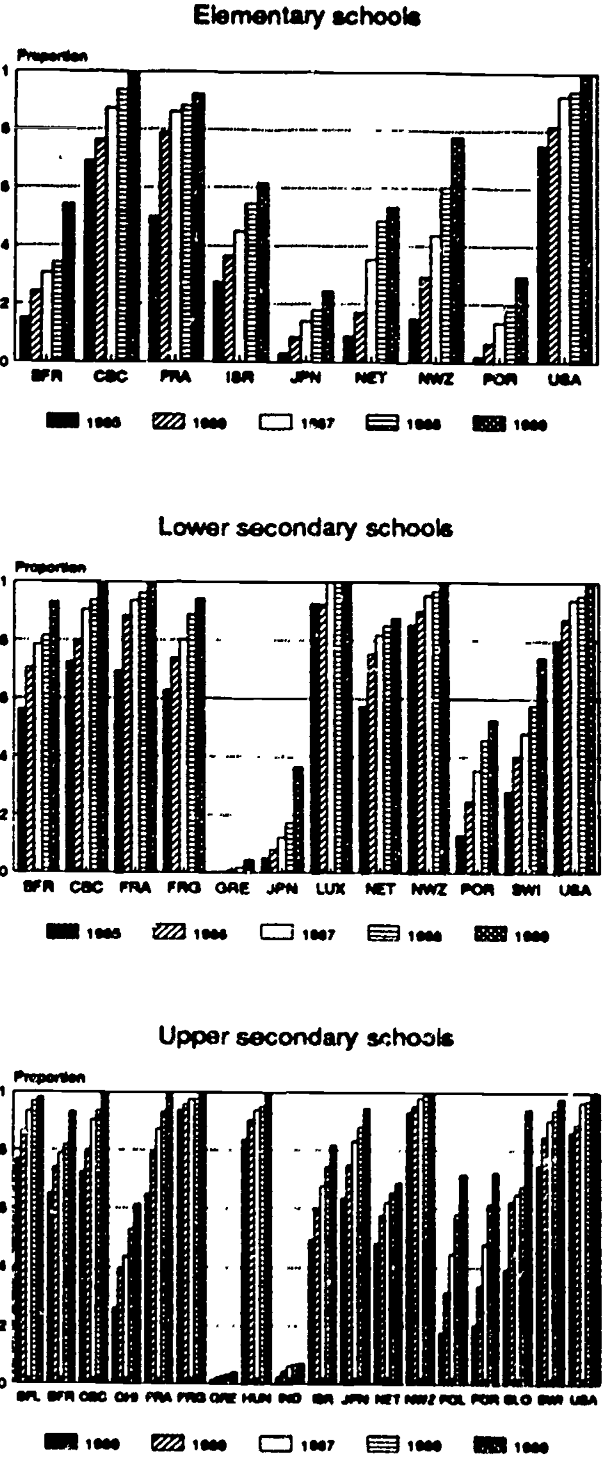

Figure 1. Proportion of schools having computers over the years.

The median number of computers in lower and upper secondary schools is in general higher than in elementary schools. Comparing the first year of educational computer use across populations, one finds a stable trend of upper secondary schools starting first, followed by lower secondary schools and the last the elementary schools. However, the differences between countries are quite large, and Pelgrum & Plomp (1991) showed for instance that many educational systems were, in 1989, at the level of British Columbia and the USA in 1985 or 1986 with respect to the median number of computers in schools.

Table 1
Medians of number of computers in 1989 and year of first use (according to computer coordinators)

	Country / Educational System																		
Use of Computers	BFL	BFR	CBC	CHI	FRA	FRG	GRE	HUN	IND	ISR	JPN	LUX	NET	NWZ	POL	POR	SLO	SWI	USA
Elementary schools																			
First year	-	86	83	-	85	-	-	-	-	86	87	-	87	87	-	86	-	-	83
Student:computer ratio 1989	-	28	21	-	23	-	-	-	-	17	14	-	64	62	-	301	-	-	23
# computers	-	5	17	-	2	-	-	-	-	18	10	-	2	2	-	3	-	-	19
Lower secondary schools																			
First year	84	84	82	-	85	85	88	-	-	-	87	83	84	83	-	87	-	87	83
Student:computer ratio 1989	27	34	12	-	31	46	52	-	-	-	143	48	26	34	-	287	-	21	17
# computers	12	12	43	-	15	11	8	-	-	-	7	16	18	17	-	5	-	9	18
Upper secondary schools																			
First year	83	82	82	86	83	80	86	83	86	84	85	-	83	82	87	86	83	83	82
Student:computer ratio 1989	32	38	12	43	26	48	44	28	572	26	32	-	35	37	53	289	58	20	14
# computers	12	11	43	23	24	14	17	17	2	20	25	-	25	18	10	5	11	19	27

Notes. - = data not collected, 1985-1988: recall; 1989: actual; 1990: expected.

The student:computer ratio varies substantially, for elementary schools between about 15-25 in British Columbia, Israel, Japan, France and the USA and almost two to three times as many in countries like the Netherlands and New Zealand. Exceptional is Portugal with a student:computer ratio of 301, which is caused by the fact that Portuguese elementary schools are quite large. It is interesting to note that the student:computer ratio in France suggests a more favorable picture for elementary schools than the absolute number of available computers. This can be explained by the relatively small school size of elementary schools in France (with a median of 71 students compared to, for instance, 233 in Belgium-French and 830 in Portugal). On the whole, the student:computer ratio is more favorable in secondary schools than in elementary schools. There are however, again, large differences between countries, showing that in British Columbia and the USA the conditions for integrating computers in the school curriculum are most favorable, while in other countries the ratio's are almost two to three times as high. It is also interesting to note that, although Switzerland has a relatively low number of computers per school, the student:computer ratio is quite favorable (and almost at the level of the USA) due to the fact that Swiss schools on the average are relatively small.

One of the questions arising from the results presented in Table 1 is whether schools have enough computers. This question is difficult to answer from a theoretical perspective because so many factors are involved, such as the goals of computer use, availability of adequate software, training of teachers, etc. However, we may get a tentative answer to this question by looking at the problems educational practitioners perceive as serious in using computers.

One of the questions presented to all respondents (principals, computer coordinators and teachers) contained a list of about 30 problems (related to hardware, software, teacher training and skills, and organization) which could be experienced as serious in using computers for educational purposes in the school. Respondents were asked to check each problem that they considered as serious in using computers in the school, but also to select from the list the five most serious problems. Table 2 contains the percentages of school principals and computer coordinators who included a particular hardware problem in their top five selection from the total list of problems.

Table 2

Percentage of school principals (P) and computer coordinators (C) including a particular hardware problem in their top-five selection of serious problems in using computers in school

		Country / Educational System																		
Hardware Problem		BFL	BFR	CDC	CHI	FRA	FRG	GRE	HUN	IND	ISR	JPN	LUX	NET	NWZ	POL	POR	SLO	SWI	USA
Elementary schools																				
Insufficient computers	P	-	52	64	-	54	-	-	-	-	36	46	-	73	60	-	63	-	-	58
	C	-	58	61	-	46	-	-	-	-	34	29	-	70	66	-	67	-	-	54
Insufficient peripherals	P	-	10	26	-	8	-	-	-	-	12	18	-	16	24	-	17	-	-	37
	C	-	13	22	-	8	-	-	-	-	21	15	-	24	20	-	21	-	-	32
Difficulty maintenance	P	-	8	16	-	30	-	-	-	-	14	0	-	0	13	-	3	-	-	6
	C	-	6	15	-	24	-	-	-	-	14	4	-	1	11	-	2	-	-	10
Limitations of computers	P	-	4	10	-	25	-	-	-	-	18	12	-	21	5	-	8	-	-	12
	C	-	12	16	-	23	-	-	-	-	29	18	-	15	5	-	20	-	-	11
Lower secondary schools																				
Insufficient computers	P	43	50	53	-	37	18	32	-	-	-	50	17	37	62	-	70	-	40	63
	C	33	34	32	-	36	22	14	-	-	-	61	26	33	38	-	66	-	31	52
Insufficient peripherals	P	21	14	27	-	7	5	13	-	-	-	15	13	14	24	-	27	-	14	37
	C	20	16	8	-	4	16	13	-	-	-	11	11	11	18	-	26	-	7	24
Difficulty maintenance	P	2	5	10	-	18	3	16	-	-	-	4	13	7	14	-	3	-	4	8
	C	4	7	4	-	22	8	23	-	-	-	5	48	9	20	-	5	-	9	11
Limitations of computers	P	13	5	7	-	18	12	8	-	-	-	9	26	2	8	-	11	-	14	15
	C	16	9	10	-	18	24	6	-	-	-	9	30	10	13	-	21	-	22	16
Upper secondary schools																				
Insufficient computers	P	44	51	53	54	49	19	-	36	59	44	47	-	44	53	31	72	54	28	65
	C	41	39	33	42	38	14	-	24	59	41	46	-	28	43	21	69	m	26	50
Insufficient peripherals	P	32	16	27	35	18	8	-	31	16	17	18	-	16	22	23	26	7	11	33
	C	27	17	8	33	16	12	-	32	16	19	16	-	9	18	21	31	m	6	19
Difficulty maintenance	P	4	4	10	29	16	3	-	16	23	16	9	-	11	12	35	4	11	12	8
	C	5	8	4	35	14	7	-	13	22	18	6	-	9	18	35	5	m	12	9
Limitations of computers	P	20	4	7	25	12	14	-	23	6	24	19	-	8	17	15	10	16	22	14
	C	19	10	11	30	11	24	-	29	10	28	17	-	13	14	14	17	m	31	18

Notes. - = data not collected, m = insufficient number of cases (n<50 or missing cases >20%).

From Table 2 one may infer that the lack of a sufficient number of computers and peripherals (although less frequently mentioned) is perceived as a serious problem by a large group of respondents in many countries.

In some countries (for instance, in lower secondary schools in Belgium-Flemish, France, Germany, Luxembourg, Portugal and Switzerland) relatively large groups of respondents complain about the limitations of computers (like being out of date). In future analyses we will try to determine wether this is related to the type of computers available in the schools.

The availability of software

This survey contained a number of questions about the availability of software in the schools. The computer coordinators were asked to check which of the following types of programs were available in the school:

drill and practice, database, tutorial programs, lab interfaces: automatic, word processing, data acquisition, painting or drawing, programs to control devices, music composition, programs to control interactive video, simulation, CAD/CAM, recreational games, CAI authoring language, educational games, item banks, programming languages, record/score tests, spreadsheet, grade book, mathematics graphing, computer communication, statistics, and tools/utilities

The results described by Pelgrum & Plomp (1991) show that, except for Portugal, in most participating countries more than 80% of the computer using **elementary schools** possess drill and practice software. For tutorial programs there are large differences between countries: in the USA it is quite common for schools to possess these programs, whereas, for instance, in France only 27% of the schools have programs of this type. Word processing software and educational computer games are also available in many schools, although the percentages for word processing found in France and Israel (respectively 66% and 62%) are relatively low. Databases and spreadsheets are less widespread. Furthermore, it is interesting to note that the availability of programming languages in elementary schools varies considerably between as well as within countries: about 70% or more of the schools in Belgium-French, France and Israel have programming languages available. This points to the potential use of LOGO. On the other hand, in some other countries (New Zealand, the Netherlands and the USA) only a small group of elementary schools (18-34%) possesses programming languages.

In **lower secondary schools** the picture is somewhat different. Software for word processing, spreadsheets and databases is widely available in most countries. The availability of database programs is relatively low in Belgium-French, France, Germany, Japan and the USA. Programming languages are also widely available in lower secondary schools, although the percentages of schools possessing programming languages are relatively low in Belgium-French, Japan, the Netherlands and the USA (respectively 67%, 61%, 67% and 42%). Drill and practice and/or tutorial programs are available in many lower secondary schools in some countries (the Netherlands, New Zealand and the USA), but in a relatively small number of schools in other countries (for example, Belgium-Flemish, Greece, Portugal and Switzerland).

Many **upper secondary schools** (more than 70%) possess programming languages (Portugal only 68%) and word processing programs (China only 27%). A general trend is that in comparison with lower secondary schools the availability of drill and practice and tutorial programs is somewhat lower in upper secondary schools, but spreadsheets, databases and more specialized programs (like programs for controlling devices or CAD/CAM programs) are available in more schools.

The computer coordinators were also asked to indicate for which school subjects software was available in the schools.

A majority of **elementary schools** possess software for mathematics and mother tongue. However, software for informatics (that is, learning about computers) is not as widespread.

In **lower and upper secondary education** many schools in the participating educational systems possess some software for courses to learn about computers (informatics) and for mathematics. There are, however, remarkable differences. For instance, the percentage of schools having software for mathematics in lower secondary education ranges from 10 % in Greece to about 95 % in New Zealand and France. Similar differences are found for software that can be used in other courses, such as science and mother tongue.

This study did not record which programs are available in the schools, and whether there is any shortage of particular software, or what the quality of the available programs is. However, there are a few indicators that can throw some light on the last two questions. These indicators consist of the inventory of problems that were presented to the respondents with the request to select five problems (from a list of 30) that were experienced as most serious. Table 3 contains the percentages of respondents including a particular software problem in this selection.

Table 3

Percentage of principals (P) and computer coordinators (C) including a particular software problem in their top five selection of serious problems in using computers in the school

Software Problem		BFL	BFR	CDC	CHI	FRA	FRG	GRE	HUN	IND	ISR	JPN	LUX	NET	NWZ	POL	POR	SLO	SWI	USA
Elementary schools																				
Insuff. software	P	-	32	35	-	19	-	-	-	-	34	62	-	46	34	-	38	-	-	25
	C	-	54	32	-	21	-	-	-	-	47	75	-	57	48	-	48	-	-	32
Softw. difficult	P	-	2	1	-	5	-	-	-	-	1	3	-	3	4	-	1	-	-	5
	C	-	4	3	-	5	-	-	-	-	4	3	-	7	3	-	8	-	-	8
Softw.not adaptable	P	-	13	3	-	11	-	-	-	-	3	29	-	26	5	-	4	-	-	5
	C	-	13	3	-	11	-	-	-	-	5	23	-	19	4	-	7	-	-	4
Poor manuals	P	-	3	1	-	6	-	-	-	-	4	4	-	4	13	-	1	-	-	1
	C	-	4	2	-	6	-	-	-	-	2	8	-	6	8	-	3	-	-	2
Lack info softw.	P	-	5	7	-	13	-	-	-	-	9	14	-	6	15	-	3	-	-	9
	C	-	13	7	-	11	-	-	-	-	7	13	-	7	18	-	8	-	-	5
Softw.other lang.	P	-	2	8	-	1	-	-	-	-	3	8	-	3	3	-	6	-	-	8
	C	-	3	2	-	0	-	-	-	-	3	1	-	8	2	-	18	-	-	8
Lower secondary schools																				
Insuff. software	P	32	34	39	-	13	21	37	-	-	-	36	9	53	20	-	41	-	33	25
	C	50	38	27	-	18	30	55	-	-	-	65	59	53	34	-	55	-	37	36
Softw. difficult	P	3	1	8	-	4	5	6	-	-	-	7	0	18	1	-	2	-	5	1
	C	0	2	1	-	5	5	3	-	-	-	4	8	17	4	-	4	-	9	1
Softw.not adaptable	P	15	6	11	-	17	3	12	-	-	-	12	4	34	2	-	4	-	11	8
	C	25	10	3	-	13	4	10	-	-	-	14	4	20	5	-	8	-	12	9
Poor manuals	P	2	3	8	-	3	5	23	-	-	-	4	0	4	2	-	2	-	7	2
	C	8	11	7	-	4	9	41	-	-	-	7	0	6	5	-	8	-	13	5
Lack info softw.	P	6	12	11	-	14	5	17	-	-	-	18	18	6	7	-	7	-	8	4
	C	9	15	7	-	13	14	18	-	-	-	20	4	8	17	-	12	-	8	6
Softw.other lang.	P	8	4	2	-	0	8	27	-	-	-	0	26	2	1	-	3	-	4	0
	C	9	2	0	-	1	1	29	-	-	-	0	22	3	1	-	10	-	6	0
Upper secondary schools																				
Insuff. software	P	30	31	39	57	22	-	25	48	32	38	-	47	39	32	55	35	41	19	18
	C	36	35	26	58	23	-	26	47	34	40	-	44	44	25	56	55	m	28	30
Softw. difficult	P	2	1	0	0	1	-	4	4	3	8	-	7	4	0	1	1	6	8	0
	C	1	2	1	1	3	-	4	3	5	2	-	4	3	0	1	2	m	9	1
Softw.not adaptable	P	13	9	11	4	9	-	3	6	11	18	-	19	21	13	10	5	18	8	14
	C	15	5	4	4	7	-	3	6	11	8	-	17	17	9	6	7	m	4	8
Poor manuals	P	7	5	8	8	4	-	11	13	5	2	-	5	6	1	23	1	4	13	3
	C	13	6	7	6	6	-	8	19	7	9	-	6	6	5	30	7	m	14	5
Lack info softw.	P	8	16	11	8	10	-	8	8	18	13	-	11	6	10	11	8	6	8	12
	C	4	12	7	8	9	-	18	15	10	9	-	12	15	14	14	11	m	8	6
Softw.other lang.	P	4	0	2	18	1	-	0	6	13	5	-	3	2	0	5	3	2	3	0
	C	7	6	8	14	0	-	1	5	10	7	-	1	3	0	3	8	m	4	0

Notes. - = data not collected, m = insufficient number of cases (n<50 or missing cases >20%).

Table 3 shows that a shortage of software is experienced as a serious problem by many respondents, while the lack of information about software and the adaptability of software is mentioned relatively frequently as the second problem, although these percentages are not very high. The observation from Table 3 is consistent with the priorities for computer-related expenditures mentioned by computer coordinators, who mentioned the need for a greater variety of instructional software most frequently as highest priority.

The use of computers in existing subjects

A first question to address is how many teachers are using computers. For a subset of countries that handed in complete data sets, we were able to estimate the percentage of teachers in computer using schools actually using computers for instructional purposes (see Table 4). Although this is a rough indicator (counting even teachers that use computers marginally), it is quite interesting to see in Table 4 that in computer using **elementary schools** most of the teachers in grades 4-6 use computers. However, in lower **secondary schools** in most countries the integration of computers in existing subjects is still an activity of a rather small group of teachers. In upper secondary schools the percentage of teachers using computers is higher than in lower secondary schools, except for Germany (mathematics and mother tongue), New Zealand (mother tongue) and Portugal. Especially revealing, but also promising for the near future, are the relatively high percentages of computer-using teachers in the USA, where in 1989 (compared to 1985) a considerable increase of teacher use could be observed. Table 4 also shows that, as a trend, mathematics teachers are more inclined to use computers for their lessons than teachers in other subjects. In New Zealand there is a relatively high proportion of mother tongue teachers in lower secondary schools using computers.

Table 4

Percentage of teachers of existing subjects using computers in computer using schools

	Country / Educational System										
	BFL	FRG	IND	ISR	LUX	NET	NWZ	POL	POR	SWI	USA
Elementary schools	-	-	-	96	-	74	92	-	-	-	76
Lower secondary schools											
Mathematics	8	42	-	-	8	14	38	-	20	21	56
Science	4	10	-	-	m	4	17	-	15	15	39
Mother tongue	3	17	-	-	7	8	36	-	7	11	44
Upper secondary schools											
Mathematics	30	28	44	5	-	61	64	28	9	46	61
Science	21	22	53	6	-	32	37	11	7	31	58
Mother tongue	5	4	10	2	-	8	12	1	2	10	47

Note. - = data not collected, m = insufficient number of cases (n<50 or missing cases >20%).

For a complete overview of the subjects for which computers are used in schools (irrespective of the number of teachers using computers in a subject and, hence, different from Table 4) we refer to Table 5. This table shows that across populations in most countries the use of computers is most frequently mentioned for the subjects mathematics and science; in elementary and lower secondary schools mother tongue and social studies are mentioned relatively frequently too, while in upper secondary schools in quite some countries commercial studies are mentioned.

In order to find out what teachers (who use computers as well as the non users) see as the major obstacles in using computers one may look at the problems users experience as well as the reasons for not using computers as indicated by the non using teachers. The results described by Pelgrum & Plomp (1991) show that the four problems that are most frequently mentioned are: lack of hardware, lack of software, problems with finding enough time to learn about computers or lack of time to prepare lessons in which computers are used. In elementary schools, teachers also frequently mention their lack of knowledge. The ranking of these problems in terms of relative frequencies differ from country to country and future analyses will be aimed at trying to identify which circumstances are of potential influence on what teachers perceive as problems in using computers.

Table 5

Percentage of computer coordinators indicating computer use in particular subjects

Country / Educational System

Subjects	BFL	BFR	CBC	CHI	FRA	FRO	GRE	HUN	IND	ISR	JPN	LUX	NET	NWZ	POL	POR	SLO	SWI	USA
Elementary schools																			
Informatics	.	79	60	.	80	.	.	.	.	39	48	.	48	72	.	35	.	.	65
Mathematics	.	75	76	.	82	.	.	.	.	86	96	.	92	78	.	54	.	.	83
Science	.	22	54	.	42	.	.	.	.	13	51	.	11	36	.	23	.	.	51
Mother tongue	.	69	90	.	84	.	.	.	.	74	55	.	94	79	.	26	.	.	79
Foreign language	.	2	4	.	1	.	.	.	.	74	8	.	16	4	.	24	.	.	4
Creative arts	.	13	44	.	40	.	.	.	.	9	21	.	27	31	.	27	.	.	13
Social studies	.	38	63	.	44	.	.	.	.	16	37	.	87	32	.	28	.	.	51
Commercial studies	.	8	43	.	8	.	.	.	.	8	8	.	9	26	.	8	.	.	8
Technology general	.	1	11	.	29	.	.	.	.	0	8	.	8	8	.	8	.	.	8
Lower secondary schools																			
Informatics	88	93	91	.	76	93	97	.	.	.	26	100	94	77	.	15	.	97	68
Mathematics	36	51	68	.	89	84	12	.	.	.	58	39	62	84	.	42	.	66	68
Science	14	15	66	.	56	39	8	.	.	.	46	37	32	25	.	19	.	41	43
Mother tongue	8	16	69	.	72	37	8	.	.	.	20	22	48	83	.	14	.	42	60
Foreign language	22	12	15	.	51	22	2	.	.	.	30	15	22	25	.	9	.	22	6
Creative arts	2	3	54	.	16	9	9	.	.	.	11	8	8	21	.	9	.	20	13
Social studies	6	5	53	.	31	30	8	.	.	.	27	11	26	54	.	21	.	18	31
Commercial studies	15	33	86	.	29	27	2	.	.	.	8	45	28	70	.	19	.	31	22
Technology general	17	5	44	.	76	12	2	.	.	.	36	4	15	8	.	2	.	6	-
Technology specific	11	13	47	.	29	18	8	.	.	.	8	19	29	18	.	18	.	7	14
Home economics	2	8	24	.	14	1	8	.	.	.	18	4	2	7	.	8	.	3	13
Upper secondary schools																			
Informatics	96	92	91	92	81	92	97	73	98	98	50	.	72	90	81	67	98	97	90
Mathematics	50	63	68	32	64	94	23	66	62	26	51	.	59	83	63	32	54	54	71
Science	35	34	66	31	54	65	3	51	64	34	43	.	42	35	57	31	35	45	58
Mother tongue	8	11	69	2	33	34	8	9	22	15	13	.	33	61	4	12	5	21	57
Foreign language	39	12	15	6	32	19	8	34	14	26	16	.	36	15	18	18	13	13	23
Creative arts	9	3	54	1	6	8	3	5	13	5	5	.	3	23	3	4	2	7	20
Social studies	8	4	54	4	21	41	4	18	19	3	17	.	33	55	2	17	8	17	32
Commercial studies	52	54	85	18	64	19	[illegible]	9	19	41	31	.	35	83	1	36	16	54	75
Technology general	16	7	44	1	34	7	3	37	4	7	15	.	8	8	8	4	7	11	.
Technology specific	25	20	47	4	48	18	6	34	9	34	8	.	18	24	2	23	22	22	43
Home economics	8	2	24	8	7	1	8	8	2	8	14	.	8	4	20	8	5	1	33

Note. - = data not collected.

Staff development and teachers' knowledge and skills

The results described by Pelgrum & Plomp (1991) showed that staff development activities mainly consist of introductory and application courses. In secondary schools in many systems, courses in computer science/programming and in computer use in specific subjects are available. Authorities are quite supportive of staff development. The limited role of universities and (teacher) associations in providing teacher training is remarkable.

Computer related training mainly deals with applications, problem analysis and programming. It is remarkable that pedagogical/instructional aspects are the least mentioned topics although using teachers mention these topics more often than non users.

Many teachers have informal contacts with colleagues within their schools.

The framework for the study referred to in the previous sections included the knowledge and skills of teachers in handling computers as one of the factors influencing the integration of computers into existing subjects. This factor is difficult to measure (not only in cross-national but also in national surveys) as the testing of teachers in most countries is rather controversial. In this study a self-rating scale consisting of a list of statements about computer related knowledge and skills, asking teachers to indicate by checking 'yes' or 'no' whether they had the knowledge or could perform the action indicated in the statement.

Some evidence about the validity of these scales was collected in 1988 in England and Germany during the pilot phase of this instrument. That pilot test consisted of administering the self-rating scales in combination with a set of multiple choice items related to each of the statements in the self-rating scales. Analyses of these data showed that both measures were similar in a relative sense (namely, there were high correlations between the self-ratings and the multiple choice part), but there was also quite a high similarity in an absolute sense (almost all respondents failing on a particular multiple choice item checked 'no' on the corresponding self-rating item). Based upon these results, it was concluded that it was worthwhile to include the self-ratings in the study.

Table 6 contains the results of the self-ratings by teachers. This table shows that in some educational systems the median of the percentages for the non using teachers in existing subjects on some of the three scales is 0. The results show that using teachers in existing subjects know more than their non using colleagues. The scores for the using teachers in elementary schools are in general lower than the scores at the other levels. In this level in the scale "Programming" in New Zealand and the USA the median score for both using and non using teachers is zero, which, in combination with the other low scores on this scale, is an indicator of the low priority of programming among the using teachers.

One might have expected that the computer education teachers in lower and upper secondary schools would have higher scores than the using teachers in other subjects. Although, in general, this trend can be observed, in many educational systems the scores of the using teachers do not differ greatly from the computer education teachers (see, for example, in upper secondary schools the scale "Programming"). Some educational systems are noteworthy. In Switzerland on the scales "Programming" and "Capability" in both lower and upper secondary schools, the using teachers and the computer education teachers do have the same scores. In other educational systems, there are sizable differences between the using teachers and computer education teachers on the scale "Programming", namely in lower and upper secondary schools in New Zealand and the USA, and in upper secondary schools in Poland, Portugal, Slovenia. Further analysis is needed to explain this contrast in these educational systems and the much smaller differences in the other educational systems.

Table 6

Median percentage on knowledge and skill scales of male and female teachers (users)

	Country / Educational System																		
	BFL	BFR	CBC	CHI	FRA	FRG	GRE	HUN	IND	ISR	JPN	LUX	NET	NWZ	POL	POR	SLO	SWI	USA
Elementary schools																			
Know-scale																			
Male	·	m	56	·	44	·	·	·	·	m	44	·	33	44	·	·	·	·	44
Female	·	m	33	·	33	·	·	·	·	m	22	·	22	33	·	·	·	·	33
Programming-scale																			
Male	·	m	0	·	40	·	·	·	·	m	20	·	0	0	·	·	·	·	0
Female	·	m	0	·	0	·	·	·	·	m	0	·	0	0	·	·	·	·	0
Capability-scale																			
Male	·	m	63	·	50	·	·	·	·	m	50	·	50	63	·	·	·	·	50
Female	·	m	50	·	25	·	·	·	·	m	38	·	25	38	·	·	·	·	50
Lower secondary schools																			
Computer teachers																			
Know-scale																			
Male	78	m	m	·	·	m	m	·	·	·	m	m	89	100	·	89	·	m	89
Female	67	m	m	·	·	m	m	·	·	·	m	m	73	78	·	56	·	m	78
Programming-scale																			
Male	80	m	m	·	·	m	m	·	·	·	m	m	100	100	·	60	·	m	80
Female	80	m	m	·	·	m	m	·	·	·	m	m	50	60	·	40	·	m	60
Capability-scale																			
Male	75	m	m	·	·	m	m	·	·	·	m	m	75	88	·	88	·	m	88
Female	63	m	m	·	·	m	m	·	·	·	m	m	63	75	·	75	·	m	75
Using teachers*																			
Know-scale																			
Male	m	m	67	·	78	m	m	·	·	·	m	m	m	78	·	m	·	m	67
Female	m	m	44	·	44	m	m	·	·	·	m	m	m	33	·	m	·	m	44
Programming-scale																			
Male	m	m	20	·	80	m	m	·	·	·	m	m	m	60	·	m	·	m	40
Female	m	m	0	·	20	m	m	·	·	·	m	m	m	0	·	m	·	m	30
Capability-scale																			
Male	m	m	75	·	75	·	m	·	·	·	m	m	m	69	·	m	·	m	75
Female	m	m	75	·	38	·	m	·	·	·	m	m	m	50	·	m	·	m	63

(continued on next page)

Table 6.7 (continued)
Median percentage on knowledge and skill scales of male and female teachers (users)

Country / Educational System

	BFL	BFR	CDC	CHI	FRA	FRG	GRE	HUN	IND	ISR	JPN	LUX	NET	NWZ	POL	POR	SLO	SWI	USA
Upper secondary schools																			
Computer teachers																			
Know-scale																			
Male	100	100	m	67	89	m	m	89	67	89	m	-	m	100	89	100	m	100	100
Female	89	89	m	56	89	m	m	78	78	78	m	-	m	89	78	100	m	78	89
Programming-scale																			
Male	100	100	m	100	100	m	m	100	80	100	m	-	m	100	100	100	m	100	100
Female	100	100	m	80	60	m	m	100	100	100	m	-	m	100	80	100	m	80	80
Capability-scale																			
Male	88	88	m	75	[illegible]	m	86	88	63	88	m	-	m	86	88	100	m	88	88
Female	75	75	m	50	75	m	m	63	75	75	m	-	m	75	75	82	m	88	88
Using teachers*																			
Know-scale																			
Male	m	m	m	m	78	m	m	73	67	m	m	-	m	78	m	m	m	m	67
Female	m	m	m	m	44	m	m	56	56	m	m	-	m	56	m	m	m	m	44
Programming-scale																			
Male	m	m	m	m	100	m	m	100	80	m	m	-	m	80	m	m	m	m	40
Female	m	m	m	m	20	m	m	60	80	m	m	-	m	40	m	m	m	m	20
Capability-scale																			
Male	m	m	m	m	75	m	m	63	50	m	m	-	m	75	m	m	m	m	75
Female	m	m	m	m	38	m	m	38	63	m	m	-	m	63	m	m	m	m	63

Notes. - = data not collected, m = insufficient number of cases (<30 females and/or <30 males, or missing cases >20%).
* using teachers are computer using teachers of existing subjects (mathematics, science and mother tongue).

Another result which should be pointed to is that in many educational systems for the using teachers in existing subjects the scores on the "Programming" scale is higher than on the other two scales. Here again, further analysis is needed to explain this phenomenon.

Discussion

This paper contained some of the results from a description by Pelgrum & Plomp (1991) of the status of computer use in 1989 in 19 educational systems.
Although the summary given here is rather short, still a picture arises that can be very succinctly characterized as follows: throughout the world there is a continuous (albeit quite unequal) development of access of schools to computers, increasing amounts of computer equipment are installed in schools and -gradually- increasing numbers of teachers/students are using computers for instructional purposes. Despite this development there is still a lot of unequity in access to computers, even in highly developed countries, and educational practitioners feel that a number of basic conditions for using computers for instructional purposes have not yet been fullfilled: there is shortage of hardware, shortage of software, teachers are insufficiently trained and teachers don't have enough time for preparing the use of computers in their lessons adequately.
What do these results mean from an educational policy point of view? We will address this question by looking at the following two derived questions: (1) Are the results in line with policy

expectations?; (2) Are there any indications from the results in what direction future policies might be developed? Before addressing these questions, we first want to discuss a seemingly paradox in the description given above.

Paradox between experienced problems and increased use?

If teachers don't have enough time, how can still such a relative large group use computers? And, if teachers say that they are not knowledgeable enough how can they make use of computers at all? A tentative interpretation may be as follows. Despite all the problems teachers expect before starting to use computers (which we may infer from reasons given for not using computers) and despite all the problems experienced by those colleagues who already use computers, the data collected in several surveys in the USA indicate that there is a steady (although slow) increase of the number of teachers using computers over years. This development may be interpreted as indicating that apparently there are forces opperating that compensate for negative perceptions about the conditions for using computers. So, although the pessimistic predictions about the problems related to the introduction of computers in education made in the earlier days of educational computer use, seem to come through, this doesn't seem to lead to withdrawal reactions of educational practitioners (that is, increasing numbers of schools and teachers refraining from using computers) like has been the case with other technological innovations in education, for example language laboratories. Apparently the negative perceptions of educational practitioners are being compensated in one way or the other by positive expectations or perceptions. One possible important compensating factor is the expected educational impact of using computers which, in general, is quite high especially in the USA (see Pelgrum, 1991). Very significant also may be the finding that teachers seem to think they observed positive changes as a result of using computers: respectively 69, 61 and 52 per cent of the teachers of mathematics, science and mother tongue in lower secondary schools in the USA sample indicated that they observed an increased availability of feedback about student achievement, an increased interest of students, and increases in student achievement. Pelgrum & Plomp (1991) found similar patterns in other countries.

Hence, in summary, when looking at the trends in the data, it looks like the computer has past its first test of usefullness as an educational medium.

Are computers used as expected?

We may now turn to the first question posed above which may be conceived as a second test of the usefullness of computers in education, namely whether the use of computers in educational practice is consistent with expectations put forward by enthusiastic proponents. One of the most provoking expectations expressed in the past was about the potential of computers to reshape education into an institution emphasizing the learning of productive skills by offering students an attractive learning environment heavily dominated by self exploratory (by means of computer simulation) and problem solving activities. Our data seem to demonstrate that this situation is still far from being realized as the use of computers in education still is quite heavily dominated by what might be called low-level-adoption, such as learning about computers and particular applications (like word processing) and drill and practice in existing subjects, whereas simulations and self explorations as indicators of high-level-use are applied to a lesser extent. Hence, if we admit that the use of computers in education still is not meeting the expectations of enthusiastic proponents, we may turn to the second question raised above, that is which indications may be inferred from our findings as to the direction of future policies.

Possible implications for future policies

In this paper we have shown that, if we take the views of educational practitioners seriously, quite a number of interrelated problems (the most prominent being: shortage of hardware and software, teacher skills and teacher time for lesson preparation) need to be solved. Although these problems are experienced at school level, policies directed at creating solutions may also be developed at school transcending levels. Given the amount of time required to effect changes in any of the domains related to each of these problem areas it seems realistic to make a distinction between short term and long term strategies with respect to the implementation of computers in education. In developing a short term strategy one may take certain limitations and currently popular patterns of (low level) computer use for granted and try to devise measures to consolidate and optimize the use of computers within these constraints, while a long term strategy would consist of focusing on realizing high level use. We will first give here some examples of possible short term and long term strategies.

A **first example of a short term strategy** is related to limitations in the hardware infrastructure of schools.
The hardware infrastructure available in many schools does not allow that many teachers and students can use the equipment at the same time. As a consequence, as long as there is no drastic change in the number of computers per school or the organization of lessons as whole class activities, one may expect that the use of computers is restricted to either a few teachers which can use computers intensively, or many teachers who use computers only incidently with all students in their classes ('whole class use'). If the hardware structure is not changing on a short term, then one might question whether whole class use of computers must be stimulated. The other way of using computers might offer a real alternative, namely the use by the teachers as an aid in teaching, for example for demonstrations in the classroom. With a limited number of computers in a school, this type of use would allow in any case that many teachers in parallel can use computers in their instruction. A clear advantage of such an approach could be that computers are integrated throughout the school curriculum in many subjects. Disadvantages are that additional equipment for each class is needed (like overhead plasma screens) and that students cannot profit directly from the interactivity characteristic of a computer. Adopting such a strategy will have consequences for the type of software to be acquired, but might also lead to increasing costs for software acquisition as programs need to be made available for the whole range of subjects in the school curriculum.

A **second example of a short term strategy** concerns the problem for teachers of finding time to prepare lessons with computer use. Across countries principals, computer coordinators and teachers mention this problem as one of the major ones (it is almost consistently in the top four). This may be caused by the fact that usually applications of computers during a lesson requires preparatory activities different from the ones teachers are used to (which consists of using a textbook as major source for lesson preparation). Assuming that teachers who use computers, still use their textbook one might opt for a short term strategy consisting of integrating software descriptions in the textbook by either educational publishers or software producers. Effects may be expected especially if during the development of materials the perspective of the 'teacher as learner' is taken into account. Courseware designed from this perspective must have many procedural specifications (careful 'how-to-do-suggestions') which help the teachers to deal with the key problems of lesson preparation, namely lack of background knowledge and skills, changes in didactical role, and insufficient view on possible learning outcomes (Van den Akker, 1988). The importance of this angle of looking at the time problems is, that the shortage of time which is perceived as an important problem for teachers is not compensated by providing more time, but by trying to improve the quality of other variables in the teaching process (in this case the quality of the educational software and other curriculum materials).

Examples of **long term strategies** are much more difficult to give, because such strategies should contain full elaborations of goals and means. We may interpret our findings regarding the status of computer use in 1989 as the first response of schools to the challenge to "join the computer revolution" (Walker, 1986, p.35), namely to start with the easiest applications, such as the teaching of computer education courses, and applications like drill and practice by taking the whole class to the computer lab. Walker rightly points to the fact that "anything else requires more money, more effort and expertise from teachers, and more variance from existing school practices" (o.c. p.35). Should we be disappointed by this situation? We do not believe that this is necessary, if authorities and educators are willing to look at computers in education from the perspective of a complex innovation to be introduced in educational practice and consequently want to invest in designing long term implementation strategies aimed at creating new learning environments by means of new technologies. Walker (1986, p.33) rightly states that "if even a small part of the visionary dreams of computer-based education is to be realized, major changes will be required in the day-to- day activity and interaction patterns in classrooms. ... Developing these new patterns will require collaborative effort on a large scale sustained over a decade or more." If we look at the status of the use of computers in education from this perspective then we may consider the present situation the beginning stage of a long process that may take many years. If policy makers, administrators, teachers and courseware developers consider the present situation from such an implementation perspective, and if they are willing to undertake initiatives contingent with such a situation, by choosing short term strategies in the perspective of long term strategies, then we may expect a development away from the easiest responses preserving traditional schooling to innovative approaches aimed at creating challenging learning environments with the help of new technologies. In devising long term plans one needs insight in how different factors in the process of implementation of computers in education affect each other. It is hoped that further analyses of the data resulting from stage 1 and the data to be collected in stage 2 of this study will contribute during the forthcoming years to increasing our knowledge of how different factors affect the pace and direction of the implementation of computers in education.

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Appendix A

National target population and sample sizes

Belgium-Flemish

Population 2 (lower secondary education) and Population 3 (upper secondary education).
All (state, province/community and catholic) schools offering comprehensive general or comprehensive technical/arts education.

Belgium-French

Population 1 (elementary education).
All (state, province/community and catholic) schools, except special education (3,7% of all students).
Population 2 (lower secondary education).
All (state, province/community and catholic) schools offering comprehensive general or comprehensive vocational education (technical and arts). Excluded is vocational education (22,8% of all students) and special education (3,9% of all students).
Population 3 (upper secondary education).
All general secondary and vocational schools, except special education (3,9%).

Canada-British Columbia

Population 1 (elementary education), Population 2 (lower secondary education) and Population 3 (upper secondary education).
All schools.
For the Principal and Computer Coordinator questionnaires no distinction was made between Population 2 and Population 3.

China

Population 3 (upper secondary education).
All schools in the cities/provinces Beijing, Shanghai, Xingxiang city (Henon province), Inner Mongolia, Guangxi Zhuang autonomous region, Jiling, Anhui, Sichuan, Guangdong provinces.

France

Population 1 (elementary education).
All schools except private education (15% of students) and special education (less than 0,5% of students).
Population 2 (lower secondary education).
All schools except private education (students in "Collèges": 20% of all students) and special education.
Population 3 (upper secondary education).
All schools except private education (3% of students).

Federal Republic of Germany

Population 2 (lower secondary education) & Population 3 (upper secondary education). All schools in 9 Bundesländer (58% of all students).

Greece

Population 2 (lower secondary education) & Population 3 (upper secondary education). All schools except private and evening schools (altogether 4% of all students).

Hungary

Population 3 (upper secondary education). All schools.

India

Population 3 (upper secondary education). All schools in Delhi and Utter Pradesh, Maharashtra, West Bengal and Tamil Madu (which are the states with the maximum number of computer using schools (in respectively the regions NORTH, WEST, EAST AND SOUTH).

Israel

Population 1 (elementary education). All schools except special education (7% of all students). *Population 3 (upper secondary education).* All academic schools and technological schools with courses leading to certification. This excludes vocational education as well as independent schools (about 4% of all students).

Japan

Population 1 (elementary education) and Population 2 (lower secondary education). All schools except special education. *Population 3 (upper secondary education).* All general and vocational schools.

Luxembourg

Population 2 (lower secondary education). All general and technical secondary schools.

The Netherlands

Population 1 (elementary education).
All schools except special education.
Population 2 (lower secondary education).
All schools except (5% of all students) international transition year, english stream, individual agricultural education, agricultural education and nautical education.
Population 3 (upper secondary education).
All general secondary, social nursery, economical/administrative and technical schools. Excluded are all other vocational schools (about 6.4 % of all students). Teachers were only sampled from general secondary schools.

New Zealand

Population 1 (elementary education).
All schools with students in standard 4 except the Correspondence School and special education.
Population 2 (lower secondary education).
All schools with students in form 3, except the Correspondence School and special education.
Population 3 (upper secondary education).
All schools with students in form 7, except the Correspondence School and special education.

Poland

Population 3 (upper secondary education).
All schools.

Portugal

Population 1 (elementary education).
All schools in the public school system of the continental territory, except distance education.
Population 2 (lower secondary education) & Population 3 (upper secondary education).
All schools in the public schools system of the continental territory.

Slovenia

Population 3 (upper secondary education).
All schools.

Switzerland

Population 1 (elementary education).
All schools in the French speaking part with students in the age of 10 years.
Population 2 (lower secondary education).
All schools except schools in canton Argau, Genève, Vaud.
Population 3 (upper secondary education).
All schools except schools in canton Genève.

USA

The sampling frame included all U.S. schools, public and private, that contained a 4th grade or higher, plus vocational and "alternative" high schools. The frame excluded separate schools for the special education population and also excluded schools that only exist to provide part-day or part-year pull-out classes for students from other schools.
Each school was allocated to one or more of three sub-frames, "primary", "lower-secondary", or "upper-secondary", depending on whether it contained a 5th grade, 7th or 8th grade, or 10th, 11th, or 12th grade.
Sixth-grade-only schools were allocated to the primary sub-frame and 9th-grade-only schools to the lower-secondary sub-frame.

Table B.1

Number of cases per educational system and category of respondents

Country / Educational System

Elementary schools	BFR	CBC	FRA	ISR	JPN	NET	NWZ	POR	USA
Principals									
non using	102	1	33	101	157	102	101	152	0
using	145	152	340	159	206	113	379	100	425
undetermined	0	1	15	0	0	14	4	3	0
Coordinators									
non using	8	0	6	0	29	1	3	10	90
using	69	136	315	156	186	125	361	90	307
undetermined	2	0	4	2	151	1	2	152	28
Teachers									
non using	153	40	21	21	664	26	61	0	163
using	75	337	188	305	370	193	329	0	271
undetermined	0	0	0	0	13	1	1	0	1

Lower secondary schools	BFL	BFR	CBC	FRA	FRG	GRE	JPN	LUX	NET	NWZ	POR	SWI	USA
Principals													
non using	61	14	0	7	26	367	99	0	19	1	114	303	0
using	221	172	138	393	302	60	264	27	237	122	150	669	415
undetermined	5	0	0	19	2	6	0	0	6	0	2	30	0
Coordinators													
non using	3	1	0	0	3	2	33	0	0	0	17	1	72
using	131	112	120	413	299	113	216	27	236	127	146	463	303
undetermined	6	3	0	0	6	39	105	0	1	1	108	6	27
Computer teachers													
non using	55	6	11	0	0	99	64	0	3	4	25	22	0
using	144	55	30	0	51	55	136	66	192	103	75	252	230
undetermined	1	6	0	0	0	1	4	1	4	0	11	2	1
Subject teachers total													
non using	226	178	327	401	344	408	811	90	404	248	116	580	356
using	24	17	100	258	219	6	178	2	48	146	38	127	235
undetermined	1	0	0	15	2	7	2	0	13	0	5	0	1
Teachers math													
non using	84	61	124	158	69	138	253	23	150	84	45	214	106
using	15	7	20	141	129	6	85	0	26	62	17	60	84
undetermined	1	0	0	3	1	2	0	0	0	0	1	0	0

(continued on next page)

Table B.1 (continued)

Number of cases per educational system and category of respondents

Country / Educational System

Lower secondary schools	BFL	BFR	CBC	FRA	FRG	GRE	JPN	LUX	NET	NWZ	POR	SWI	USA
Teachers science													
non using	73	53	128	145	91	138	259	30	132	88	45	199	113
using	2	4	17	61	48	0	74	2	13	22	13	25	75
undetermined	0	0	0	3	0	1	2	0	9	0	3	0	1
Teachers mother tongue													
non using	69	64	75	98	84	132	299	27	122	76	26	167	137
using	7	6	63	56	42	0	19	0	9	62	8	42	76
undetermined	0	0	0	9	1	4	0	0	4	0	1	0	0

Upper secondary schools	BFL	BFR	CBC	CHI	FRA	FRG	GRE	HUN	IND	ISR	JPN	NET	NWZ	POL	POR	SLO	SWI	USA
Principals																		
non using	6	6	0	90	4	0	436	2	408	33	49	56	0	143	65	5	16	1
using	254	192	138	329	360	198	30	306	471	151	613	160	133	429	155	74	303	424
undetermined	0	0	0	0	24	0	5	3	1	0	0	34	0	1	0	6	5	0
Coordinators																		
non using	0	0	0	3	3	1	0	0	3	0	57	0	0	2	10	0	0	31
using	224	137	118	277	359	193	29	282	469	148	549	170	138	313	155	37	282	337
undetermined	1	6	2	5	2	7	0	5	1	0	44	0	1	150	66	14	0	42
Computer teachers																		
non using	4	1	2	12	14	1	7	15	15	4	83	1	1	0	18	7	30	0
using	349	133	104	275	325	91	76	282	458	244	415	9	136	177	137	46	576	285
undetermined	2	0	0	0	4	0	4	0	0	2	3	1	0	0	6	10	8	0
Subject teachers total																		
non using	310	181	179	0	373	262	137	704	385	163	1931	97	273	297	116	129	558	311
using	57	37	77	35	168	68	2	148	295	16	209	33	138	65	44	7	140	254
undetermined	1	0	0	0	4	1	13	0	0	0	7	7	0	1	0	13	4	0
Teachers math																		
non using	130	70	74	0	139	107	45	226	140	55	[illegible]	32	80	120	50	47	167	99
using	30	23	13	19	72	41	2	61	114	5	93	24	70	23	27	1	59	77
undetermined	1	0	0	0	3	1	5	0	0	0	0	0	0	0	0	11	2	0
Teachers science																		
non using	110	68	58	0	132	102	39	204	138	59	830	35	100	154	42	30	204	97
using	17	12	28	16	78	25	0	78	167	10	103	8	53	41	14	6	60	83
undetermined	0	0	0	0	0	0	7	0	0	0	5	6	0	1	0	1	1	0
Teachers mother tongue																		
non using	70	43	47	0	102	53	53	274	107	49	591	30	93	23	24	52	187	115
using	10	2	36	0	18	2	0	9	14	1	13	1	15	1	3	0	21	94
undetermined	0	0	0	0	1	0	1	0	0	0	2	1	0	0	0	1	1	0

END

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