SOCIAL EUROPE

Supplement on NEW INFORMATION TECHNOLOGIES AND THE SCHOOL SYSTEMS

Report on the Newcastle and Bologna seminars and extracts from the proceedings of the Nice summer school

COMMISSION OF THE EUROPEAN COMMUNITIES

DIRECTORATE-GENERAL FOR EMPLOYMENT, SOCIAL AFFAIRS AND EDUCATION

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INTRODUCTION

THE COMPUTER IN THE CLASSROOM : THE FACETS OF THE EUROPEAN VIEW

In accordance with the Council Resolution of 19 September 1983 relating to the introduction of new information technology in education (OJ N°. C 256 of 24 September 1983), the Commission has been organising a series of meetings at Community level to support the action of the Member States and stimulate the exchange of information and useful cooperation.

The seminars held in Newcastle (July 1984) and Bologna (May 1985) for policymakers responsible for introducing new information technology in education, members of the educational Inspectorate and those responsible for teacher training formed a continuum with the Marseilles seminar of December 1983 on "Informatics and Education". The report on the Newcastle seminar was prepared by Ms Virginia Makins, a journalist with the Times Educational Supplement, and it reviews the discussions and demonstrations arising out of the seminar, which was organised by the UK authorities in close liaison with the Commission. The Bologna seminar was reported by Mr Giovanni Vicentini, a journalist with the Italian national broadcasting company RAI, and it gives account of the various discussions, speeches and demonstrations at the seminar, organised jointly with the Italian authorities.

As part of the process of pooling the experiences of Member States, the Commission is also organising summer schools to take stock of the state of research and development in the Member States in precisely-defined areas connected with NIT and education. These provide participants with an opportunity to put their own views forward and hear those of others, to raise major problems needing more or better solutions, and to map out directions for future research.

The summer schools also aim to provide a focal point to pull together the currently unconnected threads of research on a topic which, in Europe, is still in its infancy and to stimulate new research as a cooperative effort between Member States.

The first of these summer schools on NIT and education was organised in liaison with the French authorities in Nice in July 1984 to consider the use of application-oriented computer languages in education. The final report on the meeting was prepared by Mr A. Coullet (of the Centre de Formation des professeurs à l'Informatique - the centre for teacher training in computer studies) and Mr P. Thebault (Rectorat du Lycée du Parc Impérial). Selected extracts from their report are presented here.

The next educational summer school was held in Liège in July 1985, and dealt with NIT and primary school education. It was organised jointly with the Belgian authorities and the teaching laboratories of the Universities of Liège and Ghent.

M. LEENS

EUROPEAN SEMINAR ON NEW INFORMATION TECHNOLOGIES IN EDUCATION

Newcastle upon Tyne, 3-6.7.1984

Seminar organised by the Commission of the European Communities
and the Council for Educational Technology

Report by Virginia MAKINS

INTRODUCTION

The seminar on New Information Technologies in Education that met in Newcastle in July 1984 was an unusual one. It isn't every international conference that you see experts and educationists playing with electronic trains, settling down to puzzles in mathematics and chemistry, trying to design logic circuits, or programming toy-like machines to draw pictures.

The idea was to give delegates from the ten member countries of the EEC some practical experience of the work done to introduce computers and computer-based systems into British schools, in order to tackle key questions about the potential and problems of bringing new technologies into education.

In particular, the seminar discussed what was the appropriate age and educational level to introduce children to various uses of computers; how far today's pupils needed to understand how the technology works; what impact the use of new technology should have on curriculum content, organisation and teaching methods; and how far developments in one country could usefully be translated for others.

The United Kingdom was an obvious base for this particular exercise. Most EEC member countries have focussed on introducing information technology at the upper secondary vocational level of education, and have only recently begun to plan national strategies for introducing computer awareness courses for all pupils at the lower secondary stage - let alone into primary education.

Only two countries, France and the UK, have pursued policies to promote the introduction of new technology into schools at all levels - developing materials for its use across the curriculum in both primary and secondary schools, and for computer awareness courses for all students.

Of the two countries, the United Kingdom was quicker off the mark in its policy to bring computers and microelectronic systems into schools on a large scale, and is widely considered to gone the furthest in the development of imaginative software and teaching materials for schools to use in a wide variety of ways.

UK government programmes have promoted the development of software and other teaching materials throughout the country, worked on new methods of distributing software to schools, produced teacher training packages, and sponsored the development of microelectronic teaching devices in both the public and the private sector.

The materials are designed to introduce both primary and lower secondary pupils to a wide variety of computer applications - including text and information handling, through word-processing systems and simple databases, computer control through input and ouput devices, materials to introduce all eleven to thirteen year olds to logic gates and basic microelectronics, as well as more conventional computer-based learning packages. All these things have been done by some individual schools and teachers in most EEC member countries - but in the UK (as increasingly in France) they have had a high level of institutional support.

The seminar was the second in a series sponsored by the European Commission, to further the EEC policy that all pupils in member countries should be introduced to the uses and applications of new information technologies, and be aware of their social implications and consequences. That policy had been embodied in a resolution passed by the Council and Ministers of Education in September 1983, which called for a series of meetings between 1984 and 1987 to pool the experience of member countries, and promote exchanges and co-operative developments.

The focus was to be on appropriate objectives and methods for courses to introduce all pupils to the uses and social implications of new technologies; on the application of new technology in different subjects of the school currculum; on the contribution of new technology to the education of children with special needs, and on the strategies needed to make sure that girls became involved.

A more recent policy document on Technological Change and Social Adjustment, endorsed by both the Education ministers and the Labour and Social Affairs ministers of EEC member countries at two meetings in June 1984, strengthened the Community's emphasis on promoting new technology to improve the economic health and competitiveness of European member countries.

In this document, education and training was seen as one of three priority areas for Community action, and two important strands were identified : the need for initial and continuing training of high-level specialist manpower, and the need to increase awareness and familiarity with new technologies both in schools and among the general public.

At the first meeting on new information technologies and education which took place in Marseille in December 1983, delegates had become very aware of the different approaches of different member countries to the introduction of new technology in schools, and had begun to establish the common framework needed for more specific discussions and exchanges. One of the main demands from delegates at that conference had been for more chance to see what other countries were doing, and sample the products they were developing.

So, at the Newcastle conference - jointly sponsored by the European Commission and the Education Departments of the United Kingdom - the main aim was to give delegates as much practical experience of the best of the software and computerised learning systems being developed for British schools as time allowed. (Work done in special education, though seen as very important, was not shown or discussed, since it was to be the focus for another EEC conference.)

On the first evening of the Newcastle seminar, the two main speakers set the scene for the next three days practical experience and discussions. Mr Aneurin Hughes, the chef de cabinet of the Member of the Commission responsible for Education, Employment and Social Affairs, reaffirmed the economic imperative for European countries of trying to catch up the United States and Japan in the new technology field.

Otherwise, he warned, "we will be like China in the 19th century - with a long history and a rich culture, but economically impotent faced with the then leading-edge industrial technologies of Europe and the United States."

Of course, he said, we needed a massive increase in specialists, and in research and development. But we also had to prepare all young people for the new world of new information and computer technologies. We must make children aware of social implications - not least the "potential for an abusive centralisation of power". And we had to explore the possibilities of using new technology to help the less-favoured, in special education, in adult literacy programs, and as a way of remotivating both children and adults who had missed out on educational chances and qualifications.

Sir Keith Joseph, the Education Minister for England and Wales, described some of the particular uses of new technology that the delegates would see, and stressed its potential not only for special education, but for children with moderate learning difficulties. He also reiterated the importance of making sure that girls did not miss out.

It was important to decide which aspects of new technology were worth developing in cost-benefit terms, he said. In countries where local government had to take the specific decisions on the introduction of new technologies into schools, central governments should make sure that good information was available for decision-making.

DO IT YOURSELF TIME

The practical part of the seminar, when delegates spent the best part of a day working with computers and teaching materials, was designed to give them a basis to tackle a list of questions. In the event, the seminar's discussions focussed mainly on the following : -

* At what stage in a child's education does a computer become useful? What are good uses of computers in the early stages?

* Should all children acquire a basic understanding of microelectronics-based technology? How much do they need to know about this technology, and is school the place for them to learn about it?

* What characteristics of a program make it interesting or instructive for children? Are basic utilities, such as word processors, databases and spreadsheets, more valuable than programs designed to help children learn a particular topic, or explore a simulated set of circumstances?

* How usefully can programs developed in one country be transferred to another, suitably translated for different languages and machines?

* Does the work so far indicate the need for changes in curriculum content and organisation; teaching and learning styles; the role of the teacher; and pupil assessment?

* What reasons do teachers have for declining to use computer-based learning materials? Are they valid reasons?

The session was introduced by Richard Fothergill, Director of the Microelectronics Education Programme (1). He described the range of work that is being tackled, and how it is affecting - or should affect - the attitude and approach of teachers.

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(1) The Microelectronics Education Programme for England, Northern Ireland and Wales, had effectively been running for three and a half years. Before it started, a few local education authorities and individual colleges had developed strong teams to promote the use of computers in schools, and develop materials. But the work had been patchy : many authorities had hardly started. MEP's brief was to encourage work in curriculum development, the production ofsoftware and other materials, and teacher training, across the country. A lot of the materials on view at Newcastle were the result of MEP projects and developments. Scotland has its own Scottish Microelectronics Development Programme : some of its materials and training strategies were also seen or described at the seminar.

Fothergill stressed that, while it was intrinsically important to give young people some understanding of the microelectronic control and information systems that were now having so much industrial, commercial and domestic impact, the work being done had deeper educational value. It could foster important skills of design, problem-solving, and the ability to collect, handle and evaluate information and use it to generate and test hypotheses and to make decisions.

When it came to materials designed to encourage teachers to use the technology to help children learn the subjects of the normal secondary curriculum, Fothergill said that a small number of enthusiastic teachers had been making all the running, and that software and materials developed so far did not begin to cover the secondary curriculum in depth. The work, he said, had gone through a "fairly considerable evolution of thought and practice", but it was still in its infancy when it came to "purposeful impact on the curriculum".

He went on to describe some of the more interesting uses. Modelling programs allowed children to use computers to investigate and explore for themselves some of the factors and variables in topics such as the growth of a flowering plant, or energy conservation in a home. Such programs often covered material found in the normal curriculum, but meant that they were approached in a different way: "not so overburdened with facts, but permeated with an attitude that encourages exploration and deduction."

He also pointed to work with simple word processing systems and with databases. Teachers had found that word processors helped children to write fluently and creatively from an early age. Building and using databases for different purposes introduced them to important learning and information-handling skills.

Fothergill's call for "information studies" to be a central part of the curriculum did not seem to strike many chords in the delegates, if their discussions were anything to go by. But after seeing the range of materials developed so far, most delegates seemed to agree with his view that new technology could help to develop important skills and concepts in children.

And they certainly agreed with him when he said that considerable, and continuing, in-service training was needed to help teachers to make much of the new possibilities, and that even a massive one-off in-service programme was likely to achieve very little.

After Fothergill's introduction, the delegates scattered into various workshops where they could try out the materials for themselves. There were workshops for secondary science and mathematics, for technology, for humanities, for language teaching, for the primary stage, and for computer awareness and computer studies.

The workshops were arranged so that people could work in twos and threes, spending twenty minutes or so with each activity, with demonstrators on hand to explain the materials and teaching intentions. It wasn't long enough fully to investigate the potential of a program, or the teaching intentions behind it - but it was long enough to get a fairly good idea of some of the possibilities.

Neither the delegates, nor this reporter, had time to get round all the materials available: all I can do here is try to describe a few of them, and some of the delegates' reactions to them. They were not always impressed by the quality of the software, or convinced of its educational value. But they were impressed by its range, and by the consistent aim to make it attractive and entertaining, using colour and graphics and sound and games. They had a lot of fun with it themselves, and thought that most of it would be fun and motivating for children.

One set of materials that impressed almost everyone was a kit desgined to teach eleven year olds the basic concepts of microelectronics - logic gates, input and output, pulsing, counters and memory. Children experiment with small circuit boards that can be joined to each other when necessary, and as they learn, undertake design projects such as building a circuit for an alarm system that will turn itself off in daylight.

Delegates rapidly invented their own projects - for example one was trying to make a counter that was counting in hexadecimal numbers (base 16) use decimal numbers, and drawing other, more expert, delegates into the problem. Most people agreed that the kit was a good practical way to teach the principles of basic microelectronics - though not everybody agreed that was something that every child should learn.

Various gadgets to teach children about computer design and computer control were available. A simple computer controlled lathe could cut polystyrene into symmetrical shapes : first you designed your wine glass on the computer screen, then the lathe cut out a prototype for you. There were lego vehicles, whose movements could be programmed by computer, and a more sophisticated programmable computercontrolled "buggy" with various sensors on board.

The workshop showing approaches to computer studies and computer awareness courses had other materials to teach the beginnings of computer control - including an electric train that had to be programmed, and a simulation of a CNC lathe. Other simulations showed different uses of computers in real life - an airline ticket reservation system, a flight simulator, a simplified file handling system based on the one British Petroleum uses to control the movements of personnel on and off oil rigs. There were also materials to teach computer programming, based on the language COMAL, favoured by Denmark, Ireland and Scotland.

For history, geography, and economics, there were a variety of simulations - many of them potentially useful for more than one subject. You could plan a tourist industry for an island with appropriate beaches and historical monuments, seeing the consequences of your choices about where to place hotels, and what kind of tourist you wanted to attract. You could manage the workers and materials in a company that made supermarket trolleys : "Much too oversimplified, I don't see what they'd learn with this one", said one delegate.

You could fix the EEC potato support price, or run a farm, choosing your crops and managing your labour force, and seeing the effect of different variables on your profits : "they begin to see why farmers grow the crops they do" said a teacher. You could investigate the balance of payments on an economic model :"very good", said more than one delegate, "they can get in an experimental way a sense of what an economic model is, and can investigate what happens when they change the variables."

There were displays of children's work with databases for history and social history. A priamary school project where children had put data from their school register on file, and had used it as part of a wide-ranging study of their village in 1880, impressed many delegates.

In mathematics and science there were various packages that demonstrated functions and phenomena in graphic ways, and allowed students to investigate what happened they change key variables. Some simulated reactions, for example of the behaviour of molecules when factors such as temperature and pressure were altered.

Delegates were not impressed with everything they saw : "This is totally incomprehensible", said one, looking at a jittery simulation of the life of a bee. "I could do this much better with a pencil and paper", said another, of a program supposed to teach principles of scientific classification. But no-one doubted the power of the computer to simulate, and show in concrete and graphic ways, phenomena and concepts that had previously had to be tackled in abstract or algebraic terms that made them inaccessible to many children, or to demonstrate vividly scientific phenomena - such as a nuclear explosion - that could not be shown in other ways.

The science workshops also showed a computerised laboratory tool that could calculate and display the results of experiments and in theory allow children to conduct elaborate investigations, and investigate hypotheses, which lack of time and the need for laborious calcuations and records would have previously made impossible.

Both English and foreign languages were featured in the languages workshop. There was an adventure game that had proved successful in getting children to write creatively, and a program which was claimed to encourage children who are normally not very interested in analysing texts to look closely at any text chosen and fed in by their teacher.

A rather similar program for foreign language teaching was also on show, allowing pupils to build up a text word by word : a teacher claimed that giving pupils programs that only responded to a foreign language were good for motivating pupils. Delegates were told that language teachers were also beginning to explore more imagininative and communicative ways for students to use the technology.

An enthusisatic teacher of French demonstrated the results of spending his Sundays putting French radio news broadcasts onto a simulated teletext system, then giving them to his upper secondary students to read (on the computer screen) and to look up references (what is the CRS or the CGT, where is Bordeaux?). "French at this stage is usually very literary - now they're beginning to see it as a modern language," said the teacher.

Word processing systems were available in various, more or less simplified, forms, to make the business of writing, revising and editing less laborious for children. One system replaced the conventional keyboard with a five-button, one-handed keypad, four of which could be linked to one computer so that four children could write on it at once.

On visits to primary schools, some delegates saw six year olds using this system with confidence, after two and a half hours computerised tuition in the use of the keypad. "It's clear that children can learn to write on the screen before they can write with a pencil and paper" said one delegate. "I don't know if that is good or bad, but it is interesting," said one.

Logo - a powerful but easily learnt programming language, designed to teach learners of all ages, from kindergarden up, principles of programming, problem analysis and solving, and mathematics - was on show in many forms : in computer control, in programmable drawing machines, and in "turtles" that enabled students to draw pictures and complex geometric shapes on the screen. French and British primary experts could be found in corners having enthusiastic Logo conversations - the French having gone further in using the full capabilities of Logo with young children, and not just the "turtle graphics" facility.

Later, when small groups of two or three delegates visited one of more than 20 local primary and secondary schools, they saw some of these applications of new technology being used by pupils in classrooms, delegates were not always impressed by every detail of what they saw. But they were convinced of its motivating power with many children who would normally not get much out of school, and with its potential for even the youngest primary children.

SOFTWARE DEVELOPMENT AND DISTRIBUTION

The third morning of the conference was mainly given over to ways of developing interesting software, and of distributing it to schools. David Walker, Director of the Scottish Microeletronics Development Programme, began by asserting that once teachers got fairly deeply involved in software development, they also became involved in wanting to change the curriculum.

He argued that new technology encourages faster curriculum change, and "shortens the time gap between new inspirations." When teachers start developing software, they become much more critical about curriculum content. "New Technology isn't just a tool, it's a key to open up the abilities of teachers."

He described how one group of teachers on an in-service course moved through successive stages. First they flirted with "drill and practice" programs, using amusing sound and graphics to get children practising basic arithmetic. Then they moved on to simulations, useful to help teachers demonstrate things like sine and cosine waves in mathematics, and to more creative programs where users could use shapes and colours freely to create pictures and designs.

At this stage, they became interested in databases and their uses. They also started creating simulations where pupils took a role - for example of a housing officer : the pupils had to allocate housing to families with different needs, and write to the families explaining their decisions.

As they moved on to this kind of program, Walker claimed that teachers began to evaluate the whole secondary curriculum more critically. Gradually they wanted more sophisticated simulations and databases to prepare children for adult life : he showed part of a program which gave the vital statistics of six very different parliamentary constituencies, and asked the pupils to devise a policy manifesto that might win an election.

Walker argued that teachers should not learn to program themselves, but should learn enough to specify the content of programs, and to maintain the software. "With new technology there should be a continuing loop of raising teacher awareness, and a resulting impact on curriculum design", he said.

During the morning other approaches to software development were described - involving teachers, programmers and go-betweens who could help explain the needs of one group to the other. One important requirement was that software should lead pupils into investigation and discussion and discovery learning.

Ways of distributing software were also demonstrated and discussed. A very wide range of possibilities emerged. Programs could be transmitted by telesoftware. A British system, mainly used by hobbyists, was demonstrated : at the moment the educational programs on it were "mainly rubbish", according to one speaker, but the system clearly had potential for schools.

Radio had been used to transmit software that receivers could record onto cassettes. The Microelectronics Education Programme had developed a bar code reader, that could be used to read programs into a computer, as well as for computer awareness courses. The possibility of accessing databases in other countries, for the cost of a local telephone call, was demontrated.

Some of these techniques could be used for the exchange of software between European countries - provided they had access to each other's machines, or interfaces to allow different machines to talk to each other. They also opened up possibilities for a variety of links and exchanges between schools and colleges in member countries.

HUNT THE PEDAGOGY

There were two main discussion sessions at the conference (1). In the first, small groups of a dozen or so delegates, began to bring the experience of the workshops to bear on the key questions the conference was asked to tackle (see page 5). In the second, on the last day, delegates split into three groups, representing the three main stages of schooling, primary, lower secondary and upper secondary, to try to reach some answers to the questions.

The first discussion sessions were off-the-cuff reactions to what the delegates had seen : the second more structured. Mostly, they were an attempt to disentangle the pedagogy from the technology's obvious capacity to entertain and motivate students who might otherwise be very uninterested in the content of the work. "At last we are beginning to talk about pedagogy", said a veteran of the earlier seminar at Marseille, with some relief. There was little question that pupils would enjoy a fair proportion of the work the delegates had seen : the question was, what would they learn from it ?

Many delegates appreciated the intentions of what the British demonstrators considered their best software : the work pioneered by creative teachers, and intended to get students exploring and discussing and testing hypotheses. But they believed that ordinary teachers would need a lot of training and encouragement to use it in the way that was intended.

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(1) This report is based on dropping in and out of discussion groups and talking to group leaders and members afterwards : it covers many of the themes that arose, but is not a systematic account of the whole debate.

Few would have gone so far as the Italian delegate who said that the work could be seen as "blackmail, trying to frighten teachers into changing their methods." But many believed that the great majority of teachers had a long way to go before they would subscribe with conviction to the pedagogic intentions behind the materials.

Several people argued that the most productive way of using the technology was to give children utilities such as databases and word processors, rather than programmed educational software based on traditional subject matter. The utilities would positively encourage teachers to encourage children to explore and ask questions : "we must get away from software that puts the teacher behind the scheme and get teachers out into the classroom where they belong".

But several groups agreed that there was little point, at this stage, talking about "good"and"bad" software.Partly, that was because what mattered was the way the teachers used the software. Even the narrowest drill and practice programs - normally labelled as "bad" among sophisticated educators - could have their place when carefully used. Partly it was because many experienced delegates felt that most teachers would have to go through the stages David Walker had described - starting with drill programs, and being led on to a more open view.

There was general agreement that there was a lot of scope to use the technology in primary education. For one thing, primary teachers were much freer to experiment, to break down subject barriers, and to give children time to explore and learn in an open-ended way (though not all countries offered the freedom of primary teachers in Britain, Denmark and the Netherlands). The most important uses in primaries were those that encouraged logical thinking, problems solving and information handling.

Some delegates foresaw many more problems in using new technology in secondary schools in productive ways :"I see no fruitful future unless there are fundamental changes in timetables, curriculum and the use of buildings" said a Belgian delegate.

The pedagogic ideas behind much of the work delegates had seen in micro-electronics and computer control were generally approved : delegates liked the materials which encouraged students to design and experiment for themselves. And Logo was greeted with enthusiasm, particularly for primary schools. It was seen as an excellent way of teaching problem solving, and the forms of thinking essential for information technologists - particularly the ability to break problems down into manageable chunks and make an algorithm (or logical step by step procedure) to solve them.

Experienced logo hands also argued that using Logo-based materials at the primary stage had proved a very succesful way of getting girls going on information technology - a main concern of both the European Community and of many delegates.

But there were worries about the uses of computers with very young children. Several delegates argued that research should be done, investigating how young children handle information, and the effects of giving them new computer technology : such research might lead to the production of better hardware and software. And one or two people argued that until children could communicate much more easily with the machines, the technology's potential would not be realised.

Many delegates were concerned about the use of simulations, particularly with young children. There was a real danger that children would be given simulated experience on the cheap at school, when they needed first-hand experience. With programs available to simulate, on the computer screen, everything from finger painting to football, delegates agreed that the important principle was that no experience should be simulated on a computer when it could be experienced in real life.

But most delegates did see a lot of teaching potential in simulations. In subjects such as science, mathematics and economics, simulations could vividly show things that were impossible to demonstrate in other ways - the effects of changing variables on economic models, or the ecology of a pond, or the behaviour of molecules under different conditions.

Simulations could also help to teach concepts that had previously been too abstract for many students, and allow the students themselves to explore the effects of changing variables and conditions. The crucial job for teachers was to show the limitations and approximations in the models and simulations.

This power of computers to make things less abstract, using their unique capacity simultaneously to process words and numbers and symbols and pictures, was considered by many to have extraordinary potential for making previously difficult concepts and subjects matter accessible to many more students. One example given was mathematics, where algebraic relations could now be demonstrated dynamically and graphically, and problems which previously had required abstract algebraic solutions could now be handled arithmetically, with appropriate alogorithms - expanding possibilities for less able students.

On the last morning of the conference Ivan Wallace, Northern Ireland's Senior Chief Inspector, returned to the crucial question of teachers' response to the technology. His talk was called "Information technology - a help or hindrance to curriculum development?" He argued that considerable changes in curriculum, teaching aims and methods, were needed to prepare children for a world of rising unemployment, frantic comptetition increasing social intolerance, violence, and distress.

So far, he said, significant changes in curriculum approaches had come thanks to "the courage of key teachers to place their educational convictions above the expectations of the community". Now, at a time when teachers most needed support at high level to meet the needs of a world where "rapid change is the only certainty", they were mainly getting criticism, and blame for economic and technological factors outside their control.

Society was sharpening demands that schools should aim at high levels of academic qualifications - demands which, for many students, carried the inbuilt prospect of failure, alienation, and loss of personal dignity. Cognitive skills were valued, and preactical creative and aesthetic activities devalued : "the education of the whole person is neglected."

Basic skills these days, he argued, are concerned with social, political and economic awareness, with the ability to engage in rational argument and discussion, with the ability to absorb, interpret and reflect critically on a mass of information fromdifferent sources - some of it presented in technically sophisticated ways.

New information technology could influence not only how we teach, but what is taught : it can "liberate much of our teaching from the constraints which have bound it in the past". It should be used in ways which promote active thinking by pupils. "We have barely begun to scratch the surface : we have the technology, we need to develop the pedagogy".

Changes of curriculum structure, packaging or content would not be enough to change direction. Radical changes in teaching are needed. School leavers are said to be deficient in communicating, working as a team, taking initiatives, making intelligent decisions on the basis of limited information. Was this the result of pedagogic methods that promoted individual rather than co-operative endeavour, and discouraged talking, initiative and independent-minded thought ?

New technology, properly used, could encourage pupils to think. But we had to give the system time to change. There were three main sources of resistance to new technology : teachers, the design of the materials, and decisions about what was worth doing.

Teachers resist new technologies because they are frightened it will put their jobs at risk, because they are unsure of their new role as managers of learning, and because of lack of time to keep up with new developments. There were plenty of Luddites hoping to break the threat of new technology, or waiting for it to go away. They had to be persuaded that it was non-threatening and supportive in the classroom.

Teachers also rightly considered that a lot of the present software was of low quality. Skilled teachers must be involved in the development of software, that used the technology's potential for problem solving and setting. We also had to recognise that the best computer assisted learning was not just a reworking of traditional methods, but was concerned with adding new skills and knowledge to the curriculum. Teachers and the public had to be encouraged to accept that, for example, the ability to argue sensibly was as important as the ability to remember a body of facts.

There were no obvious or easy pathways for the education system to come to terms with present needs. But new technology certainly provided powerful instruments to support real change, and to promote the fundamental shifts in attitudes and expectations without which any change could only be superficial.

Ivan Wallace's paper, with its focus on the need for genuine changes in curriculum aims and teaching methods, and its recognition of the enormous difficulties in persuading both teachers and the public of the need for such change, was warmly welcomed by many of the delegates. The issues he raised will be central to the next meeting in the series, at Bologna in 1985, which will be concerned with teacher training for new information technologies.

ANSWERS AND QUESTIONS

The outcome to all the discussion was fairly clear answers to most of the questions the seminar had set out to tackle.

At what stage in a child's education does a computer become useful ?

There was complete agreement that computers could be used in education from the earliest primary stages, and indeed that primary schools, with their relatively flexible curriculum, were the best place to introduce children to various aspects of new technologies. This was a marked change from the Marseille seminar, only six months earlier, when the discussion had focussed almost entirely on secondary schools.

Should all children acquire a basic understanding of microelectronics based technology ?

The delegates divided on this one. The primary group believed that children will ask questions about how the technology works, and that primaries should spend time on the technological side. At the secondary stage, some delegates thought that all children should have some understanding of microelectronics and microprocessors. They believed that it was important to demystify the technology. They also argued that the subject would help to teach logical thinking and problem solving.

Other delegates thought it was unnecessary that all students should learn microelectronics : it should remain an option. But there was unanimous agreement that all children should learn to use information technology at school, and that analysis and discussion of the social and economic effects of microelectronics should be part of the curriculum for all students.

What characteristics of a program make it interesting or instructive ? Some programs, such as word processors, databases and spreadsheets can be considered as basic utilities, others are designed to help a child learn a topic or explore a simulated set of circumstance. Is one approach more valuable than another?

Most delegates seemed to agree that the best programs were those that put students in control of their own learning, and allowed them to explore concepts and ideas. Software that encouraged discussion between children working in small groups was particularly valuable, though programs designed for individuals could be useful for children with learning difficulties. The question should be the other way round : first decide the pedagogic necessities, then design software to fit them.

There was a resistance to trying to identify "good" software at this early experimental stage : "we must continue to let 1000 flowers bloom". One important attribute of any good software was complete documentation, describing pedagogic intentions and the range of resources and methods that should be used alongside the software.

As to the question about the value of utilities as against other educational programs, most delegates agreed that it was rather like asking whether potatoes were more valuable than rice.

Could programs developed for one country be translated and used beneficially in others? Are there cultural or educational barriers ?

Delegates did not seem to see many problems about the translation of software :"We're already doing it and it takes six months", said a Dutch delegate. But people agreed that it was important to exchange the pedagogic ideas behind the programs, not just the software itself.

Does the work you have seen indicate the need for changes in curriculum content; curricular organisation; teaching and learning styles; the role of teachers; and pupil assessment ?

The answer was yes for all headings. New technology would not force changes, but would make them possible or even encourage them. It would make it easier to do things people had been attempting for some time - breaking down subject barriers, or expanding adult education.

Two reasons were put forward for concern about new technology's influence on assessment. The technology should not be used for continuous assessment of a narrow range of skills, simply because that was now possible. "There's a danger of too many files on a young human being just because it's easy to collect data". And traditional criteria for assessment should not be used to judge new teaching intentions.

What information handling skills will youngsters require towards the end of the decade, and should school prepare pupils for them ?

Many delegates thought this an impossible question : "Anyone who could answer it would deserve a Nobel prize". But one or two people thought it the most important question of all. Children should learn where to find information, how to assess its value, and how to use it to solve problems and make decisions.

The group discussing the upper secondary stage said that there should be more work on computer studies. It was important not to confuse teaching programming with teaching information and computer skills. Students must be taught to solve problems and make algorithms in their native language - a different, and more important skill than being able to code the solution in a computer language. Courses for older students were needed at a variety of levels, both for specialists and for people who had missed out on information technology earlier in their education.

Can an educational program be useful to children of all abilities ?

Yes, was the short answer.

What reasons do teachers have for declining to use computer-based learning materials ? Which are valid, and how can they be discounted ?

The two main reasons put forward were fears about job security, and dislike of the narrow, programmed learning character of much of the software on the market : "they see it as a Skinner box that will set back teaching by 20 years". Where software was creative and open-ended, teachers needed a lot of training in the pedagogical intentions behind it. The limitations of present hardware were also seen as a deterrent : research and development was needed to make the technology more powerful and accessible for children.

After dealing with the questions, the groups turned to action that might be taken at Community level to encourage exchange and co-operative development. Two main areas for research were identified. One was on the educational and psychological side, investigating the effects of computer-assisted learning, particularly on young children. The other was on the technical side, developing more powerful and compatible systems, and making the machines much more accessible to students.

There was a suggestion that some software should be developed at Community level, for subjects such as history and economics, which could help to give children in all member countries a European perspective. Work should also be done on the use of new technology in combating illiteracy.

The Community was seen as having a crucial role in facilitating the exchange of information. One group called for a European database with information on all available software. All groups wanted the EEC to continue to promote exchanges of experts, teachers and materials.

In the seminar's closing address Geoffrey Hubbard, Director of the UK Council for Educational Technology, identified another role for the European

Commission : to monitor the effects of different government responses to technological develpments and their social and economic consequences.

Hubbard told the delegates that it was now clear that the intelligent, imaginative use of new technology expands the range of learning opportunities. Furthermore, he argued that the evidence from the countries which had gone furthest in bringing new technology to education shows that "there is a threshold, a level of investment of resources which, once passed, results in a significant change in what goes on in schools".

But we should resist being drawn into the question :"can you prove that by the use of information technology pupils learn more or quicker or better ?" "If the application of information technology does improve the quality of education, that is a highly desirable but uncovenanted benefit. The aim is to make pupils aware of, and familiar with, the technologies and to develop in them attitudes that we see as being helpful to the members of the society of the future."

Hubbard described the three aims of education as developing the potential of the individual, fitting pupils for the world they would have to live in, and developing their capacity to determine their own standards and values. New technology was not essential to the first and third aims, but was central to the second. Basic skills of literacy and numeracy would continue to be crucial for students. But so would intellectual abilities such as finding and organising information, logical and structured thinking, and general problem-solving skills.

There was also a technological and economic imperative : "Neither individual countries nor the Community as a whole can resist the pressure of Japan and North America; we cannot contract out." But it was an acceptable imperative : the advantages to education were real.

Hubbard described likely changes in the technology which would affect its uses in education. The falling cost of hardware would soon mean that computers became a personal tool, belonging to pupils : the school would provide a computing environment - network, data storage, printers. We had hardly begun to see the implications of developments outside education, such as the use of interactive videodisc and expert systems (which put expert knowledge on a computer in a way that enables the computer to offer intelligent advice and, when asked, give reasons for its decisions.)

Hubbard concluded by saying that in an uncertain world, where the old ways of distributing wealth and providing employment were disappearing, the less instrumental aims of education -developing individual potential and personal values - became crucially important. Students must be prepared to take part in the debate about what kind of future was desirable, and how it could be achieved, and it was the duty of influential educators to see that they were prepared for it.

"We (educationalists, educational administrators and politicians) have rather more influence than most people. Yet we cannot take much pleasure from the extent to which we have shaped our world. It is more dangerous, more unstable, more inequitable, less compassionate than we would have wished. Our successors will have to deal with even more dramatic change than we have; we owe it to them to give them every help we can, in the hope that they will make a better job of their future than we did of ours."

The Newcastle seminar was considered a great success by the participants. As more countries had become aware of the irresistable demand - or necessity - for wide use of information technology in education, the benefits of exchanging information and experience became even clearer. Seeing the products of one country that had advanced further than most down the new technology trail helped to sharpen the discussion of future possibilities.

It also pointed sharply to the need for more focus on pedagogy, and on how teachers could helped to make the most of the technology. At best information technology could further changes in curriculum and teaching methods that had been advocated for many years. But a vast effort was needed, both to develop better software and hardware, and to prepare teachers for its use.

The delegates left Newcastle looking forward to the next two seminars in the series, that were planned to address those two questions. The first, in Bologna, would discuss teacher training, and the second, in Berlin, would tackle hardware and software. As one delegate said : "These exchanges can gain us months, if not years."

THE NEW INFORMATION TECHNOLOGIES IN EDUCATION :

TEACHER TRAINING

BOLOGNA, 7 to 10 May 1985

Report of Proceedings by Giovanni VICENTINI

INTRODUCTION

The Bologna Hall of Culture and Conferences was treated to a glimpse of the future for four days last 7th to 10th May when groups of experts from the EEC Member States gathered to discuss the almost-daily growing influence of computers and new information technologies on the educational process. The aim of this seminar, organized in the wake of the Marseilles and Newcastle meetings with the assistance of the Commission of the European Communities, the Ministry of Education, the Inter-University Data processing Centre (CINECA), the Region of Emilia-Romagna and the Bologna municipal authorities, was to offer a serviceable response, confirmed by practical experience, to the ways, functions and time needed to enable educators to face up to the task of exploring the new developments in a world already turned upside down by the microelectronic and information revolutions, with which, it is a salutary reminder, school-children have already learned to come to terms. Is there nothing new left under the sun? "Why", mused Apollinaire, "they have taken an x-ray of my head. Here I am still living and yet I have seen my own skull. Is that not something entirely new?".

From x-rays to computer: the statement is still less clearly demonstrable. The electronic age itself changes it, belies it. The information society moves forward, microprocessors are found in every home, and artificial intelligence is making its presence felt.

Will the school follow the same evolutionary steps? And how will the learning process, cognitive skills and basic literacy skills fit into the newly organized scheme of things?

What is being done to teach the teachers? These are just some of the many questions (in a never-ending flow) to which the Bologna seminar addressed itself, working from the premiss that while the problem was couched in more or less the same terms for all Community countries, the strategy varied from country to country for reasons stemming from the diversity of historical contexts, languages, traditions, cultures, educational structures and ways in which educational problems were approached.

Fortunately, we are not starting off completely from scratch; we already have early experiences to compare, from which we can map out common operational ground because we have a common goal, that of bringing a rational response to the challenge presented by the new information technology, within the constraints of specific national characteristics.

The revolution is afoot.

Europe is faced with a major challenge, and since the figures speak for themselves. D. Lenarduzzi, Head of Division at the Commission of the European Communities, introduced the works, vouching for the realistic picture they presented and their potential as the basis of a discussion involving the Italian authorities represented at the seminar, Franca Falcucci, the Minister of Education, Professor C. Rizzoli, the Chairman of CINECA, L. Turci, the President of the Region of Emilia-Romagna, and Mr Imbeni, the Mayor of Bologna.

Mrs Franca Falcucci, the Education Minister, highlighted the cultural significance of the new information processing technology as a phenomenon with an impact on both daily social and business life. Italy had already conducted a number of experiments in this field in higher education, but was currently getting ready to take a qualitative quantum leap forward with a systematic programme of central government intervention, implemented in stages and aimed at the professions, and taking into account levels of funding and the pace of technological advance. Mrs Falcucci illustrated the guiding principles and strategies of the plan for her country, emphasizing that the approach to new technology would not simply be one of introducing computer studies as an ad hoc part of the general school curriculum, but using electronic data processing technology to bring about changes in the traditional ways in which subjects currently on the curriculum are taught (with mathematics and physics at the top of the list), which would inevitably lead to a revision of the educational content of the subjects concerned. Mr Lenarduzzi described for participants the reality of the scene today in an overview of the various situations, interspersed with assessments of the basis of each. His conclusion was that this was a case of 'learn before you leap'.

Two Europeans in three are affected to some degree in their working lives, whether directly or indirectly, by new technology. Five percent of the Community's working age population (or 5 million people) are actively employed using it. Europe is a large-scale importer of new technology manufactures, running a deficit of more than $10 billion (approximately 10% of the Community oil bill). The European market (which represents around one-third of the world market) accounts for only 10% of the world's new technology manufactures; Out of every 10 new technology products, only 4 are made in Europe. Nine out of every 10 personal computers sold in Europe originate in the United States; 8 out of every 10 videorecorders bought by Europeans are manufactured in Japan.

All this came at a time when more than 15 million Europeans (40% of them young people under 25) are out of work. The Community could reverse this trend by developing its own industries and aiming to satisfy the wants of a massive potential market of 320 million people (if the figures prove accurate) from January 1986 onwards.

But a programme couched in those terms also called for certain initiatives: avoiding overlapping and duplication in scientific research programmes, grouping researchers together, working out common laws and standards - which effectively means avoiding repetitions of the PAL/SECAM fiasco, promoting the transfer of research and know-how. Mr Lenarduzzi recalled the Community's achievements in this respect: firstly, the celebrated ESPRIT programme which, with effect from January 1986, will harness the brainpower of 3,000 Europeans working in Europe's twelve leading businesses, more than 700 smaller firms, universities, and research centres; and secondly, the RES programme.

The agreement concluded in December 1984 offers positive encouragement to academic effort, the introduction of machinery to facilitate mobility of researchers, twinning arrangements for research centres and the transfer of European know-how.

There was also a comprehensive programme in the field of BIOTECHNOLOGY, French proposals for a EUREKA programme aimed at creating a hi-tech Europe, and the more recent IRIS programme -

born out of an Italian initiative - concerned with the social consequences of introducing new technology into an industrial society. In other words, Europe has a lot on its plate. The financial cost to the Community of implementing these programmes will be 3% of the resources it allocates to scientific research - an amount which the Member States have promised to double between now and 1989 to put the Commission's proposals into effect. These specific commitments are supplemented by funding from financing instruments such as the European Social Fund (with a budget of 2 billion ecus, 75% of which is earmarked for projects for the under-25s, linked to the introduction of new technologies and vocational training schemes).

58 million students throughout the Community have to be prepared for the new information society.

Without being too wide of the mark, it would be safe to say that by the year 2000, half of the workforce will have had to change the type of job they do.

The European Community is running three sharply defined programmes in this field, all impinging on precisely the theme dealt with at the Bologna conference.

Of the various interesting initiatives currently underway, one is particularly representative of the rest.

Between 7 and 13 July, the 150 prizewinners of European competitions for young people of 16 to 18 with a particular interest in NIT will visit Turin, where they will have the opportunity to tour some of the most advanced companies in the "sunrise sector".

During the first two weeks of July, the Universities of Liege and Ghent will be organizing a summer university at Liege for a group of 30 to 40 researchers on the educational aspects of software.

80 study grants and information centres are also on the drawing board, and a number of conferences, seminars and meetings along the lines of those staged in Bologna and its two predecessors in Marseille (1983) and Newcastle (1984) will also be organised.

The issues are important - a high proportion of the Community's 3.5 million professional educators have never received any formal training in the new information technologies.

Bologna was expected to give the green light for that, because the time had come to forsake talk for action.

There can be no denying the facts. That point was driven home by one of the UK delegation, referring to an article which appeared in "The Observer" in 1964, reporting that Professor Archibald Roy of the University of Glasgow had bet a pound that Man would land on the moon within the following ten years. He was eventually given odds of more than 10 to 1 against, and five years later pocketed one thousand pounds.

If, today, anyone wished to make a similar bet that, within ten years, mankind would discover traces of other life forms in some remote part of the universe, he would be unlikely to get odds of much more than 10 to 1, for so greatly has our consciousness expanded that the future may well hold surprises in store for us.

Put in those terms, for a lively debate, the problem contains both a central core and displays a wide range of major facets. The kernel or essence of the problem is: what should we be teaching? whose job is it to decide? who should teach the teachers, which ones and how many? how and where? what type of course and how long (literacy, basic and advanced training)? how much will it cost?

This is destined to be a long drawn-out process of cultural change, then, since computers and microelectronics are set to occupy an increasingly central role in our daily routine, rather than being relegated to a minor role as equipment in the learning process both in school and in post-compulsory education.

We must come to terms with the computer. But if two are to live as easily as one, the relationship must be based on knowledge. If marriage is a science, as Balzac claimed, then so is life with the computer and microcircuitry, or even more so: it is a graft which will either be accepted or rejected. But to encourage acceptance...which brings us back to square one.

Clearly, the introduction of new technology into the classroom (the 'courtship' before the 'marriage') raises a host of educational questions about the teaching and learning process. But which? Computers challenge the very nature of the education and learning experiences on offer in today's schools, and the way in which they are dispensed.

The issues are education and teacher training, then. But it doesn't stop there. For them, the computer is the unfolding of a never-ending story of continuing education. And that is what will bring about changes in both the method and content of what is taught. The computer in the classroom will not only impinge on technical and scientific subjects. Quite the reverse. Even a philosopher may understand the soul of the machine. That is not to deny the problem of educational software, and while experience shows that the best results are obtained when educational software production is left to the initiative of teachers in the same way as school textbooks now are, the priority must be to offer educators favourable conditions to enable them to get maximally acquainted with computer technology. All of which was discussed at Bologna in a seminar articulated around four separate working groups.

1. Teacher training strategies

The first group worked on teacher training strategies, taking the British model as a starting point for a comparative survey of strategies in the other Community countries. A proposal emerged for a generally-applicable method of proceeding, which would not be identical in all cases, however, due to differences in national education systems.

The United Kingdom took stock of its own experiences over the past five years, marked by an abundance of courses and aimed, in the words of the delegates, at encouraging pupils and teachers at all schools to make use of the new technologies. Their experience might be described as a cascade strategy, spreading outwards in ripples from the centre.

The starting point is the organization of course content and subjects by the central government education department. The local education authorities are responsible for giving the necessary support to local teachers in using the equipment made available to them. These tutors are neither university graduates or academics, nor high-powered industrial experts. They are "pares inter pares", drawn from the ranks of classroom teachers.

Not all teachers will take these courses, either because of LEA financing constraints, or through fear of displaying their ignorance and losing both their self-esteem and their status in the eyes of their colleagues. One proposed way of remedying that is through remote learning systems, such as the teaching packages put together by the Open University, which include a microcomputer to enable teachers to study at home.

The strategies adopted will affect teachers on all rungs of the educational ladder, from infant schools through to secondary schools, in the belief that advanced information technologies have a part to play in the curricula of all science and humanities subjects. The parallel awaits confirmation.

Some teachers use IT as a teaching aid, others use it as a key, a methodology for teaching other disciplines. It establishes that the United Kingdom, through its Microelectronics Education Programme, is heading towards a new computer- and microelectronic-mediated culture. This way, the pupils achieve two goals: by coming to understand exactly how this fascinating new communications technology works (which it is thought could mean 'talking' to the computer whose processes of ratiocination are essentially human since it was designed by the human brain) and the impact it has on society, they are exposed to a higher form of logical process which can assist their general education. One example of this is the word processing application, which frees pupils from grinding considerations of neatness to give their writing a greater degree of creative flow. The same applies to databases.

The only selection process operating on pupils is that of self-selection: girls were less interested, perhaps due to too-high a technical content in the early stages. Courses are of two types: a general course open to all teachers working together; other, more specialized courses, are based on specific subjects such as history, geography or biology. The United Kingdom considers results have been positive overall: 75% of the teaching profession (440,000 individuals) have come within the scope of the plan. Today, with four and a half years of experience to build on, the Programme is resolutely looking towards the future.

It remains for the Government to take a decision based on the proposals put forward. The principal problems for the future are the design of and changes to the curriculum. Teachers have so far been attending short courses (40 hours over 5 days) or more extended courses of up to 150 hours.

Future plans will centre on those among them who were sufficiently keen to follow up initial training with longer courses.

Contributions from other delegations in the group brought out a number of interesting facts, pointing up common situations which had given rise to different priorities and hopes.

The education officials of the various Member States compared their national programmes for introducing microcomputers in schools, which pointed up vast differences in the schemes. One point common to all was that computing was not simply to be put on the curriculum as a science subject, but rather used as an aid to learning. Business was quick to make its views known through a manager of an Italian computer company, who was also a member of the national commission responsible for drawing up the plan to put microcomputers and data processing technology in Italy's higher secondary schools. He reported that industry had high hopes that schools would produce firstly a culture, and secondly a teaching process which would be capable of helping young people understand advanced information technology and their importance to the shape of the society which was awaiting them, and which they themselves would have a direct role in building.

The working party proposed solutions to a number of problems. They were unanimously agreed that the initiative should lie with the education authority, preferably for a locally-based strategy along British lines. But whom to train, and how many? The unanimous view was: all teachers without distinciton, given that NIT is not an ordinate of culture, but rather a bedrock. That offers a prime opportunity for a profitable approach. At the beginning of the course (at the computer literacy stage), it would be useful to have a 'mixed bag' of teachers from a variety of disciplines in the sciences and humanities; at more advanced stages, they could be grouped for specialization into groups of inter-related disciplines. In any event, as Professor Remo Rossi, Director of CINECA, noted in his final report, teacher training in NIT does not spell the death of more or less long courses for the two essential levels of intervention, but it must develop a firm structure capable of assuring continuity of training. Which brings us back to the 'never ending story' with the teachers/actors playing against the backdrop of continuously changing scenery. I am reminded of Rousseau's words in his book "Emile or Education": Dare I reveal here the greatest and most useful of all the rules of education: the thing is not to gain time, but to lose it". The professionalism of educators needs to follow hard on the heels of fast-moving technology. That means appropriate adjustments need to be made to programmes, influenced by the world of work, industry, commerce, the pupils themselves, even. And the clear goal is to achieve a true adjustment of society which will be passed on to curricula.

But who should train the trainers? Here again delegates were all agreed: it was a flow process, starting perhaps with the universities, local structures and even (why not?) the computer industry itself; this would lead on to the already-trained teachers. A system of permanent, local facilities was, it appeared, fundamentally important, as offering general access to 'neighbourhood' research centres.

The group then discussed the content of training. What should the trainers be taught? Educational software, certainly - but not that to the exclusion of all else. The emphasis, then, was on basic training, electronic spreadsheets, databases, word processing. What should be taught? Teach the teachers how to teach. This is more than just an aphorism, it is a real necessity given the paucity of effective help from the academic community in this area.

But what were and are the reactions at the chalk-face to the proposals for introducing NIT? Interest and enthusiasm apparently. The French delegation claimed that 110,000 educators would have been familiarized with NIT by next October. And yet one acute problem remained; the one shared by all the Community's teachers, that of low pay. Without the incentive of a financial or career advantage, enthusiasm would tend to dissipate rel-

atively quickly.
Other inter-related problems were the nature of the information, the training and the equipment themselves.
One problem remains unclear: that of cost. You cannot draw up a balance sheet for an operation which has yet to progress beyond the first stage. Not only that, but it must not be lost to sight that the setting of the problem will change as things progress. In any event, the initial, fairly precise, estimates of the capital outlay needed fixed the maximum per capita cost to each Member State at 4 ecus.

2. Educational aspects

Which teachers do we train? What level do we take as the baseline? Should training be differentiated by pupil age or subject matter? All these questions were raised in the second working party dealing with the educational aspects. The discussions converged on a single conclusion: all educators should receive both familiarity and more advanced training, irrespective of their discipline or level.
What we should be moving towards is training covering many facets of the new technologies. That includes initiation into the use of the computer as a teaching aid on the one hand; and on the other, an exploration of languages such as Logo and Prolog for an essential familiarization with the programmer's role. An understanding of author and programming languages is indispensable.
One question remains unanswered, however: should the trainee be taught programming skills or regarded simply as an end-user? A minimum level of technical knowledge was essential. Purpose-designed software already existed on cassette (such as word processing and databases, for example) which it was inconceivable that teachers should not know about.
A further problem was raised: the ability of the teacher to evaluate the software, given that the more extensive his understanding of computing, the greater a consumer of commercial products he will be. One view widely shared by the members of the

working group was that a teacher capable of choosing course textbooks should be able to exercise the same discrimination with regard to the selection, control and management of software, with absolute discretion as regards content, educational objectives and access. Any form of direct State intervention in the evaluation of software quality would appear wholly inappropriate, however.

Clearly, training must be closely related to the current state of technological advance, to what is available on the market and on the experiences of other schools in moving on to future projects tied to the rapid development of NIT. The challenge is there, it only remains to take it up. That said, however, it also brings us back to square one: are these skills to be the preserve of a select few or all teachers? The answer is - all. But that means defining the levels of learning required.

3. Basic training or specialized training?

The third working group achieved a remarkable degree of consensus on the subject of specialized training (spreadsheets, databases, etc.). The same could not be said of basic training, however, which may have owed something to the vague objectives of the programme and the extent of the phenomenon itself. In contrast, there were no reserves whatever about what the training should be grounded in, nor over the fact that it should not be left entirely in the hands of academics in institutes of education who may well be out of touch with 'chalk-face' reality.

In his summary report, Professor Rossi observes that "To such questions as: what sort of knowledge should be dispensed to those who will be teaching information technology to others, and to those who will merely be using it; how do we assure that the methodologies of learning related to all the new technologies take their proper place in the syllabus, there is no easy or ready answer."

With these points of reference established, the delegates praised the opportunities opened up by NIT in the classroom to produce rather than reproduce culture, and taking account of the fact that its influence would have a modifying effect on either the method of learning, or on the content, of all subjects on the curriculum.

4. The role of the teachers in the transformation of teaching aids

Electronic data processing equipment and the other new information technologies raise a variety of problems relating to the role of the teacher, the importance and use of teaching aids, the importance and quality of software. This theme gave rise to a lively discussion among the members of the fourth working party. Statistics compiled by Stanford University showed that the majority of students considered computer-assessment of their academic abilities to be both fairer and more objective than the grades awarded by even the best teacher.

This was a new and fascinating response which led to a significant debate over how microcomputing technology should be defined in education.

The most recent stream of thought to emerge claims that the mistake to avoid at all costs, and one which stems from a simplistic approach to the problem, is to view the computer as an electronic teacher. If it is difficult to imagine software which could successfully teach a child the 3 'R's, how can the computer possibly be seen as a rival to the human teacher?

The didactic process must not simply discount the teacher/pupil relationship; advanced information technolcgy must be looked on as an aid to more rewarding, more effective study. In other words, what normally happens when computers are put into the classroom is that the software is found to be of poor educational quality and, instead of being a valuable aid to learning, reflects no more than the enthusiasm of a small group of self-taught teachers who have learned the rudiments of programming and tried to put their knowledge into practice.

This has produced programs of varying degrees of complexity and educational quality which do no more than allow a pupil to follow a mathematics or text-based lesson looking at a terminal instead of looking at a blackboard as he usually might.

The logical connection between the new technologies and education is not what springs first to mind - the software on whatever medium is used - but the effort made by the schcol to transform the information into knowledge, widsom and experience. We should be thinking in terms of a school which teaches children how to use and understand advanced information processing techniques. The software used to support this task would be wholly different in character from that mentioned above. The examples are not overwhelming in their number: among the most straightforward are programs to manipulate large quantities of data (databases), programs to manipulate words (word prccessing), programs allowing music to be composed on the computer, and programming languages such as Logo and Prolog which are both an aid and a stimulant to reasoning and the creation of new designs and concepts, accessible even to pre-school children.

The new technologies thus offer us the opportunity of expanding our intellectual horizons and transforming information technology into a source of knowledge. It is in these terms that we should view their influence on the teaching process. Teacher training courses should therefore focus on the use of data processing technology as a way of storing and retrieving information, working out, testing and reformulating hypotheses.

The general impression gained is that the majority of Member States are still a long way off formulating clear plans and fixing precise objectives.

One point which attracted general assent was the central role of the teacher in the production of educational software. At the present time, a number of programming languages exist - author languages - which are particularly useful for writing teaching programs. Author languages do, however, demand a fairly high level of programming skills. The simple fact that not all teachers are capable of using them, therefore, gives rise to damaging discrimination between schools. There are two possible ways of tackling this problem:

1) by using programming-free author systems, which are nothing more than programs which will enable a teacher to write

educational software without having to learn a programming language

2) by close collaboration between teacher and programmer. The teacher would design and write specifications for the software, the specialist programmer would give it shape. The two stages are neither distinct nor self-contained, and the United Kingdom is currently studying ways of providing teachers with the optimum environment in which to communicate their ideas through non-programming languages enabling them to write their specifications in plain and, so far as possible, unambiguous, language.

Independently of the methods for the production of educational software, it is also necessary that the teacher or group of teachers feeding the idea to the programmer should already have some experience of the computer as a teaching aid.

All delegates seemed agreed on the need for some form of recognition for teachers undertaking to introduce new technology into their schools.

There has to be some encouragement to get things moving.

The presence of the teacher, with his intellectual luggage of teaching experiences, is important; we cannot settle for spontaneous initiatives. This problem was highlighted during interviews with Dutch teachers, who condemned the lack of adequate support structures. The teacher, even where he has not written the software he is using, needs to be able to evaluate it in order to make valid and coherent choices with regard to his educational imperatives. Teacher re-training musthelp develop this kind of critical faculty through demonstrations giving teachers practical experience to fall back on. One interesting moment was provided by a simulation of a work-study situation with a computer in a "standard class" programmed in the French "Informatics for All" project, which stands a reasonable chance of being put into operation at the start of the next school year. In this, a network is set up based on a BULL central computer with a floppy disk drive and printer linked to up to 31 terminals comprised of a colour monitor with a THOMSON home computer. Each user will work at his own pace entirely independent of all

others, loading what he wants from the main computer's disk into the memory of his/her own home computer.
Using an appropriate protocol, the pupils hooked up to the central computer can also communicate interactively, exchanging information with other pupils using the network.

Building a strategy for a fast-changing world

Each of the four working groups followed up and discussed concrete examples of how this proposition applied in their own environments (the United Kingdom, Belgium, the Netherlands and France, respectively) following the general theme of the seminar and presenting their prepared material. The comparisons proved highly enlightening.
One aspect which emerged very clearly out of the dialogue generated between the participants, was the need to prepare Europe's schools and colleges to live with, and make the best use of, the new technology.

5. The experts' view of the learning process

The plan under discussion was undeniably surrounded by precisely-defined pedagogic constraints, which were considered in greater depth in a round table, chaired by Monique LEENS (for the EEC Commission). The personalities and wealth of experience of those taking part - two economists and computer experts Gunter ALBERS (University of Kaiserslautern, West Germany) and Jacques PERRIAULT (INRP, France), and two mathematicians: the first, psychologist Michele PELLEREY (Universita Salesiana de Roma, Italy) and the second, the philosopher Seymour PAPERT (MIT, United States) - made this one of the most enriching forums, whose conclusions had the stamp of absolute authority.
These four led the plenary session whose job it was to formulate valid proposals on an array of questions: at what age should children be familiarized with NIT; what impact would NIT have on schoolwork, which would inevitably undergo changes; how can teacher interest best be stimulated in the new teaching methods.
What can the computer do, PELLEREY was asked. His reply was: "It

all depends on the teaching model you use". Subject to reserves about SIMULATION techniques, which lead students to work on representations rather than real situations, the rapporteur suggested that three areas of teacher training could be identified: the first consisted in a re-thinking of currciulum subjects; the second, in which teachers acquired the ability to work with a computer; and the third, in which the computer became a tool of the learning process.

PERRIAULT and ALBERS held the view that society had entered a new phase, a transitional stage in which society was being shaped by the computer. In the future, the road to follow in didactics would be to formulate a model in which innovation took the form of a repetitive model. PAPERT, the father of Logo, did not consider that hopes had not been met. PAPERT began by saying that people were asking what influence Logo had on the child. His reply left no room for doubt: computers and the Logo language have no influence on anyone. What counts is the use made of them; what influences children is the way they are integrated into the teaching process. So the question could be put another way: how can we integrate the new technology in the development of culture in schools?

The first approach put forward by PAPERT used a minicomputer, brought with him expressly for the purpose, to highlight the aspect and extreme usability of the machine. This computer was far more powerful, despite being cheaper, than computers currently used in schools; it boasted a massive memory, excellent graphics and the ability to run several languages. It was a workhorse: that was its outstanding feature. Those who viewed it as a monster were just as mistaken as those who were up in arms before the picture of small children sat in front of computer screens for six hours a day. There was no difference between a computer of this size and a pencil. Computing power was constantly being crammed into smaller packages. We shall forever be seeing increasing numbers of people in front of their 'pencil'. But so what? The objections raised are born out of the lack of understanding that most people have of technology.

PAPERT could not resist an anecdote. Imagine, he said, a society somewhere in the world, with schools but where no-one has yet discovered writing or the pencil and where all teaching is by oral tradition. Then, one fine day, someone invents writing, pencils and paper, and is firmly bent on introducing them into schools, convinced that that would be a good thing for the pupils. Someone takes up arms against it, saying he considers it of unproven worth, and rather than give each child a pencil, they should first try with one pencil per school to see what happens. If the results are conclusive, they could progress to two pencils in each school and so on until each child has his or her own pencil. In the same way, the present debate on putting a computer in the school in the certain belief that the educational consequences can be evaluated from it has many points in common with that analogy. In reality, the role the computer can play in a culture while leaving access to computers free is entirely different. Thus, the assessment made at this seminar by quantifying the potential results obtainable from using a computer bears no relation to what will happen in the future. The relative <u>periods of time</u> over which NIT is to be integrated into the education framework is another much-discussed topic. Experience should teach us that the future is here today. The forward march of time cannot be turned back, and the opponents of progress who argue that educational structures which have taken shape over centuries do not need changing are living in the past. We have available to us an extremely wide array of new tools and we are putting up further resistance by hindering the rate of infiltration of computers.

The problem also has its social dimensions: here, PAPERT criticised the fact that experience of working with computers is tending to be the preserve of people with no adequate training and who are hidebound by outmoded patterns of thought busily constructing a future which should rather have been the work of the experts.

In his view, what was needed was a series of private centres throughout the Member States to conduct trials which would lead future developments, as well as different centres for a comparison of methodologies adopted, which could then be introduced into schools at a better-than-trial operational level. One thing is certain: within ten or twenty years the computer will come to be universally accepted; that is, children will have the same access to them as they do to pencils today. There would not just be a computer in each classroom, but one on each desk. We might ask ourselves at this meeting in Bologna what can possibly be accomplished in today's school with one single computer to a class full of children when the aim is to use it in a variety of disciplines. But these are secondary considerations. What really counts is building a computer culture within the school. What happens in a school today? You put a computer in it; you try to get hold of programs to teach maths, for example, or reading, and that is about all it amounts to. For PAPERT, that is the wrong way to go about it, because the short-term benefits are very few and of no benefit to the learning process. We lose nothing by dropping this 'instant results' approach to NIT entirely, to concern ourselves with what can be got out of it in the long term.

Computers are regarded in a different light from that generally adopted. Take the case of a mathematics teacher. As long as he has pens and paper, the teaching will remain static. That is fine for some, but not for those who reject the immutability of teaching styles; those who prefer colour to formulae, movement, inter-personal contact, the exchange of ideas, discussion, reasoning and argumentation. Fine. Used in the teaching of mathematics, a computer supplied with appropriate software (Logo) can make considerable changes to that situation; and the person who so far, by nature and habit, has thought of mathematics as a difficult subject now sees the obstacles he thought insurmountable crumbling before his eyes, simply because he has been brought to reason in a different manner. That is just a small example of what a computer can do for the didactic process. That is why it is a mistake to concentrate on filling the market with programs or software offering instant results but only a modest level of achievement, when what counts is to think up something really worthwhile, capable of exploiting the full potential of

NIT, even if it cannot be done immediately and has to wait a few years longer.

But which computer to use? And what is the best age at which to introduce it?
The most important consideration for PAPERT was what to do, even before knowing when it should be done. PAPERT had arrived at the conclusion that, in the future, teachers and pupils would have to get together and come to see the computer for what it really is and what it can do: a co-worker who can help them with their research and their work. That was PAPERT's view. Overall, the round table offered a further opportunity for developing the theme in depth: there are more people working with data processing equipment than there are teachers. That was something schools would be advised to take into account.

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6. Proposals and Prospects

At the plenary session which marked the end of the conference, Luigi GRANELLI (Italy's Minister for Scientific Research) and Franca FALCUCCI (Minister of Education) put forward a number of ideas, judgements and proposals concerning the political authorities with decision-making responsibility.

Mrs FALCUCCI, current President of the Community's Council of Education Ministers, and an ardent proponent of the introduction of new information technology in education and, as far as Italy is concerned, of systematic and programmed state intervention through a gradual and flexible process taking account both of financial commitments and the rate of technological development according to the national plan which she illustrated during the inaugural session of the conference, emphasized the need for cooperation between universities, schools and research centres.

Minister GRANELLI noted that one of the key goals in the construction of Europe was to create the People's Europe.

The Community had, however, to think in terms of strategies to improve the quality of life, to expand employment, to meet the serious problem of wasted brainpower and, in consequence, to consider whether it should not harvest its resources if it was to take up the technological challenge on the world stage.

If that was its aim, it would need to target an increasing amount of resources towards the new technology sectors. At the present time, the Community allocated some 3% of its resources to research over all these fields. Doubling that figure to 6% could lead to disequilibrium. The risk is that, whatever the EEC's intentions in the matter, it would remain no more than a 'green' Community seething with frustration at the tangible and rapid progress made by other countries.

In short, using the forum of the Bologna conference to stress the need for greater investment in the new technologies, the need to spread those technologies over all levels of education, to interlock the new technologies ever more tightly with the training process, was also to remind the Community as a whole and the Member States individually of the need to harmonize their policies, cut out waste, and to set aside and concentrate their resources into a highly decisive sector. Minister GRANELLI recalled a proposal to this effect recently put forward by Italy to the Council of Research Ministers meeting on 23/4/85 in Rome and forwarded to the Commission for study. This was the IRIS programme, the keynote of which was directly in line with the proposals arising out of the Bologna seminar. The ESPRIT program unquestionably represented a qualitative leap forward for the Community in terms of its commitment to the informatics sector aimed at helping Europe catch up in the field of microelectronic technology; but we must now be on our guard against seeing informatics as an end in itself or simply as a means to industrial progress. We need to acquire greater recognition for the idea of a broad-fronted information revolution, spreading into all sectors where it can find a useful application.

The aim of the Italian proposal was to incite the Commission to generate new programmes or coordinate existing programmes such that computer processing applications in the fields of health care, education, transport administration and protection of the environment should have a series of advanced technology spin-offs with consequences for the quality of life in Europe, through the creation of new jobs for those generations with skills and aptitudes in the field.

Information technology, with its applications in many fields of economic life - and consequently in schools - can be looked on as almost a natural phenomenon and therefore capable of a variety of applications.

The problem lies in seeing how that technology can best be adapted to those uses - and especially to the ends of education and vocational training. While the problem we must confront and resolve, above and beyond the problems of teaching and learning themselves, is not to regard the school as a vast market into which to pour finished goods but rather as an enormous laboratory in which to search for the elements which will improve the quality of those products, we must not leave out of our reckoning one factor with a determining influence on the entire sector today - and that is the changing relationship of hardware and software within courses.

The cost of the former falls while that of the latter rises; inevitably, since designing suitable software and defined functions is undeniably a more complex task than surrounding oneself with the necessary computers and peripherals. And that is not all. It is almost inconceivable that the programs so designed could be easily transposed in countries with distinct cultural traditions, differing educational levels, and facing different obstacles in relation to vocational training, professional qualifications, and so forth. Increased investment is needed into program production, therefore. We should not find that cause for alarm, since, at some point in the future, we run the risk of finding our schools and public services filled with sophisticated equipment which we are incapable of using properly for lack of capital in the form of software suitable for our particular applications. The cost will be high, but a choice has to be made, and national governments would be well advised to resist the pressures to direct investment into hardware, or the acquisition of computer equipment, rather than into software development.

The theme discussed by this conference - that one of the best producers of educational software is the classroom teacher himself - is more than borne out by the evidence.

Over and above the cost of software, we must also be highly attentive to quality, which, if it is to be extended to such delicate processes as education and vocational training, cannot dispense with safeguards established by the State.

This is more than a problem of standards - it is equally a problem of having official bodies with the necessary expertise to guarantee the validity, quality and fitness for purpose of one piece of software as opposed to another, which is able to carry out its own checks on the applicability of the results, and which can place the cost/quality problem in perspective.

Clearly, the Minister concluded, we must improve the general quality of appreciation of the potentials that information technology has to offer, not only by de-mythifying the miraculous aspect of it, but also by eliminating the fears about using it - which are the product of culture lag - bearing in mind that computer literacy as part of continuing education in the information processing field is the necessary precondition to the full-scale application of new information technology.

A European impetus in the sector is the sine qua non of a benefit of value to the Community, without which national policies will remain tangled up in nationalist controls dictated by their own experiences. That will naturally demand a different form of dialogue between university and school, and between technology and the production function, to destroy the myth that the only point of technological progress is to produce more in order to consume more, losing sight of any more human or humanistic purpose which could be served, and served well, by these instruments.

The Bologna seminar clearly encompassed all that, and had generated a host of ideas and broad guidelines along which to work.

That was also highlighted by Mr A. KIRCHBERGER (for the EEC Commission) at the close of proceedings. He was persuaded that this conference, like its two predecessors, could be instrumental in sparking off a series of actions, and that the point on which all were agreed was the need to harness all the potential of the NIT to the school curricula.

But while cooperation was a prerequisite, it was not a synonym for standardization.

It was desirable that school and university should cooperate to the hilt to make up the shortfall in senior technical and commercial personnel in the research and development sector. The European Commission acted as a catalyst, stimulating the reaction between the inputs from all sides. From the wealth of material produced by Bologna, it could single out only a few proposals: the retraining of teachers is a priority task, even if the lack of homogenous data on the subject seems to call for an update study; problematic though it may be, a cost analysis needs to be done on training courses; it would be a salutary exercise to compare the practice in quality control over programmes in the various countries (with their diversified structures), with the objectives set, and for whom the quality control is carried out; concerted action at European level was called for over the question of curricula, not to turn out a uniform product, but simply because it would serve the interests of the entire Community.

But the proposals must not fade away with the close of the Bologna conference, they must be filtered and developed by a high-level group of senior national officials, in concert with the Commission, set up by the Member States and working to clearly-defined priorities. The goal, as has been said time and again, is teaching teachers to teach. The information revolution will not wait for those who miss the bus.

The Bologna seminar (a Community seminar, let us not forget) put up a number of recommendations to the Commission of the European Communities: conducting an in-depth survey into teaching conditions; analyse the costs of teacher training; determine the conditions for the production and standardization of educational software; promote research and development into currciulum design.

All the national Governments have already made extensive investments in providing schools with information technology resources; the EEC should acknowledge the value of the educational software produced, promote exchanges, define common standards for servicing warranties, coordinate the copyright rules governing the software markets in each country, and promote works on the topics discussed which will be of interest to all without exception.

Criticisms and comments will assuredly not be slow in coming forward.

ABSTRACTS OF THE RESULTS OF THE EUROPEAN SUMMER SCHOOL : "APPLICATIVE NIT LANGUAGES AND THEIR USES IN EDUCATION"

1. "USE OF COMPUTER LANGUAGE IN EUROPEAN SCHOOLS"

The French educational Ministry and the Commission of the European Communities, organised a summer school in Nice from July 3rd-13th 1984 on the theme "Applied Languages and their use in the educational system".

This summer school which brought together academics from different E.E.C. countries was opened yesterday by Mr. D. LENARDUZZI head of division of the Commission of the European Communities, Mr. D. GRAS, technical advisor to the French Education Ministry, Mr. P. VERDIER, Rector of the Academy of NICE and MR. M. AZZARO president of the University of Nice.

In their introductory speeches these personalities stressed the importance of this occasion which, for the first time, brought together, within the framework of a European policy designed to harmonise teaching methods, teachers and researchers from all the EEC countries.

The aim of this summer school was to provide a complete, up to date picture of the state of play in the different Member States on a specific theme which had important pedagogical implications for the whole area of new information technologies.

Mr. VERDIER emphasized the human factor by reiterating that the existence of hardware is not in itself enough, and that in addition to software, which may not yet be developed, one needs to train men and women to use it so as to avoid a situation where a small minority who "know" impose their system on a majority who "don't know". One must now add a new task, "to use the machine" to the traditional role of the school (i.e. "to teach how to read, write and count"), and to do this one has to establish teaching methods for the various subjects and proper adult training as quickly as possible. It will not be enough for the education system merely to offer a technical introduction to the new information technologies : it will also have to teach today's and tomorrow's adults to live with this new equipment and to adapt their way of life to its rigorous methods of working.

New information technologies will completely revolutionise pupil/teacher relationships and will call into question existing teaching methods, if they do not render them entirely obsolete ....

Mr. LENARDUZZI made reference to the importance of education to the European Communities. It is an integral part of the European dimension, for the Community represents 272 million inhabitants of whom 60 million are pupils, 3.5 million are teachers and 4 million are students in 3500 university institutes.

He also listed the various actions of the Community in the field of education :

* education of migrants' children (2.5 million in the EEC).
* Seeking to bring education systems more into line with each other, making available grants for study visits so that interested parties can see for themselves how other countries' education systems are run and by establishing a common studies programme with official recognition given to the period spent in a foreign university.
* Publication of a European Student handbook.
* Policy for integration of handicapped youngsters.
* Illiteracy.
* Foreign language teaching : all 18 year olds should have had an opportunity to learn 2 foreign languages.
* Equal opportunities for girls and boys at school.

Mr. LENARDUZZI concluded by saying that he hoped this summer school would promote the setting up within the Community of a network of experts in the field of new information technologies and the standardisation of the different computer languages. The ideal solution would be to agree on European or world-wide standards.

Mr. GRAS, representing the French Government, which had held the Council Presidency for the last 6 months, explained the reasons why his government supported all the lines of action listed by Mr. LENARDUZZI.

He stressed that Europe, which represented the largest industrial area and which had the greatest potential for research, was trying to develop a more coherent policy in the area of new information technologies and communication. France was participating in this effort, especially as far as NITs were concerned.

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This European Summer School was an excellent example of the will to make progress, as was, though on a different level, the ESPRIT programme. Positive actions such as these should help Europe to join the ranks of those other countries which lead the field in these particular areas.

As far as its national education system is concerned, the French government has launched a wide scale programme for the development of NITs in teaching. Computers should not simply be objects for higher education research. They should also play a key role in changing the education system. They represent new pedagogical tools and they enrich and add to basic knowledge. The programme anticipates the introduction of 100.000 micros into schools and the training of 100.000 teachers. It already seems likely that these objectives will be reached and even exceeded. The National Ministry of Education is also undertaking action in the audio-visual area. More flexible distribution methods are already taking the place of current teaching by television and the interactive computer-controlled video-disc, which links image and computer, will very soon be introduced into the school system.

As for the sort of software linked to these new technologies (basic computer languages, education software, video-discs etc.), this is an area which will have a decisive impact in future. It is therefore important to encourage and to coordinate European research and production. This summer school is a first step along a particularly promising and common road.

2. Abstracts of the main speeches.

M I C R O - P R O L O G

Marc BERGMAN
Lecturer - Université de Marseille Luminy

Many programming languages have been proposed since Artificial Intelligence was developped, sometimes as answers to particular problems.

Two of them clearly rise above the rest. The oldest, LISP, dates form the early sixties. This language is based on a mathematical model using Lambda calculation. It was proposed by John Mac Carthy, was for a long time exclusively favoured by those doing research in that field and has given rise to a whole family of languages using lists as a sort of basis for presenting concepts and objects.

LOGO may be quoted as a particularly well known example used in education, and another one is SMALLTALK.

More recently, in the early seventies, PROLOG(PROgramming in LOGic) has been designed to respond to the specific problems of processing natural languages. In fact its author, Alain COLMERAUER, wanted it to be an automated demonstrating tool. J.A. ROBINSON had established an automatic inference mechanism known as the RESOLUTION PRINCIPLE and it is this very principle which has been included in PROLOG.

Thus, with premises such as : "Socrates is a man" and "all men are mortal", the answer given by PROLOG is the deduction "Socrates is mortal". In other words, a line of reasoning may be stimulated, and conclusions may be infered, from a set of known facts which represent the universe in which PROLOG works as a problem solver.

Another intrinsic feature of PROLOG is the way programs and data are based on a "tree" structure. In fact this idea is set at a very high level of abstraction; it is, moreover, very natural : few people are aware that they organise their thoughts and knowledge in this way. Intellectual aptitudes depend directly on the branching structure of thoughts and when programming in PROLOG we are led to make explicit this organisation. In comparison many modes of representation used in computing appear to be of a clearly inferior level and nearer to machine language.

The characteristic features of PROLOG (mathematical logic and branching structure) give this language ease and flexibility when programming; its declarative and predicative form (by logical formulation of facts) contrasts with the rigidity of algorithmic languages which appear puritanical and restrictive.

A few examples written in PROLOG could profitably be given here, of inference productors or deduction machines : anyone could then admit to their legibility regardless of their computing comptetence. Unfortunately there is no room here to introduce these developments but we would like to mention experiments in education in Great Britain where school children of 10-14 are using a dialect of PROLOG, Micro Prolog, and are programming directly in this language.

Richard ENNALS is directing this particularly convincing experiment and introducing logic as a programming language. Another experiment in "LA REUNION" uses PROLOG to help children who speak Créole at home to be taught in French : the core of the software has been designed as an incremental data base on which the pupil can use an expert system. Finally in Marseilles, France, where PROLOG was born, we have begun experiments in primary and secondary schools.

It would doubtless be presumptuous and in any case premature to draw conclusions and estimate the value of these experiments. In each case the teachers who are conducting them are old LOGO users..... Can it be that the turtle is losing its fans ?

We do not wish to flaunt an optimism which lies, partially, in an intrinsic potential of PROLOG which was lacking in other programming languages.

Doubtless, the LISP-like and the PROLOG-like family of langages are providing education with much more flexible and powerful tools. The fact that today computer design has been inspired by the basics of these languages is evidence of the future importance of Artificial Intelligence in the development of computing technology. Today LISP and PROLOG machines exist and are at the heart of a Japanese plan for fifth generation computers.

Nevertheless these machines must not be thought of as replacements for the human brain : they allow us to approach and solve new problems but this does not in any way mean to say they will be more intelligent than man; they will give him the possibility of new creations, new progress and new spheres of intellectual activity. We have, at most, circumvented certain areas of intelligence (with the help of the machine) but we cannot yet say that we have covered all aspects of intelligence.

The biggest difficulty is to get young people to fit the use of the computer into their thoughts and activities. Again that does not mean that computers will usurp thought; it cannot even be held that in years to come the human being will not be able to think without them.

THE USE OF LISP IN TEACHING

Jean-François PERROT, Paris University (6ème)
Laboratory of Theoretical Computing and Programming.

LISP is on the agenda. The success of artificial intelligence and more generally the public's demands for powerful, flexible and user-friendly software (like the well-known text-editor EMACS) gives an industrial dimension to this venerable language. After FORTRAN, LISP is the oldest programming language and still widely used : initiated in 1958, it was developed almost exclusively in universities and research laboratories, beginning in the U.S.A. then launched on the entire world. Its development is directly linked to that of artificial intelligence to which it gave its principal means of expression. LISP has had a deep influence on many programming languages, notably LOGO and SMALLTALK.

Its intrinsic qualities and capacity to function on small computers make it a priviledged instrument in computer science education. The aim of this paper is to analyse the factors which render LISP attractive in the field of education. We shall briefly describe the LISP-80 system used in the French National Education system and some of its applications.

I. WHY LISP ?

We belive that LISP has a particulary important role to play in computer science education for 2 reasons :

- LISP is extremely well adapted to non-numeric interactive programming, especially in artificial intelligence where one encounters difficult and non-structured problems and where the programs override the execution time.

- LISP is simple and its structure transparent. Its study is a remarkable lesson in computing. Its simplicity guarantees the programmer's liberty and in turn renders programming in LISP a lesson in responsibility. It also can be adapted to both small computers and main-frames.

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These two main features are aimed at two different publics :

The first is teachers and the second students. In practice this distinction disappears. What is important is to raise the computer-science competence of teachers and this is where LISP can be a key contributor in their learning.
On the other hand one must not underestimate the students'programming abilities : JP ROY's research at the Alsace School shows that sutdents in the baccalauréat class tackle artificial intelligence problems very effectively; and this is only the beginning !

In truth these two aspects of LISP are, in practice, closely related (cf for example the development of "programming environments", where the teaching interest is obvious). LISP programming is a complete experience which should foster serious reflection amongst the teaching body.

II. DID YOU SAY NON-NUMERIC ?

Many people still see the computer as a number crunching machine, whereas it has become a machine which processes all kinds of information and in which numeric information is secondary.

This information is of course coded in a binary form and is easily interpreted as a number : one can thus automatically carry out numerical calculations, and the first machines have been designed with this sole objective in mind, with great success as everyone knows. The idea that information could perfectly well do without a numerical interpretation came about slowly. One had first to find a conceptual framework for the information. Then one needed to wait for technological progress to produce viable memory banks large enough to store the necessary programming structures.

This has now been accomplished and the feats of the artificial intelligence pioneers have become accessible to all. There is today a fantastic flowering of software, the majority of which (text editors, data-base management) deal with non-numeric information.

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It is difficult to define the objective in non-numeric computing because it can be "anything". The problem of "representing understanding" is a key question in artificial intelligence. Beginners in LISP confirm this difficulty by taking time to grasp the approach. One needs to acquire the reflex of representing things in binary trees; some examples are given in the second part of this paper.

These arguments need not be extended except to reiterate that in its 25 years of existence LISP has been the preferred language of some of the best programmers in the world. LISP literature is very abundant. The bibliography lists some recent European works.

III. LISP IS VERY EASY !

The role of every programming language is to provide a link between man and the machine. Man cannot think in binary code, and his every day language is not communicable to the machine. A satisfactory language should free man's thinking and use the machine efficiently.

LISP is remarkable in this respect and unbeatable on the quality/price ratio.

LISP offers a very adaptable and agreeable intellectual framework and great precision in the running of the machine. LISP allows you to literally pilot the computer, a tremendously efficient tool in the hands of an adept. It runs easily on an 8-bit micro-computer as we shall explain later.

Other functional languages allow for more sophisticated methods but are more demanding and complex such as MK or SCHEME .

The traditional languages improperly called "algo-ritmic" (ALGOL, PL/1, PASCAL, ADA) impose restrictions throughout. The latter were conceived for industrial applications and not as an intellectual challenge.

They reached a complexity such that J. BACHUS voiced a radical critique -LISP showed the way as early as 1958 !

IV. WHAT CAN ONE DO WITH THIS TOOL ?

It can be used in imaginative teaching by using the interaction between the editor and the interpreter. For example to draw a design, one writes intructions with the editor; these are then interpreted at each step and the design is perfected with each iteration.

It can also be used as a development system to write specific software. Three examples were presented in Nice :

- LOGO-EN1 created for the National Centre for Educational Documentation by I BORNE ;
- MICRO-SMALLTALK, from the same author ;
- the impetus for expert systems PENELOP-84 by J. BONAUD, H. MEYMY and R. VOYER .

The first is a complete LOGO system which can be modified and extended because the program is in LISP. It lacks space, however, notably for the atoms. It is the only LOGO available for MICRAL, LOGABAX and SIL'Z and is extensively used for teacher training and primary school experiments.

The second is a small system for object-oriented programming, which is an application of P. COINTE's work. It is similar to LOGO and has generated a large interest from teachers. It will be used in primary school experiments.

The third allows the construction of simple expert systems (level 0) It therefore permits experimentation in this field by teachers.

V. OVERVIEW AND CONCLUSION.

The efforts undertaken by state school policy with LISP-80 are to be continued via an ambitious software project within the framework of AGLAE (Workshop of Applied Software in Education) of the Paris University -6ème, and under contract to the National Centre for Educational Documentation.

This software will include LOGO, a version of SMALLTALK and a system for formal calculations: It will be compatible with the new 1985 National Education Computers based on the 6809 and the 8086.

We can conclude by quoting P. GREUSSAY :"LISP leaves the imagination relatively intact". It seems important to us that a maximum of teachers attempt this experience to pass it on their students.

COMAL

Borge R. CHRISTENSEN - States College Tonder (Denmark)

COMAL (COMmon Algorithmic Language) was designed in 1974 as a structured language for use in school.

A substantially improved version, COMAL 80, was designed in 1978.

It has more powerful structures then FX. PASCAL and a very friendly user environment, whereas its data structures are somewhat more limited.

It is used in Denmark to introduce computer studies in secondary and vocational schools. It has also been used to implement process control.

Latest development : implementation of "micro-universes" and models of computer control systems to be used in education.

It has also appeared to be a very efficient means of introducing computer studies for students who are going to use PASCAL or ADA later on.

USE AND LEARNING OF LOGO IN EDUCATION

A. M. VALKE State University - GHENT

PROBLEMS AND QUESTIONS IN RELATION TO RESEARCH

- Qualitative level : the accent is on detection and induction processes
- Quantitative level : research lends itself more easily to measuring effects
- Applicative research : using logo and examining problem-solving skills in mathematics.
- Fundamental research : extending the logo-language

Programming languages designed for educational purposes are s metimes simplified versions of more complex languages as is the case of LOGO and LISP.

If programming is to be part of the curriculum, genuine programming languages must be used unless they are too difficult for the children.

LOGO or LISP ? What exactly do we want to do ? Are not several languages necessary ? Is translating from one language to another a problem ? With children translation is nonsensical, since they use the language as a code. Moreover, if they have to solve several problems at once, language level, user level, communication level, it is going to add to their difficulties. However translation is part of technological information...

In the near future these problems will be of relative unimportance with the advent of universal symbolic languages or iconic languages.

PROBLEMS AND QUESTIONS IN RELATION TO THE INFLUENCING PROCESS

How can we introduce LOGO so pupils will get full benefit from their experience. ? Adulst are also a necessary part of the computer culture environment as an aid to the creative experimental learning process. New primitives, commands and possibilities need the teacher's presence to induce new needs in pupils. Sticking to turtle geometry is easy whereas list processing is far from it. The only solution to this problem is a rethinking of the tool. Finally the active help of the teacher in pointing out the relationships between earlier and new problem situations is absolutely necessary to ensure transfer of experience.

USE AND LEARNING OF LOGO IN EDUCATION

B. Pierre BIERNAUX - Brussel free University (GRAAL)

The independent learning and LOGO research group (G.R.A.A.L.) was founded in June 1982 by researchers from the sociology department of the Free University of Brussels. Today it includes members from different fields, primarily teaching, vocational training and rehabilitation. These people are to carrying out a research programme centred on the idea of creating and studying a new learning environment (with the help of LOGO) where each person (and in particular the low-achievers) can harness the power of the computer in order to use it as a means of discovery and to develop his cognitive faculties and thereby actively master his own learning within a micro-society in the construction of which he actively participates.

THEORETICAL FRAMEWORK AND RESEARCH AIMS :

Following Papert's idea -that the computer should become, through LOGO, an "object-to-think-with, an instrument of refelxion, an object which should primarily become a social process, giving birth to tomorrow's educational methods" (*)- the G.R.A.A.L. tried to create "the Samba computer school model" (*), within the social context of schools and other institutionalised places of learning. In this manner one could venture to study "which kind of computer culture could develop within social groups whose foundations were not previously prepared for a technology-based culture" (*).

Considering the complexity of the project, this research must be multidirectional and yet carried out in a unifying spirit. That is why these studies are not restricted to the sole observation of children learning in the LOGO environment, but encompass also the other elements of the whole environment.

Furthermore, the novelty of this field of research and the chosen point of view, suggested the approach of "concentric-circles", closely linking action and research.

Our initial concern was to define for ourselves a general framework permitting a scheme for hypotheses employing essentially exploratory research methods.

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(*) Seymour Papert "Mindstorms : - children, computers and power ideas"

Considering the LOGO system as the forerunner of a new method of learning, relatively unknown in our society, (and as a result little used in our school system) we set ourselves the following goals :

1. To determine the phenomena and processes of acceptance or refusal of the LOGO tool :

- by the population directly concerned : students (children, adolescents, adults).
- by the teaching establishments represented essentially by the teachers (in normal and special schools, including those for illiterate adults, etc...)

2. To draw out and to determine the ways of introducing LOGO into the existing school system, keeping in mind their demands and constraints.

3. To study the conditions for use of the LOGO system, considering its own objectives as well as those of the relevant institutions, and to give options for LOGO's integration.

4. To define the minimal training requirements and their programs, depending on the function of each group : teachers of children, adults learning with LOGO, or future LOGO experts.

5. To study the implications for and foreseeable contributions to the social, affective and intellectual development of children in a LOGO learning environment integrated into the school system.

The project, which started in February 1982, has two main parts :

The first, of an essentially exploratory nature, was to allow us better to define our initial hypotheses and to teach ourselves about the use of the LOGO system in very different environments. This was completed in July 1983.

The second began in September 1983 and was aimed at long-term experiments on the prolonged use of LOGO in different educational systems.

PATTERNS OF WORDS

Mike SHARPLES - Edinburgh

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Dry path

Lonely moon fades subtly
In cold plains
Black clouds
Frost fades by wish

We feed slowly

Black path fades to red rocks
I feed

This poem was written by a 15 year old boy with the aid of a computer program.

The "Poetry from LOGO" scheme does not aim to produce poets or teach poetry but gives children an opportunity to explore their own language.

Creative writing is a craft, and language is the material used. Most people use language unconsciously. A computer program can help them be aware of the linguistic rules, styles and conventions involved in using languages.

Previous programs have been adapted to develop logo procedures to generate poems.

The first program generated words at random. A procedure, PUT, is followed by a list of words to go into the "box". Another one, POEM, draws the words out in random order. The first number given to "poem" indicates the number of lines in the poem, and the second the maximum number of words in a line.

The children suggested the words should be ordered as parts of speech, and developed and tested their own algorithm.

The labelled words were given as input to a logo procedure that generated words to follow a grammatical pattern. Finally the children wanted the poems to make sense, so their words were given meaning tags and a final set of logo procedures was used to match the words for meaning.

The procedure "NEWWORDS" takes 3 inputs : the part of speech, one or more poem words and a list of meanings. The procedure "POEM" takes a list as input representing the "grammar pattern".

The children not only gained personal satisfaction from creating their own poems but could also talk fluently about sentence structure, parts of speech and word function.

The program was redesigned for younger children who have no understanding of linguistic structure.
The redesigned program called "GRAM" has two commands.

"CREATE" : the child types in words from a set list of keywords such as draw; square, triangle, tilted, smaller, and up, which are interpreted by the program to draw shapes on the screen.

The next step is for the program to generate the picture description. The child uses the second command "PUT" : to create a "box" called, say "shape" to store the words square, triangle, etc. Then another box called "size" to store the words big, small, etc. So when he calls "CREATE" and types in "draw a size shape" the program will produce a random combination of words such as "draw a small triangle" or "draw a big square". So the program helps the child to group words into classes which is a small step to classifying words according to a part of speech.

Another command "GET" calls up a story pattern from the program library. The child can volunteer words to fill out the requests on the screen which are added to the original store. The child can then create his own story pattern by asking the program to generate at random a word for each part of speech.

The original program was extended to increase its linguistic power and generate HAIKU poetry (3 lines of 17 syllables). The final version of the program combines the context-free grammar with procedures to match words for meaning. The program generates a sentence pattern, chooses a word for each part of speech and prints out the English text.
Other features : the output of the original GRAM program can be fed into a second program which has prewritten rules to transform and tidy up the grammar. "Meaning tags" can also be added to indicate a meaning for the entire poem.

ARTIFICIAL INTELLIGENCE REPRESENTATION TECHNIQUES APPLIED TO PROBLEMS INVOLVED IN DESIGNING AND IMPLEMENTING INTELLIGENT COMPUTER TUTORS

T. O'SHEA - R. BORNAT - B. du BOULAY - M. EISENSTADT - I. PAGE
(Document brought to the summer school by m. SHARPLES)

The main objective of this report is to make it possible for innovators in education to create high quality computer based educational materials with a friendly user interface.

Based on Eisenstadt's (1979) SOLO system, it is designed to run on a personal computer with high resolution graphics. The Artificial Intelligence representation technique used is production rule modelling.

Starting from the work of Hartley (1973) we have produced a simple five component model with the following functions :

1. Teaching Administrator : which presents material to a student and processes responses.
2. Student History : records material presented and consequent responses.
3. Student Model : predicts the current state of knowledge and ability and future performance.
4. Teaching Strategy : relates the system's view of the student to teaching action and decides on future action.
5. Teaching Generator : yields specific teaching for use by the teaching administrator.

The link between the "ADMINISTRATOR" and the "STRATEGY" may represent a control of teaching action.

The five component model system forms the basis of C.D.T.s (Courseware Design Templates) and allows trainees to produce different types of computer aided learning material without programming skills. In the following CDT analyses we distinguish between those which do and do not act on evaluations of students' performances, and from a teaching point of view, those which

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1. only present material;
2. can also tutor the student;
3. can also demonstrate mastery of the subject being taught

PRESENTING MATERIAL (Teaching Administrator)

We have chosen to give it a general name of EXPOSITION and one characteristic is that the student cannot take control of the choice of teaching material. Most material written in conventional author languages is essentially EXPOSITION. If we replace the student history by a student profile which is the use of some series of CTD lessons or modules then we have a CDT for Computer Managed Learning.
There are two useful special cases of the Exposition CDT :
"EXAM" where the teaching generator is linear and "SLIDE SHOW" where "OK" is the only response the teaching administrator will process, meaning the student has finished looking at the slides.

TUTORING :

In this type of system the student may ask questions and the questions asked of him by the system may depend on the system's goals. Our name for the general CDT for Tutoring is QUIZ NETWORK. The student may attempt to short circuit the Student Model's predictions on his proficiency by requesting a Quiz or information.
There are two special cases : "Drill and Practice" CDT - where the student cannot intervene and "Enquiry" CDT - which is a data base system obedient to the requests of the student.

DEMONSTRATING MASTERY :

For a system to do this it must be able to actually do what it teaches, show the student how to exercise the skill he is acquiring and comment sensibly on his own attempts. Our name for this CDT is PROBLEM SOLVING MONITOR. Such systems are extremely rare since it is necessary to construct a computer based "domain expert" capable of carrying out the skills being taught. There are some examples, but one special case of this CDT is for modelling and the other special case of the problem solving monitor is the Games CDT.

HIERARCHY OF COURSEWARE DESIGN TEMPLATES :

Clearly some of these CDTs will involve the trainer using them in considerable design but our model-based approach will be easier to use and provide educationally "clearer" CBE software than existing authoring systems. The most general CDT is that which provides Mixed-Initiative Teaching. This term implies that the system should be able to teach in a variety of ways and respond to a variety of student requests. Apart from "SOPHIE" (Brown and Burton 1976) which required man-years of development per hour of intelligent system-student inter-action, this CDT remains a long term ideal.

The beginner CDT designer will find the most constrained versions of our CDT model the easiest to use as defaults will create most of the components for them. A rough ordering in terms of ease of use for a beginner is : slide-show, exam, exposition, games, enquiry, drill and practice, modelling, quiz network, problem-solving monitor, and mixed initiatives.

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