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STATUS OF INTRODUCTORY COMPUTER EDUCATION IN THE NETHERLANDS: RESULTS OF A SURVEY

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Abstract—The International Association for the Evaluation of Educational Achievement (IEA) is conducting an international comparative study on educational computer use in more than 20 countries. This paper analyzes some of the Dutch results of the IEA survey on the use of computers in lower secondary schools. The findings show that at present computers are mainly used for introductory computer courses, but that the integration of computers into existing subjects is still limited. The main problems identified in the study are: insufficient availability of courseware and hardware, time constraints and a high need for teacher training.

NATIONAL CONTEXT AND RESEARCH QUESTIONS

As part of the Information Technology Stimulation Plan (INSP) for 1984–1988, and in a cooperation with computer manufacturers, almost 2000 general secondary schools in The Netherlands were provided in the period 1986–1988 with a network of 8 personal computers (MS-DOS) and two stand-alone PCs. Along with the hardware, schools received a package with educational software, comprising: a wordprocessor, spreadsheet, database package, authoring language, etc. Curriculum development (for Information and Computer Literacy, as well as for vocational oriented courses) and in-service teacher training were intensified; a beginning was made with courseware development, which was intensified in 1987 to a 4-year, national courseware development project.

Current governmental plans for curriculum reform in lower secondary education (introduction of comprehensive education for the grade levels 7, 8 and 9) call for introductory computer education, named in The Netherlands, Information and Computer Literacy (ICL),

—as a separate, small course (20 lesson periods);
—via applications of new technologies in other subject matter areas, either as part of the content, or as a didactical tool[1].

The introduction of computers in schools is an innovation which is expected to change schools in many respects including curricula, instructional practice and school organization. It is probably the first major educational innovation which has been studied systematically almost from the beginning in the schools. This was a major reason for the International Association for the Evaluation of Educational Achievement (IEA) to conduct an international comparative study on educational computer use in more than 20 countries. The study focuses on

—national and school policies and practices,
—the type of use of computers by teachers and students,
—the problems experienced in using computers,
—and the reasons schools and teachers were not using computers.

Data were collected in most countries in the period March–June 1989, and are now being processed. The design of the study has been more fully described by Pelgrum and Plomp[2].

Given these plans, it is important to know to what extent the Informatics Stimulation Plan prepared the schools sufficiently for the introduction of ICL as a new subject in the curriculum.

In this paper the IEA data will be used to analyze how far Dutch lower secondary education is already prepared for ICL. More concrete, the following research questions will be addressed:

(1) To what extent are computers utilized in Dutch lower secondary schools?
(2) What factors inhibit the use of computers?
(3) What is being taught, and how are computers being used in ICL?

THE STUDY

The study is a survey carried out in 1989. The target population discussed in this paper are the schools in secondary education, including lower vocational schools. Within these schools data are collected from principals, computer coordinators, ICL teachers in grades 7, 8, and 9, and grade 8 teachers of mathematics, science, and mother tongue. The survey covers schools and teachers not using computers as well as those that do. The sample comprises 255 using schools, 19 non-using schools, and 667 teachers. The teachers are divided in the following categories:

—203 ICL teachers, who are all using computers for educational purposes;
—464 teachers in other subjects (mathematics, science, mother tongue), of whom 56 are using computers for educational purposes.

Questionnaires were directed at: school principals, school computer coordinators and teachers.

IMPLEMENTATION OF COMPUTERS IN GENERAL SECONDARY SCHOOLS

Table 1 shows the number of computers acquired by schools in the period 1985–1989. The figures reflect clearly the effect of the national stimulation plan; there is a steady increase in computer availability during the period of the project. 35% of the schools reported that they expect to acquire an average of 5 PCs in 1990. Most of the schools (98%) do have MS–DOS computers; but 32% still also have computers based on Z80 processors, while 39% possess other types like Commodore 64, Apple II. 26% of the schools indicated that on average 5 computers (probably the outdated ones) were not being used in 1989.

Principals report that the most important reasons for introducing computers for teaching/learning activities in their schools are:

—to give students experience with computers, which they will need in the future (97%);
—teachers were interested (86%); the data do not indicate whether it concerns all or only a few enthusiastic teachers but the degree in which teachers were interested was an important reason for schools to introduce computers;
—to keep the curriculum and methods up-to-date (65%).

We may conclude that within schools, the minimal material conditions for the introduction of ICL are fulfilled, while principals show a supportive attitude to technological innovation.

WHICH TEACHERS USE COMPUTERS?

In secondary education almost all teachers who teach grades 7, 8, or 9 a course in ICL use computers in their teaching. However, computer use in existing subjects is limited; in grade 8 in 1989 computers were used for educational purposes by 6% of the teachers of mother tongue, 11% of mathematics teachers, and only 7% of the science teachers (the average is $< 10\%$).

In summary, computers are: predominantly used by teachers of ICL (and a number of vocation oriented courses not reported in this paper); and to some extent in maths and science in the final grade of general secondary education. Further, in 1989, educational use of computers in existing

Table 1. Availability of computers in general secondary schools ($n = 255$)

	1985	1986	1987	1988	1989
Percentage of schools	76	89	96	99	100
Average number of computers	10	11	13	16	20

courses in the lower grades of general secondary education was very limited. Apparently, this area is only in a very early stage of development[3].

TYPES AND FREQUENCY OF EDUCATIONAL COMPUTER USE

Computer-using teachers were asked about the applications for which they used computers and how frequently they used them.

From Table 2 we conclude that about three-quarters of the ICL teachers used the computer in drill-and-practice at least some of the time, and one-quarter used them almost every week. This application was used almost as intensively by teachers in other subjects. In general, there was little difference, apart from drill-and-practice, between usage in ICL and other subjects. The notable exception was use of the computer in remediation, where it was almost twice as likely to be used at least some of the time in non-ICL subjects.

Usage was particularly high (70%) at least some weeks by ICL and other subject teachers in instruction by computer, and almost as high where the teacher explains or demonstrates with the computer.

In summary, we conclude that educational computer use in general secondary education is almost completely directed at the attaining of the goals of the not yet officially recognized course in ICL. Computer use in other courses is restricted in two respects, namely (i) in the number of teachers, and (ii) in the frequency of use. In 1989, we cannot yet speak of integration of computers

Table 2. Types and frequency of educational computer use. Data are the per cent of respondents in each category

	ICL	Other subject
Description of computer use in class	$n = 203$	$n = 56$
Drill: students do practical exercises on the computer		
Never	28	19
Some weeks	48	74
Most/every week(s)	24	7
Instruction by computer: software provides the actual instruction		
Never	21	29
Some weeks	45	56
Most/every week(s)	34	15
Explanation/demonstration: teacher explains or demonstrates		
Never	35	33
Some weeks	45	64
Most/every week(s)	20	3
Testing: students takes tests by using computer software		
Never	46	55
Some weeks	51	45
Most/every week(s)	3	0
Enrichment: fast learners get additional instruction on the comp.		
Never	60	59
Some weeks	32	38
Most/every week(s)	8	3
Remediation: slow learners get additional instruction on the comp.		
Never	71	45
Some weeks	22	39
Most/every week(s)	7	15
Students explore concepts on their own		
Never	29	55
Some weeks	40	34
Most/every week(s)	30	10
Other approaches to computer use		
Never	81	71
Some weeks	6	29
Most/every week(s)	13	0

in the curriculum of the general secondary school. As a consequence, we have to conclude that the part of introductory computer education, consisting of applications in existing subjects, is only at an early stage of development.

FACTORS INHIBITING EDUCATIONAL COMPUTER USE

Principals and computer coordinators in computer-using schools, and computer-using teachers were asked what problems they experience in using computers. Similarly, principals of non-using schools, and non-using teachers were asked for their reasons for not using computers for educational purposes. As the problems in use and reasons for non-use were asked in a similar way, all the results can be summarized in Table 3.

From Table 3 we learn that there is a great similarity in the problems experienced by computer users and the reasons mentioned for being a non-user. All six categories of respondents have the same four factors mentioned as the most important ones:

(1) insufficient number of computers available;
(2) not enough software for instructional purposes available;
(3) teachers lack knowledge/skills about using computers for instructional purposes;
(4) not enough time to develop lessons in which computers are used.

All these factors are conditional ones, while at this moment in The Netherlands reasons or arguments referring to educational problems in using computers seem to be less dominant.

Teachers mention as the two most important bottlenecks: (2) not enough software; and (4) not enough time. Both are closely related, because due to a lack of practically useful courseware (including student materials) teachers are frequently obliged to develop their own computer-based lessons.

The data in Table 3 could give the impression that, as soon as ready-to-use educational software will become available, not only the major problems of teachers will be solved, but also many non-using teachers will become computer users. We believe that this will not be the case. It is

Table 3. Problems in computer use and reasons for non-use. Data are per cent of respondents in each category indicating the problem or reason

	Use				Non-use		
Problems	Principal $n = 253$	Comp. coord. $n = 254$	ICL teachers $n = 200$	Other subjects $n = 56$	Principal $n = 19$	Other subject $n = 289$	Total $n = 1071$
Hardware							
Insufficient computers available	58	53	46	39	58	32	47
Insufficient peripherals available	41	36	43	27	11	8	30
Difficulty with maintenance	19	23	25	14	5	3	16
Limitations of computers	17	25	19	11	NA	4	15
Software							
Not enough software for instruction	74	71	64	63	37	48	63
Software not adaptable enough	51	46	43	23	21	20	38
Software too difficult	24	41	37	29	5	11	27
Lack of information about software	23	27	21	18	26	16	21
Instruction							
Teachers lack knowledge	60	74	52	25	53	36	53
Integration in instruction problems	58	62	44	20	26	31	47
Insuff. expertise to help teachers	39	40	40	7	26	24	33
Not enough supervising help	24	28	29	20	21	14	23
Organization							
No room in time-table to learn about	38	43	32	27	42	31	35
Inadequate financial support	44	39	35	14	16	12	31
Insuff. techn. operating assistance	32	26	20	9	5	9	20
Insufficient training opportunities	19	20	27	9	16	15	19
Insuff. access for teachers own use	17	14	15	14	11	8	13
Lack of administrative support	6	17	21	7	5	6	11
Other							
Not enough time to develop lessons	66	76	73	61	42	47	64
Teachers lack interest	23	43	37	14	16	11	26
Other problems in computer use	13	11	13	14	26	26	16

NA, not applicable.

significant that the ICL teachers, who are the most intensive computer users, are referring to educational or didactical problems related to computer use:

—45% of them are indicating that it is difficult to integrate computer use in their classroom practice;
—55%, as has already been noted, mention a lack of knowledge/skills about using computers for instructional purposes;
—41% indicate that there are insufficient guidelines and expertise available for helping teachers use computers instructionally.

The introduction of computers into education is a very complex exercise, which only has a chance of success if several conditions are fulfilled simultaneously. Referring to other innovations in education we know that the following conditions are important (see for example[4,5]):

(1) the importance of the innovation has to be recognized by teachers;
(2) practically useful materials (hardware, as well as courseware) have to be available;
(3) the goals pursued must be clear and understood;
(4) the possibility of continuing staff development.

Combining the results of this and the preceding section, we have to conclude that for the present school curriculum, these conditions—with the exception of the first one—were hardly met in 1989. There is insufficient software for instructional purposes, but above all teachers lack sufficient schooling and time to develop lessons in which computers are used for instructional purposes. Introduction of computers in education is a process which extends over a long period of time, which needs a phased implementation strategy with good planning and unambiguous goals.

INFORMATION AND COMPUTER LITERACY: CONTENT AND COMPUTER USE

We saw that the most intensive instructional use of computers is found in ICL, a course which at present has no clear status in the Dutch educational system, which has only recently been added by many schools to their curricula, and for which no clear guidelines for objectives and content exist. Almost all schools (>90%) have such a course.

To get an impression of the actual implementation of ICL with a focus on content and the use of computers in the actual classroom practice, we will therefore take a closer look at this subject matter area. In addition to what is included about ICL in Table 2, we will concentrate in this section on the types of software being used by the teacher, at home or at school, and by the students during the ICL lessons (Table 4); and on the topics being taught in ICL lessons (Table 5).

From Table 4 we may conclude that there is a great variation in the use of types of software by teachers. Although software tools are most frequently used by teachers, many ICL teachers are not using database or spreadsheet programs; while the full range of software is not used by the majority of ICL teachers.

Give the shift in emphasis in ICL since the late 70s and the early 80s away from teaching computing towards teaching applications, information handling and problem-solving[6], it is surprising that about 40% of the teachers are still practising BASIC with their students (see Tables 4 and 5).

ICL teachers indicate that they use computers predominantly for practising skills (88%); only 27% say that computers are used in problem solving activities. This is, in combination with the data from Tables 2 and 4, a confirmation of tutorials and drill & practice as the dominant computer-assisted approaches to instruction.

CONCLUSIONS

van Weering and Plomp[1] discuss how ICL is conceived in The Netherlands as a subject in the future curriculum of lower secondary education. In the Dutch plans, ICL is seen as a subject domain consisting of three components, namely elements from computer science, from information

Table 4. Types of software being used for Information and Computer Literacy by teachers (at school or at home) and/or by students ($n = 203$). Data are the per cent of respondents in each category indicating the type of usage

Types of software	Teachers	Students
Drill-and-practice programs	29	44
Tutorial programs	35	64
Word processing/desktop publish.	77	76
Painting and drawing programs	32	25
Simulation programs	27	32
Recreational games	26	42
Educational games	29	52
BASIC	44	45
LOGO	17	16
Other programming languages	17	6
Spreadsheet programs	55	39
Mathematical graphing programs	23	12
Statistical programs	16	4
Database programs	59	47
Programs to control devices/equip.	7	7
Tools and utilities	41	2

Table 5. Topics being taught in Information and Computer Literacy. Data are the per cent of respondents indicating the topic

Topics	$n = 203$
Computers and society	
Relevance (e.g. for citizen, industry)	47
Impact of comp. appl. (e.g. social, econom)	43
History/evolution	39
Ethical issues (e.g. copyright, privacy)	25
Applications	
Editing/word processing	85
Educational/recreational games	54
Spreadsheets	45
Database management	45
Drawing/painting/illustrating	33
Models and simulations	20
Telecommunications/networks	17
CAD/CAM/process control/robotics	9
Authoring languages	4
Music generation	3
Artificial intelligence/expert system	1
Problem analysis and programming	
Programming languages	40
General concepts	23
Structure of programs	22
General procedures	3
Problem analysis	9
Principles of hard- and software structure	
Basic computer concepts	67
Hardware (e.g. comp. architecture, CPU)	24
Software (e.g. software architecture)	18
Other topics taught about	7

sciences, and from computer applications. This subject domain should be realized in the school curriculum in two ways: as a separate course on ICL, as well as in applications or as content in existing courses (such as physics, mathematics, mother tongue, etc.). If we compare this ideal with our data, we must conclude that The Netherlands is only beginning to realize this idea:

—applications of computers in other subject domains are very limited;
—the topics being taught in the present ICL courses indeed reflect some elements from computer science and some applications, but the variation between schools is very great. Whether this is good or bad is difficult to say, because the goals of an introductory course in this area can be attained in many ways.

In summary, we may conclude that in spite of many developments there is as yet little coherence in the present ICL courses. Implementation of complex innovations in education needs time, and stimulation policies must reflect this characteristic. The 1992 survey will reveal whether the present activities in curriculum and courseware development and teacher training have resulted by that time in a further step into the direction of the present plans for Information and Computer Literacy.

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