SOCIAL EUROPE

Recent progress made in introducing new information technologies into education

SUPPLEMENT 4/86

COMMISSION OF THE EUROPEAN COMMUNITIES

DIRECTORATE GENERAL FOR EMPLOYMENT, SOCIAL AFFAIRS AND EDUCATION

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INTRODUCTION

Introducing computers in school : Recent developments in Community activity

In compliance with the Council resolution of 19 September 1983 regarding the introduction of new informational technologies in education(1) of 24 September 1983, and based on the 1985-1987 working programme adopted by the Commission on 14 December 1984(2), implementing this resolution, the Commission organised various meetings on a European scale on specific aspects of the introduction of new informational technologies in educational systems.

As a follow-up to the Summer University which was held in Nice in July 1984, the Commission and the Belgian authorities organised a Summer University in Liège (in July 1985) in which the Liège and Ghent experimental pedagogy laboratories cooperated from the technological and scientific standpoint.

The theme retained - new technologies in primary school - is one of the themes included in the Commission's 1985-1987 working programme, because familiarising children with computers in the compulsory education context is indispensable.

Furthermore, in addition to the role that new informational technologies can play in instruction as it is today, it seems that they could facilitate acquiring and mastering fundamental concepts and, more generally, increase learning capacity. The Commission attached great importance to these meetings which

1) JO N° C 256 of 24 September 1983

2) COM/84/722 final

gave high-level researchers (in informational and pedagogical questions) and specialists an opportunity to compare their viewpoints with their colleagues from the various Community countries and thus to create networks of European contacts.

The final report of the Summer University in Liège was written by Sylvie OSTERRIETH, from the University of Liege experimental pedagogy laboratory, directed by Professor de LANDSHEERE.

This report is relatively technical, and therefore we are presenting here the basic questions which were put to the participants as matter for thought.

For the first time in July 1985, The Commission and the Italian authorities organised a week exclusively reserved for youth in the framework of the International Youth Year. This week-long event gave an opportunity to 150 young people from 15 to 18 years of age to learn about recent developments in the use of new technologies in the industrial sector.

Participants were very enthusiastic about this event, which combined training, cultural and touristic activities.

The report was drawn up by the Eurydice European Unit

After the symposiums in Marseille (December 1983), in Newcastle (July 1984) and Bologne (May 1985), the Commission organised a European symposium in cooperation with the German authorities on new technologies in secondary technical and vocational education.

These symposiums were intended for persons making decisions about incorporating new technologies in instruction and for inspectors and teacher trainers.

The final report on the Berlin symposium was drawn up by Prof. Dr. Rul GUNZENHÄUER - University of Stuttgart - Computer Institute.

Monique LEENS.

SUMMER UNIVERSITY ON N I T AND PRIMARY SCHOOL EDUCATION

Liège, July 1985

Forty research specialists from various Member States of the European Community discussed the main aspects of introducing computers in primary school. For ten days they met in a "Summer University" which took place in Liège from 4 to 13 July 1985, where they were able to become familiar with the experiments and the works undertaken by their European colleagues and to compare their points of view.

Participants dealt with five themes in conferences, debates and demonstrations. Each theme was introduced by the fundamental questions which are reproduced below :

Theme 1 : Interactive languages for cognitive, affective and social development of children : objectives, methods and results.

For a few years now, educational research specialists have been introducing programming languages into basic education.

Three main lines of questions come up here. They pertain to the objectives to be pursued, the methods used and the evaluations that have been made.

1. What are the objectives pursued in introducing programming languages at school?

   Are these objectives cognitive, affective or social?

The first justification for introducing the LOGO* environment, and more generally programming languages, in primary school is that hope that it will encourage development of intellectual capacities. Although a certain number of indications seem to support the hypothesis of the efficiency of interactive languages in high level know-how, there are still fundamental questions which have not been answered. In particular, it must be specified which cognitive effects are expected, and it must be determined if they are durable and transferable.

What capacities is one trying to improve by using programming languages ?

- Analysing problems;
- Structuring solutions;
- Ability to
  express one's self by various means
  evaluate the pertinence of various solutions
  manage informational elements--to treat, use, conserve or eliminate these elements--in short to behave more efficiently;
- Producing divergent behaviours (creativity)?

Is one trying to obtain general cross-discipline cognitive objectives (like the capacity to solve problems) or objectives related to disciplines, like acquiring certain mathematical concepts, certain geometric structures, certain linguistic relationships ...? In that case, doesn't one run the risk of going back to intellectual gymnastics which have never been proven efficient.

* LOGO : Programming language developed according to Piaget's pedagogical theories, promoted by S. PAPERT and his assistants (MIT 1981)
The Logo environment includes te language and a methodological process based on the user's activity (pupil) in constructing his knowledge.

In current research, what is being studied is essentially the effects of using programming languages on the development of high level skills. But shouldn't other types of effects be envisaged? This would of course imply that the scope of research be widened.

Whatever option is chosen, these learning processes cannot be considered independently from their affective and social side-effects.

<u>What affective objectives are being pursued?</u>

- Acquiring a more positive self-image ?
- Being able to cope with a situation, to overcome obstacles, to meet challenges?
- Showing flexibility, adapting to new situations or to new subjects
- Keeping an open mind when confronted with a great quantity of information?

<u>What are the social objectives?</u>

- Being able to work in self-defined functional teams, to share one's view point and understanding that of others, to be creative in groups
- Being aware of the dignity of others, respecting the work of others, understanding the problems of others near and far.

2.<u>What methodological languages and environments are most suitable to meet these objectives?</u>

- What types of programming languages should be recommended (sequential, procedural, declarative)?
- Do certain languages give an advantage to certain methodologies and are they more adequate for attaining certain objec-

tives? For example, is it possible, by using certain languages, to selectively develop various cognitive skills, ranging from a simple formal translation of a problem to problem solving via acquisition and application of concepts and structures?

- What type of human environment and teacher-pupil interaction should be sought?
  There are many people in favour of discovery learning (trial and error). But is structured and even perhaps "errorless" learning more efficient?
  Does the teacher-pupil relationship change when NIT are introduced? If so, is introducing NIT in schools without adequate prior teacher training the road to diaster?
- How should classes be organised given the material available (sometimes only one computer) and given the number of pupils and their individual characteristics (for example : pace of work?

- How should these activities be included in the curriculum?

3. <u>How should evaluations be made and what are their results</u>?

- What problems should be evaluated, particularly in the affective and social domain?
- Can the pro's and con's of NIT's contribution to education be evaluated already?
- Is research going forward to evalute the introduction of NIT in education in the medium and long term?
- What characteristics should this research have to come to valid conclusions?
- Does the assessmet of the effects of NIT require having recourse to new methods or techniques?
- Are cost-benefit analyses more reliable in this field than in other pedagogical fields where their conclusions have almost always been dubious?

Theme 2 : Educational softwared for development of basic skills : reading, writing, talking, mathematics.

Basic skills (the 3 R's) have always been focal areas for schools and for research in education. Unfortunately, the bias of interest has always been directed towards the results of the instruction, not to the process. It is true that since the beginning of the 20th century, headway has been made thanks to major works on the transfer of learning and the functional approach. But in-depth psychological studies are still needed. Some are currently being done. They are based on learning models developed from psychology and informational theories. In this context what is this research on, one may wonder, and what results have been observed.

From a more general pedagogical standpoint, more than ever the functional approach seems justified : learning must meet a need that the pupil feels, it must be meaningful for each individual and must take into account his own individual characteristics. This is why there is a need for individualised or semi-individualised instruction. The functional principle means that all of the pupil's characteristics are taken into account : the level of training, affectivity, psychomotor characteristics, social adaptation... Creative expression and social potential must also be used. Although these principles are not new, can it be certified that they are generally respected in current school practice?

How can certain current pedagogical trends which reject these principles and recommend a return to "direct instruction" be interpreted? These are centred around the teacher and the subject; they emphasize low-level cognitive processes inferring that they are more immediately effective.

This movement can hardly be separated from concern about the growing functional illiteracy in most industrialised countries and problems encountered by migrant populations. Why do pupils (and apparently more and more of them) leave primary school without knowing how to read, without being able to express themselves in writing and without being able to solve that elementary mathematical problems that one meets with everyday? Why does this same inaptitude continue on into secondary education, and even higher education? How can the phenomenon be analysed. How can these difficulties be overcome both in basic education and in adult education?

The arrival of NIT has given new hope but two series of questions must be asked :

1° Can teaching and learning assisted by NIT be functional, and make use of the most advanced contributions of psychology and other social sciences? If so, under what conditions and to what extent?

2° - Is existing educational software satisfactory?
- What does it in fact contribute? Do valid achievement measurements exist? What have we learned from them?
- Is there sufficient quantity to meet demand. What fundamental and applied research and development are needed? Can priorities be given? Which ones?
- What materials and what languages correspond best to the need for creating educational software.

If the efficiency of using educational software can be demonstrated, an educational policy should be implemented.

As here it is a question of basic learning, it is important, even more than elsewhere, to ensure equality of educational chances and not to favour groups which are already privileged in other ways. In this context, the minimum equipment for a primary school and the initial and continued teacher training required to get optimum benefits must be defined.

Theme 3 : Educational software for
a) learning disciplines (history, geography, sciences and foreign languages);
b) development of cognitive, affective and social skills.

Preliminary remark

Cognitive, affective and social activities associated with this theme cannot be artifically isolated from the activities related to the two preceding themes. The principle of general methodology of instruction - notably the principle of the functional approach - are also applicable here.

A. Learning disciplines

In primary education, two trends of thought currently coexist. The first suggests an interdisciplinary and functional approach. In certain countries, for example, history, geography and sciences are grouped together under the label "disciplines d'eveil" or again various disciplines are integrated by using the project method. The second tendency, which has become more popular lately in several countries, treats various branches separately and independently.

Are the obstacles to using an interdisciplinary method and implementing the functional approach basically institutional, conceptual or are they related to organisational problems? We have reason to hope that NIT could be very useful for the organisational aspect. Research in this field and experiments with real situations must continue and should probably be enlarged.

Whatever the school of thought to which they belong, and independently from the significant aspect of learning, teachers are trying on one hand to impart knowledge; they often emphasize a tutorial and drill and practice approach. On the other hand, they pursue more general objectives, more or less clearly it's true, on a higher level : developing the capacity to analyse and to summarise a situation, becoming familiar with experimental methods ...

Drill and practice programs are easy to create and they are the most numerous today. Although they are definitely interesting and efficient, they doubtedlessly can reinforce a tendency to impose teaching methods which concentrate more on the subject than on the child, on the proper method than on the differentiated approach to problems.

Even for software, there are still a number of questions which remain open. How should it be inserted into the curriculum, for example? What would be the effects of the combination of the teaching styles -- those used by the teacher and those used by the educational software? How can software be made less rigid? Will intensive use of poor quality software reduce the faculty for adaptive responses, regrettably limit expressive codes and bring cultures to the lowest common level?

Particular attention must be maid to simulation educational software. To what extent can this be used both for traditional and functional instruction?

Also, software quality is highly variable quality. Moreover, it is often limited to graphic representation. Why not look for something else? In particular, the importance of educational games is certainly underestimated, particularly adventure games which include more varied parameters.

And what about the use of general software for educational purposes : data banks, word processing, "picture software" (rather like an improved blackboard) ... ?

One also hears about "intelligent educational software" : particularly about software which offers the user various learning strategies corresponding to his individual characteristices, for example, various types of explanations and comments. Is this type of software really efficient? Is the educational milieu familiar with it? Does it include results from research on artificial intelligence which is currently making considerable progress?

B. Development of cognitive, affective and social skills

Skills must not be developed independently of experience that is real and meaningful for the pupil. In this context, it would be useful to see what NIT may permit or facilitate for teaching basic skills.

It seems that general software - word processing, data bases or expert systems - because of their "open" aspect, should play an important role in this field.

What experiments are going on in this field? What guidelines should be drawn?

If one truly wants to pursue high-level objectives in cognitive, affective and social development, it is important to verify whether current software or that which is being developed allows us to attain these objectives. In particular, the pedagogical method, the degree of autonomy to be left to the student and the types of "feedback" available must be analysed. In this context, it should be specified which software characteristics that favour the acquisition of effective and desirable working methods, greater concentration on the job, prudent intellectual originality, ...

Similarly, the characteristics of software which are best suited for affective and social development must be determined.

Here, often reticence has been expressed with regard to the frequent use of the computer for fear that it may encourage isolation and an introverted attitude of the pupil, and may deprive him of certain aspects of interpersonal relationships such as reference to implicit understanding, connotations, ... How much truth is there in this?

Theme 4 : Creating and evaluating educational software: technical and methodological perspectives, efficient methods for developing quality products and evaluating their effectiveness.

Whether it is developed through commercial channels or on a small scale by teachers or research teams, educational software poses a whole series of problems.

From the methodological standpoint, the relationship between educational software and the curriculum is still vague. True, quality tools should be integrated into the curriculum without too many problems. But it is possible that the very existence of this software causes changes in the curriculum. For example it makes it possible to treat subjects which have been inaccessible to date because of the extent of the calculations involved or the quantity of data to be consulted or handled. In what fields does educational software influence the curriculum or could it do so? What is the extent of that influence? What content does this software communicate and what content could it or should it communicate? ... Too many questions are still unanswered and others will certainly come up as NIT make headway.

Developing software also poses various problems.

From the organisational point of view first of all, the need for "professionalism" in this field, which requires close cooperation between educational specialists, specialists in information technology and specialists in specific fields, is becoming increasingly evident. How can this cooperation be institutionalised? What framework should be used? What administrative provisions should be made to free teachers from all or part of their current duties? How can they be prepared for this job? How would the work and the responsibilities be shared...? Currently, because of the lack of concrete experiments in the field, the scope of these problems is not known. Some countries in the Community have already created centres to develop educational software where technicians and educators work together. But shouldn't we go further, and follow the example of the European Software Publishers in envisaging this problem on a European, rather than a national, scale?

From the economic point of view, it is becoming and more apparent that developing carefully prepared software with a high quality content and educational methodology is difficult and time consuming. The best experts estimate a current average cost price of one million Belgian francs (FF 15,000 = $ 20,000) for a one hour program. These programs are not produced in series by commercial firms because the investment is too high as compared to sales (notably because of pirate reproduction). Shouldn't we therefore create public services which support or organise the development of high quality software?

To accelerate and simplify the development of educational software, various manufactures are currently offering a series of tools, languages and authoring systems. But this package often seriously limits the didactic and educational possibilities of the computer. These constraints must imperatively be identified. Moreover, psycho-educationists should also draw up explicit didactic models and procedures which in their opinion ought to be applied in educational software. In this way, better tools for developing programs could be forged.

The evaluation of educational software also deserves attention. "Debugging" procedures to verify the quality of programs from the standpoint of information technology have been developed by information specialists. These should be applied to educational programs. A great number of grids and evaluation schemes have already been published to further the evaluation of the educational quality. These grids should now be integrated to produce a series of minimum requirements. Based on these lists, educational software could be given a guarantee of quality. But what independent organisation could award this guarantee? How could it become credible? Could it withstand commercial pressure? Could educational software which does not meet minimum quality standards be excluded from schools?

Evaluating the results of using educational software also poses many problems. Conclusions from current research are too scant and too divergent. An in-depth study of research methods is necessary. In addition to evaluating results in terms of acquisition, these studies should also deal with evaluating learning processes, which is a more delicate problem.

A concerted international effort is needed with regard to copyrights as concerns distribution of educational software. The there is too much at stake, in terms of human and material resources, to leave this point open. Adapting software to user needs entails a question of intellectual property. Most techniques for protecting software make adaptations impossible. Should software continue to be protected? How can the problem of pirate reproduction be tackled? Isn't unauthorised reproduction most blatant in the educational sphere? Isn't is worth considering a non-commercial distribution network? But then, how could this network function?

In order to promote distribution of educational software, a certain amount of standardisation would be desirable. This standardisation should take into account both psycho-educational and information technology factors. Defining the psycho-educational requirements to be applied to informational material is an urgent problem.

Theme 5 : Introducing new technologies in basic instruction : their impact on teaching methods and research, national and regional policies.

When analysing the introduction of NIT at primary school level, we must distiguish between the child as a programmer and the child as a user of educational software.

Bar a few rare exceptions, our countries do not have significant experience of these two aspects of introducing NIT in schools. A sufficient number of software programs and adequate material is required for this.

What policy should be adopted to meet these goals? Among the countries in the European Community, France and Great Britain, because of their national policy on information sciences, are privileged examples. But these examples may be only temporary.

How can a policy be rationally founded without doing rigorous experiments? It would be preferable to begin with laboratory experiments (limited number of pupils, high quality teachers), followed by controlled experiments in pilot schools (representative groups of pupils, motivated teachers) and finally to experiment with revised material in a representative sample of the schools concerned. Systematic observation (both case studies and observations of the classes) is needed during all stages of the study. But the infrastructure and the funds are lacking to implement this approach which is costly in terms of skills and time.

But, because of the impact NIT will and already does have in our society, blindly launching reforms that concern the entire educational system would be almost irresponsible. What are the minimum precautions to be taken? And what must be done so that teachers take all possible advantage of the new means at their disposal? It has often been recalled lately that individualised methods of instruction have existed for a long time. But they are not often applied in school practice. Why would the arrival of computers mean an immediate and spontaneous change in teacher behaviour?

How can we move on from the pilot experiment stage to the general educational system? Will a radical change of school organisation be needed? Should school architecture be changed? If individualisation or semi-individualisation really takes place, will the current breakdown into years of study subsist? There does not seem to be any doubt that introducing computers and adequate educational software in schools could lead to changes in the curriculum and in teaching and learning methods. What changes can we foresee today and under what conditions?

What methodology will be the most effective to give teachers a general understanding of informational technology so that they can become skilled users, so they can wholly or partially develop software themselves, so they are able to define their requirements reasonably for hardware and software producers?

The reply to these questions needs a great deal of research. Some research projects may be quite short; others, on the contrary, will almost certainly be longitudinal. How should they be planned and financed? Who will carry them out? University departments? Teacher training schools? ... with what type of cooperation?

What research methods seem the most promising?

What research seems the most urgent? Can the research be handled by international teams inside the Community? How can it be financed? What are the guidelines? How shall it be evaluated?

As the Summer University moved forward, teams of research specialists with mutual professional interests were created and projects for cooperation on the European level were thus developed.

"YOUTH AND NEW TECHNOLOGIES" WEEK - Turin 8-13, July 1985

INTRODUCTION

The purpose of this European event, organised in the International Youth Year by the Piedmont Region and the Province of Turin, in collabcration with the Commission of the European Communities, was to give young people an overview of the use of new information technologies.

150 young people between 15 and 18 years of age were chosen by the Ministries of National Education in each Member State.

During the opening session, Mr Giancarlo Tapparo, Assessor of Labour and Vocational Training, described the actions undertaken by the Piedmont Region to train young people in new technologies. Mr Boden, Luxembourg Minister of Education and President of the Council of Ministers emphasized the importance of community programmes dealing with new technologies. The "Youth and new technologies" week is a good illustration, he feels, of the spirit of the Milan summit meeting and symbolises a People's Europe.

Mr Lenarduzzi, Division Head of the department for "Cooperation in the field of education" mentioned how much is at stake in NIT in education:

out of 270 million Europeans, 140 million are under 25 years of age, 60 million are in the school system.

Mrs Agnelli, Under-Secretary of Foreign Affairs and Chairperson of the Italian Committee for the International Youth Year, declared that European industry must pool its resources and its projects.
The strategic force of tomorrow's industry will be that of human resources and intelligence.

The welcoming session clearly showed the fundamental role of training of youth and of education. "If Europe is to meet the technological challenges of the end of this century, it must invest in youth..."

PRACTICAL EXERCISE WORKSHOPS

As of the second day, the young people were divided into three working groups according to their language skills.

Computer workshops were organised by the CSI, FIAT and the Polytechnical College of Turin.

At the CSI, the young people took part in workshops on: graphics (monitoring air quality), managing data banks, artificial intelligence (using Prolog and Logo languages) and cartography (visualising the weather in Europe and in the Piedmont area on the screen).

At FIAT LANCIA and FIAT NONE, the workshops notably dealt with the use of interactive graphic instruments to elaborate a car model, and using a personal computer to draw up a short training course.

At the Turin Polytechnic, the young people worked in the laboratory at basic computer exercises (short demonstrations of interactive didactics on the computer).

VISITS TO FIRMS

Participants in the "Youth and new information technologies" week visited several firms.
Visiting FIAT MIRAFIORI enabled them to see the degree of mechanisation and robotisation the firm has reached. The young people had the opportunity to learn about the electronic image processing system used by the firm ILT, which has made considerable progress in automatic composition and lay-out.

At the S. Paolo Banking Institute of Turin, several microcomputers were made available to the young people who could thus work with the central system and the data banks used by the Bank.
At CSELT, which does research in the telecommunications and electronics fields, the young people visited artificial intelligence and fibre optics laboratories and the video library.
They were also able to visit the PIRELLI tyre factory where the functioning of the electronic information service between the plants and mechanized sub-systems was explained to them. At Centro Studi Automazione Tessile de Biella, the use of computers to control looms and to manage the factory aroused a great deal of interest among the young people.

These visits to plants gave rise to many comments from the young people; they made it possible for them to exchange their view points and to set up a dialogue mainly pertaining to working conditions, unemployment, retraining possibilities, the cost of mechanization, jobs lost and new job openings. The participants were also able to assess the advantages and disadvantages of using NIT in manufacturing processes and their social and economic consequences.

In some cases, these visits modified the participants' outlook on new technologies and professional life.

CULTURAL AND LEISURE ACTIVITIES

Along with this busy work programme, cultural activities were planned to give the young people a social, cultural and touristic glance at Turin and the surrounding area (visit of the city of Turin, the historic centre, the Superga Basilica, the Stupinigi castle and the Egyptian museum). The young people were able to attend a rock and jazz concert and taste Italian and Piedmont gourmet cuisine.

For the last evening, a group of young artists from Turin gave a stage play and a dance was organised.

The cultural, scientific and leisure activities allowed most of the young people to discover and appreciate the differences and personalities of the other participants. The real desire to communicate sometimes ran into the problem of having a real practical knowledge of languages.

Clearly the visit to Turin has created or strengthened the desire to communicate and will encourage young people to study European languages more closely.

A ROUND TABLE TO END THE WORKING PROGRAMME

The closing session took place in the form of a round table with the participation of Professor E. Pentiraro (Expert in Informatics and in New Technologies), Dr. C. Sabbatini (Member of the National Council for Technological Innovation CGIL), Professor Jean Donio (Professor at the University of Paris), Senator G. Fassino, Mr D. Novelli (European Parliament), Assessor G. Tapparo and Mr G. Ascani (Vice-President of ENAIP).

Part of this session was devoted to the reports of the three groups of young people. They all wanted to thank the organisers and to express their hope that another seminar of this kind would again be organised.

Article written by the
Eurydice European Unit

EUROPEAN SEMINAR SPONSORED BY THE FEDERAL REPUBLIC OF GERMANY IN CONJUNCTION WITH THE COMMISSION OF THE EUROPEAN COMMUNITIES ON THE INTRODUCTION OF NEW INFORMATION TECHNOLOGIES AT THE SECONDARY SCHOOL LEVEL

Introduction

At earlier seminars held at Marseilles (France), Newcastle (Great Britain) and Bologna (Italy), experts from European Community Member States had been able to gather valuable information on the application of data processing and recent developments in information technology in education. The key issue discussed at the Berlin seminar was basic training in information technology, data processing, and - closely related - the use of computers at the secondary school level in both general education and professional training schools.

Teaching contents and approaches in the area of data processing and basic training in information technology at the secondary school level differ from Member State to Member State within the European Community.

But as Minister Bolden (Luxembourg) mentioned in his presentation, there has been general agreement since Marseilles that:

- instruction in the most recent information technology should form an integral part of general education at the secondary level, and that:
- it is important for students to have had exposure to such technology before going on to professional training schools.

Participants at the Berlin Seminar were presented with various examples of concepts and measures applied in the Federal Republic of Germany as a basis for reflection and discussion among European Community Member States. This took the form of a lecture by

Prof. Arlt (Berlin), providing a general overview of developments in this field, the presentation of various teaching projects in the information technology area, visits to schools and industrial enterprises, as well as seminar work in four different working parties. Each seminar began with an introductory lecture.

2. Overview lecture

Prof. Arlt (Berlin Free University) first gave a brief outline of the development of computer science as a school subject in the Federal Republic of Germany, accompanied with an overview of the German education system to help explain the variety of different forms of education. He went on to show how the development and integration of a new subject - such as computer science - requires tackling a broad range of questions in four different problem areas:

- Development and testing of syllabi and background material
  Thanks to close cooperation between schools, teachers, education departments and experts, the essential work for the introduction of computer science as a subject in general education schools (secondary level II) had been largely completed by 1982.

- Development and testing of teaching material, media and software. The material needed to ensure the proper teaching of computer science in schools was successfully developed and tested, following experiments with large numbers of different models. On the other hand, the teaching software required for the introduction of basic training in information technology (in particular in the professional training school area) is still largely non-existent.

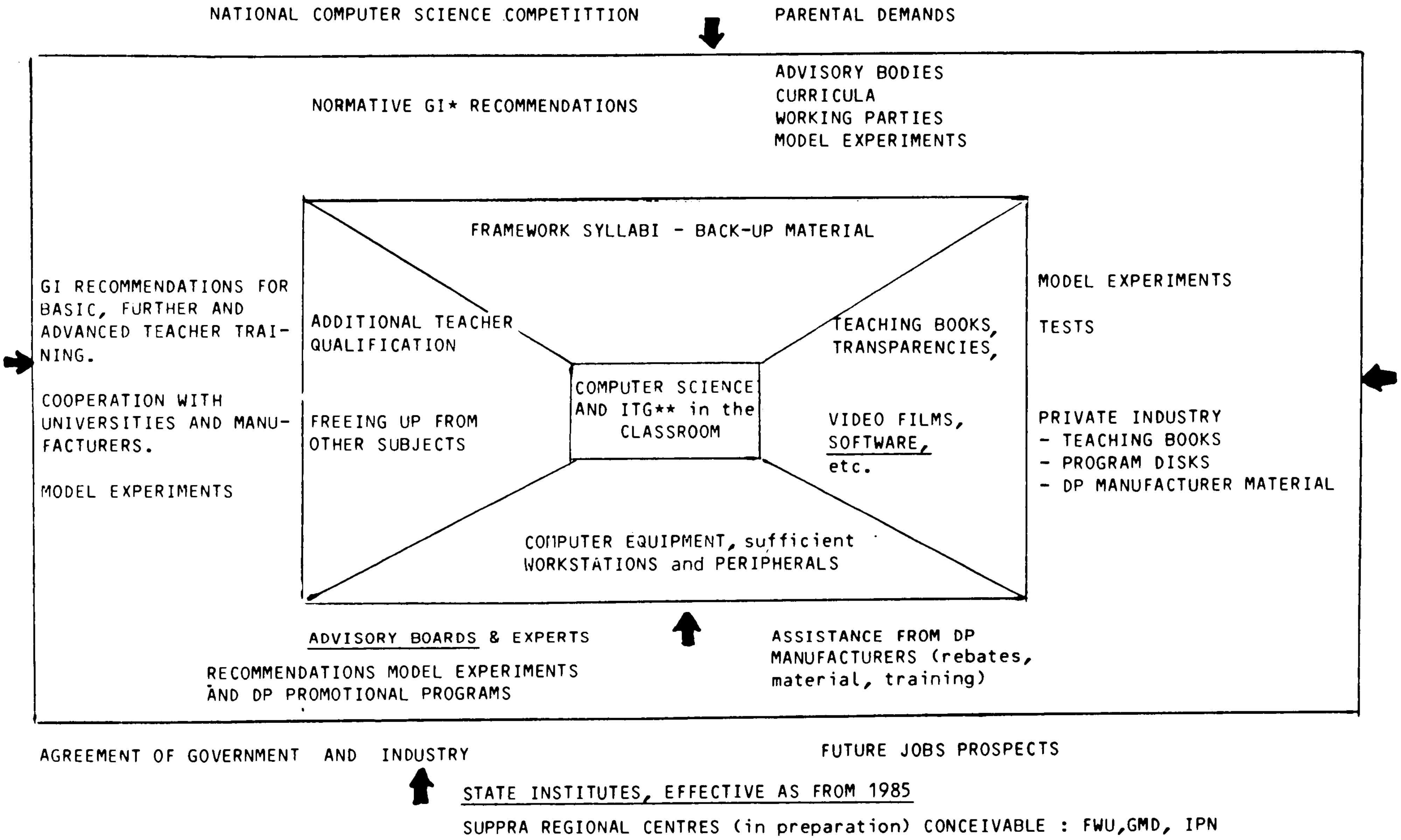
- The role of the teacher was largely underestimated in the initial phases of integrating computer science and information technology. Assistance in developing the subject was provided initially by motivated teachers (in particular at the secondary II level). At the present stage, a much larger number of teachers is required, who must first of all be trained. Extensive programmes to provide such teachers have been started in several states in the Federal Republic.

- The provision of computer systems. The acquisition and installation of computers in schools has gone ahead relatively slowly, and in some cases has been an uphill task, with the exception of the Free State of Bavaria, which has founded a state institute for the "joint development of computer science, and for the testing and maintenance of hardware and software specially produced for schools". As a result, this particular state has been able to attain a high level of uniformity in the acquisition of systems throughout the state.

The above-mentioned developments, which are shown in diagram form in illustr. 1, have received considerable support from various quarters, including recommendations from the Data Processing Society (Gesellschaft für Informatik), a youth computer programming competition, business firms, parents and other institutions.

Prof. Arlt summarized the situation by stating that the development of computer sciences as a school subject at general education secondary level II schools (primarily as a optional subject) had so far been positive. In the professional schools area, syllabi were currently being prepared in almost all German states. There was an urgent need to improve teacher qualifications as well as computer hardware. Discussions had been under way since 1984 on the development of "basic training in information technology" (in particular at secondary level I). Certain states had already introduced such instruction on a trial basis. The speed of innovation had been remarkably high for the education system.

NETWORK FOR AN INTEGRATED COPUTER SCIENCE SYSTEM (cf. Prof. Arlt's lecture)



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*GI : COMPUTER SCIENCE COMPANY - **ITG : BASIC TRAINING FOR NITC - GMD : COMPUTER SCIENCE AND MATHEMATICS COMPANY
FWU : Institute for the film and image, Sciences and teaching - IPN : Natural Sciences Institute

Prof. Arlt illustrated his lecture with examples from different German states and with diagrams.

3. Presentation of teaching projects

A number of widely differing teaching projects were demonstrated at an exhibition of hardware and software, from didactic laboratory experiments (German Federal Post Office), computer-assisted teaching material (e.g. as developed by the State of Hesse's Institute of Educational Planning and School Development), training software (e.g. for the German Civil Service Association Academy) and programmes for teaching computer sciences in the upper classes of elementary schools ("Hauptschule") (e.g. those developed by the state authorities of the Free State of Bavaria in Augsburg), to videotext for use in schools (e.g. in the State of Berlin).

The presentation included a wide but representative selection of teaching and training projects currently being undertaken within the the Federal German educational system, where considerably more is happening than could be demonstrated by the examples given in Berlin.

The different projects were at very different stages of maturity: some had hardly started, others were the result of several years' development and testing work.

The projects presented (syllabi, teaching units for basic training in information technology, simulation examples, programming languages, different videotext systems and teaching software ("teachware") for very different kinds of computer-assisted teaching) lead us to believe that they will receive widespread support.

The participants frequently gave the comment that federalized approach to education in Western Germany has at times led to an almost infinite and (as seen from the outside) impenetrable diversity of approaches, models and experiments in the field of education.

4. Visits to schools and industrial companies

Participants took full advantage of the visits to Berlin schools and industries provided for in the programme. The writer of this article only took part in isolated visits, which were certainly not representative. He will therefore refrain from making an overall judgment.

5. Contributions of working parties

The four working parties set up during the seminar examined computer science and basic training in information technology in the following four areas:

- secondary level II - general education schools
- secondary level I
- secondary level II - commercially-oriented professional training schools
- secondary level II - technically-oriented professional training schools.

In all four areas it was possible to observe how the use of computers in schools - together with instruction in computers and their basic use in data processing - has developed in three stages:

Stage 1: The computer as the subject of instruction: the only material needed is a single computer as an example.

Stage 2: The computer as a tool in (computer science) instruction. This requires one VDU workstation per 2-3 students, allowing students to program or work on various interactive applications on their own.

Stage 3: Computers as <u>a medium of education</u>; including every possible application and method of computer-assisted learning, in particular simulations, applications from the area of technical communication, tutorial learning and strategic games, as well as applications in the teaching of science, languages, social sciences and mathematics.

Not least because of these three stages of availability, computer applications penetrated initially into the general secondary level II schools (general grammar schools, and grammar schools specializing in economic sciences), leading to the rapid development of a computer science "option" (with interactive use of computers).

Currently the process is being repeated, with the computer being used both as a tool and a medium, at secondary level I and professional training secondary level II. The use of the computer as a medium will only become more widespread within the framework of basic training in information technology, where computer systems are dealt with in conjunction and in comparison with other technical media (communications systems, videotext, data banks etc).

5.1. Secondary level II - general education schools

This working party first discussed an introductory lecture given by Prof. Claus (Dortmund) on the subject of "computer science in the grammar school sixth form". Developments here are relatively consistent throughout the Federal Republic (not least due to the recommendations published in 1974 by the Data Processing Society):

a) In all states computer science is an optional subject in the reformed sixth form syllabus (secondary II) and in some schools is even an obligatory matriculation subject. This option includes, relatively consistently throughout Western

Germany, the following areas:

- solution of algorithmic problems,
- transposition of material into data structures,
- systematic working (in programming) and careful documentation,
- use of existing programs and "tools" in problem solving,
- functional description of computer systems
- (theoretical) boundaries of algorithmization
- possibilities and applications of data processing
- human-computer interface and work organization
- effects on society.

In general it is only possible to provide a limited selection of these themes. But in addition to these topics computer science teaching should also allow students to obtain practical computer skills without which the above-mentioned knowledge is no more than theory. Such skills include:

- knowledge of a (good) computer language,
- understanding the system functions of an (extended) operating system,
- familiarity with essential auxiliaries ("tools") such as program packages and data bank access techniques,
- familiarity with certain criteria for evaluating computer systems,
- exemplary knowledge of documentation procedures.

Prof. Claus added: "Such goals and skills sound very demanding; however, it only makes sense to teach them in elementary form. We are not looking to produce computer scientists".

b) The following reasons can be adduced to justify the introduction of computer science as a teaching subject:

- Social interaction and change is based on data. Information technology develops methods for producing, processing and transferring data, thereby according it a growing influence on social decision-making processes.

- Computer science offers constructive teaching possibilities, making use of widely available apparatus.
- The algorithmic model is gaining equal status with the two "motors" of scientific development: experiment and theory. Computer simulations and analyses frequently replace experiments and can also serve either to supplement or repudiate theory.
- The new technologies allow us to move ahead into new dimensions (of thought). In the future, according to Prof. Claus, we will have to plan our thinking (or more precisely: our mental routine processes), i.e. begin to think on a meta-level above that of data processing.

c) Thanks to highly-motivated teachers and students computer science has become a well-established feature of education at secondary level II. In certain federal states, more than 30% of all students in reformed syllabus sixth forms are already taking part in computer science courses.

d) Further teacher training in this area has taken the form partly of university and college courses, and partly of teachers training themselves. The training of specialist computer science teachers is only just beginning. As yet, there is no chair in computer science teaching at any Germany university. On the whole the subject is taught by a small number of motivated university teachers on a voluntary basis in addition to their regular classes.

e) The German model in this branch of education, with more than 10 years' practical experience to its name, can also serve as a basis for other European states. This model has been developed and has proved its worth parallel to, and only a little later in time than, the development of computer science courses in German (technical) universities and colleges.

f) The further development within general secondary level II was seen by the working party to lie, with the increased availability of computer systems in schools, in the growing integration of computers into the teaching of other subjects (mathematics, physics, biology, languages, social sciences etc). This would require the provision of more powerful computer systems. Provision should be made in each school for a number of good quality "work station computers" (i.e. high performance "personal computers" with a performance of at least 1 Mips and working memories of at least 0.5 megabytes), on which proven - including commercial - programs could be used. This could include data bank systems, table calculation procedures, statistical analysis methods, graphics packages and good "teachware" for teaching and problem solving. The working party suggested that such user systems be chosen and recommended on a national (or even international) level.

Interactive programming, which remains as important as ever for computer science instruction, is admittedly giving way to a certain extent to the interactive use of user programs as described above.

g) The working party also felt that in addition technical communication apparatus (such as videotext) should be made available at secondary level II within the framework of basic instruction in information technology, thereby extending and supplementing the use of the computer as a teaching tool and a medium. In no case should the use of computers be limited to "home computers" and similar miniature computers - already owned by a number of students.

5.2. Secondary level 1

In the Federal Republic of Germany the use of computers and instruction in the rudiments of data processing at secondary level I got off to a relatively late start (around 1983/84). So far no uniform patterns of tackling the subject at this level could be observed. The "pluralistic approaches" of individual federal states were leading, as Senator Laurien feared, to a "confusing muddle". Examples of such approaches included:

- instruction in the "rudiments of data processing" and computers,
- programming in simple functional programming languages (BASIC or LOGO etc.),
- the use of computer systems with very simple user programs,
- attempts to impart simple basic data processing technology notions (a sort of "computer driving licence").

There is already a recognizable tendency in the Federal Republic of Germany not to introduce a new subject (computer science or suchlike) for the time being at secondary level I but - as required by the Joint Federal and State Government Committee - to develop basic training in information technology as an integral part of existing "main subjects" such as engineering (in the upper classes of elementary schools), mathematics (in technical and grammar schools) or social sciences.

What did the members of the working party understand by the term "basic training in information technology"? After discussing Dr Goldstein's (Great Britain) introductory lecture, they agreed essentially with the theses contained in Dr Goldstein's lecture, viz. that:

- Information technology involves the storage, retrieval, processing and production of data with the help of electronic media.
- Such data can be produced in spoken, pictorial, tactile, textual or numerical form.

- Instruction in information technology (in schools) includes the economic, social, moral and political effects of data processing as well as its application in education, economic life, industry and everyday life.

This means that a secondary level I student should:

- be able to make "intelligent" use of different information technology systems for routine tasks and problem-solving,
- understand how data is stored, processed and used for communication purposes, as well as the (confidential) handling of electronic data.
- recognize the moral and social questions which can arise from the use of information technology.

From the above Dr Goldstein concluded that all students should be in a position to:

- use information technology systems for storing and processing instructions, selecting information and for control purposes,
- understand the workings of a simple 8-12 instruction computer program,
- solve (simple) problems by programming or by modification of computer programs,
- work together with other students in defining and solving problems.

Such applications at secondary level I would include work with simple, pre-programmed games, simple exercises involving the storage and retrieval of information, simple graphics applications, working in LOGO programming language; simple simulations as well as simple experiments with word processing programs.

The very differing levels of student ability in the area of information technology should be compensated for by the use of "open ended software" (programs adaptable to the levels of individual students).

Obtaining teachers qualified in this area at secondary level I is proving a serious problem in all European Community Member States involved. A number of different suggestions were discussed in the working parties. These included:

a) Initially appropriate measures should be taken to set aside teachers' fears of information technology apparatus such as computers. For example, computers could be set up in staff rooms or teachers given the possibility of purchasing such apparatus at very reduced prices. The teacher should be placed in a position of being able to identify with the new teaching tool and medium.

b) In order for teachers to familiarize themselves on their own with the new material, suitable learning material or courses at teachers' further education institutes should be provided, to allow teachers to come to grips with the use of information technology in education. Teachers must be in a position to be able to educate themselves further on their own. This could also involve the use of public communications media (television).

5.3. Secondary level II - commercially-oriented professional training

Professional training in Germany is typically carried out under the so-called "dual system".

Trainees spend one or two days a week at part-time professional training schools, and for the remaining 3-4 days receive practical training on the shop-floor. This results in close cooperation and interaction between schools and training firms.

At full-time professional training schools, which, however, are the exception, students receive both practical and theoretical training at the school itself.

For a number of professions with differing information technology requirements there now exist clear syllabus and examination guidelines. There are too many different possibilities to allow us to provide a simplified description.

Basic training in information technology has only begun relatively recently in the commercially-oriented professional training at secondary level II, in particular in those professions which are not directly involved with data processing. For certain professions there is no provision for such basic training in professional training schools. Work is currently in progress on suitable courses and syllabi.

The introductory lecture given by Prof. Asselborn (Luxembourg) provided the group work with a number of interesting stimuli. The following are examples of the 15 "experiences" as well as the large number of questions provided by his lecture:

1) Instruction on information technology which is too restricted to "modern" technology often bears no relation to real life problems.

2) Programmed instruction as provided by producers and companies is scarcely usable in professional training schools.

3) Computer-assisted instruction, where the computer is reduced to a purely teaching role, has so far not found acceptance in the commercial training area.

4) Standard programs such as word processing software, "spreadsheets" and databank software are becoming increasingly popular; however, problems still apparently remain in applying them in an appropriate fashion.

5) Communications technologies will become increasingly important, opening up completely new horizons to schools.

6) What conditions could be negotiated with manufacturers in order to simplify the use of their products in schools?

7) Would it be possible to conceive of a network of associated student enterprises, entering into "business" relationships within the framework of the school system and allowing students to gather useful and practical experience within such a simulated business atmosphere? Could such a project be promoted by the European Community on an international level?

The working party was largely in agreement that education in infomation technology had only too often in the past been limited to partial aspects, thereby losing sight of the whole, i.e. information systems. Instruction involving new data media should once again put the emphasis on the concept of information, allowing students to examine complex information systems within business enterprises. Greater importance should be given to communication processes (between human beings, between human beings and machines as well as between machines). Students should also learn to assess the economic value of information as well as understand the "power structures arising out of information systems".

The various possibilities for the "intelligent" use of suitably adapted user software (for word processing or file work etc) and the provision of such software was discussed in detail in the working party. The suggestion of creating a network of umbrella firms within a European network, initially in Belgium, the Federal

Republic, England, and Luxembourg, was the subject of lively and enthusiastic discussion.

A further focal point of joint efforts is the problem of initial and further teacher training. Efforts should be made to obtain data specialists as teachers for students from data-intensive professions. In addition all teachers should be required to acquaint themselves with basic training in information technology, in order to be able to provide instruction to different professional groups to their needs.

The Federal Republic is rapidly expanding its communications networks. More and more local networks are being created, allowing work station computers to be connected both with one another and with computer centres. The working party was of the opinion that practical instruction in handling and using the new information technology possibilities in the "office of the future" and "the communications services of the future" should be an obligatory part of secondary level II professional training.

5.5. Secondary level II - technically-oriented professional training[1]

At the current stage of development no broad-based, fully developed, officially sanctioned and permanent general instruction in information technology exists in any of the EC states represented at the seminar. And students leaving secondary level I for technically-oriented professional training do not have a uniform educational background.

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[1]The reporter was unable to attend the meetings of this particular working party. This chapter therefore consists of quotes from papers drawn up at these meetings.

Nonetheless, all states agree on the necessity of basic instruction in information technology. However, approaches to curricula, contents and teaching methods differ widely.

In the view of the working party a central problem in the teaching of information and communications technology in all states remains that of the initial and ongoing training of teachers and instructors. Major efforts are being undertaken by all states, aimed at effective and rapid acceptance by means of a "snowball" multiplicator effect. Measures to encourage further education should include not only information technology, scientific and technical aspects, but also the effects on the economic and work organization structures within individual companies - the impact of technological creation on the social contract.

The discussion made clear that these new elements in the field of information technology training also gave rise to a requirement for new teaching and learning methods. Preference should be given to those training methods which encourage, among other things, learning to how to plan, competence in the use of methods, independent working and systems thinking. Suggestions included a proposal that the European Community should organize an ongoing exchange of relevant experience and materials, using CEDEFOP for example as a vehicle.

As regards the application of user software in professional training it was determined that as a rule this does not meet the required pedagogical and teaching criteria. Such software should be improved by means of closer cooperation between computer experts and the teaching profession.

The members of the working party were united in finding that, in the area of CNC technology, process simulation based on the use of personal computers provided very suitable teaching material, for both teaching and economic reasons. Experience had shown that this kind of simulation rapidly broke down any anxiety and inhibitions still existing relating to the use of information technology apparatus.

6. Concluding remarks

Seen from the viewpoint of the author of this article, the following tasks must be tackled within the European Community as a matter of priority and without delay.

1) Models and effective measures must be planned, tested and implemented for basic and further teacher training. Exchanges of experience should take place within the Community, allowing a certain unification of contents and curricula. Exchanges between teachers could contribute substantially to such an exchange of experience.

2) The development, testing and implementation of software suitable for teaching purposes should be encouraged - not least in collaboration with data processing manufacturers and software houses - on a broad, and if possible, international level. Computer systems without special teaching-oriented user software are of little use in secondary education. Software produced locally at individual schools hardly ever meets the required quality standards. Computers can only be successfully integrated into a large number of school subjects as well as daily life if a sufficient number of programs, properly adapted to both users and tasks, are available.

3) All information technology material and apparatus used in secondary schools must be directed - not only in professional training schools - towards real-life tasks. Not least of all this material and apparatus should provide both a demonstration and an advertisement for the sensible use of information technology equipment, as well as being able to provide information on the effects as well as the limits of modern information technology.

4) Basic training in the area of information technology and the fundamentals of computer science should have priority right through the secondary education system over the imparting of short-lived technical knowledge and training on specific apparatus with specific applications. The careful building up of a fundamental knowledge and the practical use of this knowledge in building basic systems should form the basis for the "lifelong learning and handling of information technology systems" which will be a decisive factor in the life of today's schoolgoers.

The seminar on the introduction of new information technologies in the secondary school area has shown that there is no lack of ideas, approaches, plans and models for this task amongst the European partner states. The task before us is to convert them step-by-step and, as far as possible, in close cooperation between the different partner states, into practice. Given the competitive situation of Europe vis-à-vis economic powers such as the USA and Japan, with their strong position in the field of information technology, a position they are continuing to expand, decisive action becomes a duty of the European Community.

Perhaps future seminars of a similar nature to the present one will deal with more concrete and specific tasks, allowing them to be considered jointly and then tackled within the framework of joint projects. It is time for the exchange of information - however important this might be - to result in joint decisions and joint action.

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