TEACHING INFORMATICS IN THE BULGARIAN SCHOOLS

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1. Introduction

Informatics teaching at secondary school level has a long history and tradition in Bulgaria. The first steps were made in the late sixties when some optional informatics courses were taught for secondary school students in mathematics and in vocational schools. Since 1979 the Research Group on Education (RGE) under the Bulgarian Academy of Sciences and the Ministry of Education, Science and Culture (MESC) has carried out an experimental teaching of informatics in twenty seven schools both at elementary and secondary school level [13,15,25]. Informatics has been taught as a compulsory school subject for all secondary schools in Bulgaria since 1986. The procedure for introducing computers into the secondary education system, the relevant stages, objectives and tasks, were part of a complex Program for the implementation of computer technology in secondary schools, worked out and approved by the Higher Council for Education at the Ministry of Education in Bulgaria[19].

During the first three years following the adoption of the Program some promising results have been achieved [26]:
- more than 16 000 school micros have been delivered to about 1000 schools;
- a 120-hour course in informatics was made compulsory in all secondary schools for 10th and 11th grade in the 1986/87 school year;
- two versions of initial textbooks in informatics in two parts (for the 10th and the 11th grade) have been written and published[2,3,7,8];
- teachers' handbooks, as supplements to the first and the second parts of the informatics textbooks, have been written and published;
- a large number of study aids and other materials have been published;
- considerable success has been achieved in training and retraining of the teachers. About 17 000 teachers have completed an one-week (36-hour) computer literacy course; 2300 have finished an one-month course; 650 - a three-month course, and 350 - an one-year course;
- a teacher training Chair in Informatics was established at the Department of Mathematics and Informatics, Sofia University, in 1986. Similar chairs have been created in teacher training colleges throughout the country;
- research units in the area of education have been organized in some of the higher educational institutes.

In spite of the great economic and social problems the country is facing, the Bulgarian teachers and educational scientists are trying to preserve and even extend the positive experience in computer education. The great effort needed was inspired by the enormous students' interest in using computers.

2. Structure and Nature of the Bulgarian Educational System

The dynamic changes in Bulgaria and in the other countries from Central and Eastern Europe are posing new problems to be solved by their educational systems. At the same time a great educational restructuring is hardly possible because of the deep economic crisis these countries are suffering from. Some trials for overcoming the situation are described below.

One of the main directions in the recent changes in the Bulgarian educational system is the transition from a state controlled model towards a state supervision model of educational system steering. Thus the decision making power is shifting from the government towards the local educational councils and authorities, school principals and teachers. All these changes are being carried out in a legislation environment full of contradictions, where the new laws exist together with some old ones. The process of decentralization is gradually going on in order to prevent appearing of a decision making vacuum. A number of

private and specialized schools emerged and broke down the state monopoly in this area too.

The basis for the recent changes is the new Law for People Education[10]. It determines that the compulsory education is for all Bulgarian citizens between six (or seven) and sixteen years old. There is a free education in all state schools independently of the students' age. The education in private schools is paid by parents but the state is subsidizing all students under sixteen. All textbooks for compulsory education are free[10].

The Bulgarian educational system has three stages (see fig.1.):
i) elementary education (4 years)
ii) basic education (4 years after the elementary school)
iii) secondary education (3-5 years after junior high school)

There are five basic school types:
a) elementary schools - stage (i) only;
b) junior high schools - three subtypes:
b1) stage (ii) only;
b2) stages (i) and (ii);
b3) vocational schools - stage (ii) only;
b4) specialized schools, e.g culture, language, for children with handicaps, etc. - stage (i) or both stage (i) and (ii);
c) comprehensive secondary schools (gymnasiums) - three subtypes:
c1) unified secondary school - stages (i), (ii) and (iii);
c2) specialized schools, e.g. math, languages, science, culture, music, etc. - stage (iii) only;
c3) vocational schools - stage (iii) only.

At the middle of 1991 the following data was reported:

N	Educ. Degree	N schools	N students	N teachers
1	Basic Educ.	6 390	947 676	64 498
1.1	Elementary	3 333	333 572	23 424
1.2	Jun. High	2 877	592 847	37 988
1.3	Vocational	5	2 785	83
1.4	Special.	175	18 472	3 108
2.	Secondary	1123	383 953	28 769
2.1	Unified	509	71 039	5 429
2.2	Special.	116	78 486	5 256
2.3	vocational	498	233 528	18 084

The education is state funded by allocating resources from the budget of MESC and the other state organizations being responsible for running special schools, i.e. Ministry of Transport, Ministry of Trade, Ministry of Health, etc., as well from the budget of the county, municipality and commune councils.

Teacher training for the elementary, junior high and unified secondary school is carried out at university level - three universities and two teacher training institutes. The teachers in technical and vocational education are educated at technical, economic, agricultural and medical universities and institutes. There are some teacher training institutes specialized in professional education at junior high school level. The in-service teacher training and the continuing teacher training are organized by three universities and three specialized institutes.

3. Informatics Education Concepts, Approaches and Practice

There exist two basic approaches to informatics education - informatics as a separate school subject and informatics integrated into the other school subjects. Specific policies and strategies for introducing computers and related information technologies into schools of countries differ, although broad common trends are apparent [25]. In particular, there is a shift from "restricted" policies intended to promote instruction in computer science and computer literacy towards "comprehensive" policies designed mainly to increase the effective use of computer based teaching and learning across the curriculum [11].

Two main strategies for implementation have emerged [25]. The first deals with the equipment - in the broad sense - of selected pilot schools versus all schools and the second with centralization of decisions versus decentralization. It seems that the ideal strategy would be to combine these two approaches and that governments could help by introducing technology in all schools, and at the same time, by taking a major responsibility for experimenting in a very few well equipped schools in order to assess how technology actually omproves the quality of the teaching and the learning processes. Countries which have adopted this combined approach include Japan, Sweden or some States of the United States.

A combined approach of informatics education is being applied in Bulgaria: the RGE is applying an approach of integrating informatics across the curriculum in 27 schools, while the government is introducing technology in all schools and a compulsory subject "Informatics" is taught in the upper classes of secondary schools.

3.1. The Research Group on Education Approach

Since 1979 the RGE has been experimenting in 27 schools a new curriculum and new methods of teaching and learning closely related to informatics and its applications [15,16,17]. The RGE school informatics project aims at applying a flexible strategy based on integration of informatics into the other school subjects[15]. The informatics education is organized at three basic levels: primary level (1-4 grade), secondary junior level (5-7 grade) and secondary level (8-12 grade).

The primary level aims at providing initial, non-systematic informatics knowledge as a result of an encyclopedic type of education. A number of basic notions like algorithm, coding, decoding, variable, assigning a value to a variable, table, graph, procedure, are introduced and applied in some reasonable school activities in mathematics, language, music, design. The educational environment includes textbooks, computers, Logo based software (microworlds), computer games, manipulatives, Lego sets and interface software.

At the secondary junior level the informatics is taught mainly as a part of the school subject Language and Mathematics. A relatively systematic hands on course on informatics on the base of a variety of problems and activities, closely related to the other school subjects is developed. The informatics application is penetrating deeper and deeper into the other integrated subjects, e.g. Nature, Life and Manifacturing, Society. The educational software includes a viriety of microworlds and software tools providing a good basis for acquiring problem solving and information processing skills.

What are the implementation results of the RGE approach? In the experimental schools informatics is taught from the first grade onwards as a part of the encyclopedic education, and from the fifth grade onwards as a separate subject (based on the language Logo). Special textbooks and supporting educational software have been created and are regularly updated[25]. Particular attention is paid to teacher training.

Teaching of informatics avails opportunities for natural integration of all schools disciplines. The realization of this integration is one of the basic objectives aimed at in writing the informatics textbooks[14].

The diversity of problems avails each student with the opportunity to find his/her road to informatics. As a result of this instruction in informatics students:

- acquire new habits for work with microcomputers;
- get acquianted with some of the basic applications of computers in society;
- get an idea of their future applications;
- learn to use the computers as a tool for experiments and for solving problems in the different school disciplines;
- learn how to formulate the problems that are to be solved with the aid of the computer;
- acquire habits for collective creative activity.

The positive experience gained during the RGE experiment was applied in developing of set of integrated secondary school level (8th-11th grade) textbooks on "Mathematics and Informatics" for the general educational system in Bulgaria[18,19,20,21]. The integration is considered useful both for mathematics and informatics:

- informatics offers some means to clarify and extend the mathematical concepts studied and illustrate the possibilities to apply them to real situations;
- informatics offers some appropriate tools through which a great variety of solutions might obtained;
- working with computers may contribute to looking at mathematics as an experimental science and to decrease the high level of formalism usually reported as the main obstacle in an successful mathematics teaching.

3.2 A Systems Approach to Informatics Teaching

The compulsory informatics teaching in Bulgaria began in 1986. However this decision was made (not suprisingly for that time) without having enough information about the real conditions in the schools. Though great number of computers were supplied to the secondary schools their reliability was too low. Many teachers started teaching informatics after some short term training courses, if any. The informatics curriculum showed some pitfalls as well. Additional difficulties appeared on the base of some groundless decisions of the Ministry of Education for the status of the new subject and the number of hours allocated for it into the school curriculum [5].

The main aim of teaching informatics at school is closely related to the computer literacy based on algorithm construction and programming. The textbooks for 10th and 11th grade included a lot programming in Basic - the only programming language available on all microcomputers[2,3,7,8]. The initial ideas were refined and enriched and a new edition of the informatics course appeared, shifted a year earlier - in 9th and 10th grade[9,10]. A specially designed Pascal-like algorithmic language was developed and used as a tool for describing algorithms. Step by step the idea of defining some compulsory minimum of knowledge and skills was launched. It was extended afterwards to the idea of developing educational standards in informatics [5]. The RGE variant of informatics textbooks (see 3.1) was also offered to the teachers as an option to choose.

The Law of the People Education [12] gives the teachers rights to select textbooks and other teaching materials to follow in their teaching. They can even use their own lecture notes provided they match the educational standards as to the knowledge and skills needed to be acquinted. However these standards have not been developed yet.

According to a recent decision of the MESC the informatics teaching was shifted again, this time upwards - in 11th and 12th grade. This decision opposes to the general tendency of an early teaching of informatics. We consider informatics not simply as an ordinary school subject but as a tool which might enrich both content and teaching methods of all other school subjects. Such an aim could not be achieved if the informatics teaching remain at the upper two years of the secondary school. However an option for earlier teaching of informatics is envisaged by the MESC if certain school council decide that they could afford it. A number of optional and 'obligatory-optional' extra class activities are envisaged as well.

The quality of the informatics education depends very much on the quality and quantity of computers being used in schools. After a 'party decision' and a corresponing governmental decision in 1986 a mass supply of eight-bit Bulgarian made Apple compatible computers "Pravetz" to the secondary schools was launched. Every secondary school had on its disposal at least a computer lab with eight microcomputers. However the low quality of peripherals made impossible to demonstrate computer applications too far from Basic programming. During the last 4-5 years mainly sixteen-bit Bulgarian made IBM PC compatible microcomputers were supplied[5]. For an improvement of the computer usage quality, specially designed for educational purposes heterogeneous local-area networks were purchased for the schools. Although the initiative for supplying computers was shifted to the local councils and schools, a number of fully equipped with IBM PC and Macintosh computer labs were established by the MESC at some selected school settings which have already showed some positive results in educational informatics. The software used includes mainly programming languages like Basic, Pascal and Logo but the users of several application software packages at school are getting more and more [5].

3.3. Teacher Training

The programme for improvind the teachers' qualifications in computer technology and programming was an element of the complex Program[19] and covers the 1985-1990 period. It defined all types of activities related to the pre- and in-service training of teachers[25]. The main aim was to train the teachers intensively to apply computer technology in the educational and tne educational-productional process, to provide qualified teachers for theoretical and practical training of students in computer technology and programming, to train educational management staff in the application of computers to the control and management of education, etc. In the first place, the organization of qualification courses presupposes the existence of a module structure for the courses, which were divided into four levels:

- First level - duration of training one week, 36 hours. This course was intended for all teachers and management staff in the education system.
- Second level - duration of one month, 140 hours. Intended as general introduction in computer technology for nonspecialist teachers.
- Third level - duration three months, 440 hours. Intended for teachers who had to teach computer technology and programming in secondary schools. After successfully completing this course, they were entitled to teach computer technology and programming.
- Fourth level - duration of one year, 940 hours. Intended for training specialists for training teachers.

The teacher training in informatics is carried out by three universities, one higher education institution and three specialized teacher training institutions. As a rule the equipment available at these organization is quite better than those in schools. Thus an advanced and modern style of teacher training could be followed bearing in mind that the teachers would teach the same way they were tought. However only few of the teachers could apply in school what they have learned[16].

The Teacher Development program in Computer Education at Sofia University offers both pre-service (for teacher-to-be students) and in-service teacher training courses[18]. The in-service teacher training program includes three-month and one-year full time course. The topics of study are divided into five main groups:

i) Background in Informatics
   Systems and Algorithms,
   Introduction to Programming (Pascal)
   Problem-Oriented Languages (Logo Environments)
   Programming in Prolog
   Programming in Basic
   Computer Architecture
   Operating Systems
ii) Application Software
iii) Methods of Computer Application in Education
iv) English Language
v) final thesis

The teachers acquire the qualification of teacher in informatics and computer consultant at school. The pre-service teacher training covers the in-service training program and some more courses and tutorials aiming at extending the teaching practice in school of the students involved.

3.4 Extra-Class Activities

A nationwide system of extra-curricular informatics training has been set up. The facilities are run by different schools, local youth organizations, and so-called Computer Clubs. Every year over 100 pupils pass througf the National Informatics Training Camp. Several national competitions in informatics are organized, including: a National Informatics Olympiad for pupils, which is held in three rounds - school, regional and national; a Spring Informatics Tournament, which, annually, gathers more than a hundred pupils from all over the country; a programming contest for 10 to 14 year-old pupils in three rounds, etc. Participants in the national olympiads and other contests are invited to training camps in informatics and mathematical linguistics during the vacations. Special attention is paid to the training of the National Team in Informatics, which includes carefully selected school students who take part in international competitions. All this shows that a system for working with students showing high interest and performance skills in using computers has been established in Bulgaria. University teachers, research workers and informatics students are taking part both in teaching and organizing such activities. A number of competitions, seminars, tournaments, etc. are organized both at national and local level. The MESC, the Union of Bulgarian Mathematicians and other organizations publish programming problem sets, bulletins, manuals, etc.

Bulgaria was the initiator and active participant in a number of international undertakings in the field of computerization of education, e.g. the international conference "Children in the Information Age". Bulgaria is an active member of UNESCO's International Informatics Programme and IFIP Technical Comitee 3 meetings and workshops as well. An UNDP project has being worked out in Bulgaria with UNESCO as executive organization for the "Research Center for Educational Informatics", financed with 200 000 US$ and 4 000 000 levs. Within the framework of this project 12 sub-projects embracing all aspects of the use of computers in education have been executed.

4. A Glance in the Future

A new concept for informatics teaching at school has been developed [6]. The teaching aims, the informatics content and the methods of teaching were defined at a methodological level.

The informatics teaching aims at:
i) developing a general information processing ideology;
ii) acquainting knowledge and skills in applying informatics in society.
iii) promoting the interest towards informatics of all students and especially those who are highly motivated.

The informatics curriculum includes the following main topics now:

- main informatics notions and concepts;
- tools for information processing;
- information processing service;
- methods of information processing;
- problems of communication;
- programming and user oriented software interracting;
- basics of the computer software
- philosofical, social, ethical, economic, moral, legal, etc. issues of informatics.

A new model of informatics education in school was announced in 1990 [4,5]. The leading idea is to define an obligatory informatics knowledge and skills minimum. The students can choose modules from the following fields:
- programming languages and methods;
- informatics applications;
- informatics modelling.

The model was developed as an option of the exsisting informaticsteaching practice. It has the following main characteristics: The curriculum might be divided into several relatively independent learning modules. There is only one obligatory module, which matches the national standard in informatics as to knowledge and skills. This module might be upgraded with other modules depending on the preferences or the professional needs of the students. The model aims at developing mainly skills in informatics application in different fields rather than building a system of theoretical knowledge in informatics. A number of modules are dedicated to special schools conducting an advanced informatics teaching, i.e. mathematical and language high schools, professional schools in electronics, etc.

The model includes a system for selective informatics education. The selectivity involves not only the field of informatics application but the level of difficulty as well. Such a way a great variety of informatics curricula having a common core might be developed according to the real needs. Thus both the integrative and system approaches of teaching informatics are combined in one model.The major problem still is the creation and spreading out of the educational software. There exist few professional organization in this respect.

Since the beginning of 1993 a national project "School 2000+" of the National Center for Education and Science and Foundation INCOBRA was launched. Special attention is paid on the new information technologies application. The positive experience of the RGE and the general educational system will be taken into consideration as well.

The main objective of the proposed project is to contribute the national project "School 2000+" in the part of successfull IT integration in education facing th e demands of the next century. It could be achieved by:
i) defining educational goals oriented to extended IT application;
ii) defining the attainment targets as to knowledge, skills and understanding th at the students of different abilities and maturities are expected to attain at

the end of each key stage;
iii) defining a strategy for integration of IT into other school subjects, e.g. mathematics, science, language;
iv) determining a set of exemplary educational software tools as a basis for a future oriented education based on IT application;
v) developing computer-based environments in math, science and language education;
vi) developing of a strategy and methods for applying multy-media software packages, electronic mail facilities as a mean for a new type of communication and education in a "global classroom", Artificial Intelligence based tools and systems, etc.
vii) developing assessment instruments for students' achievements matching the attainment targets proposed. The main emphasis will be put on measuring the students' conceptual understanding, communication, performance and problem solving skills, planning
viii) organizing experimental and implementation activities. They will be conducted by research teams in specialized classes and schools within the system of the Ministry of Science and Education;
ix) training and qualification of educators, teachers and other specialists from the country and from abroad. Special attention will be paid to the possibilities of joint work with related projects of UNDP and UNESCO for the developing countries. There ex
xi) organizing international seminars, workshops and conferences on topics related to integration IT in education. For instance an Expert Workshop on "Integrating IT in School 2000+" is envisaged to be organized in 1994, and an International Conference -
xii) planning the future R&D activities and the way to contribute to some other international activities and projects, e.g. UNDP/UNESCO, IEA, EC and IFIP projects and activities.

6. Methodology

The project will be composed of ongoing experimental activities, testing and theoretical research. The project involves the following activities:
i) analysis of the Bulgarian in the context of the world experience, of research projects, of research papers and books, reveling conference proceedings, etc.
ii) international and national curriculum analysis as a basis for a successful integration of IT in education;
iii) educational experiments and research, including comparative studies and assessment;
iv) developing educational standards and corresponding educational documentation corresponding to the demands of 21st century.

7. Evaluation and dissemination

The evaluation of the project's outcomes is expected to be done by:
i) observation, interviewing, questioning;
ii) measuring students' achievements and attitudes;
iii) commission of experts
One of the concerns of dissemination is to make known to the researchers and practitioners in education the project activities and outcomes. The following dissemination activities are planned: publishing papers, publishing the project materials and findin

8. Significance

The project is expected to contribute:
i) National project "School 2000+"
ii) Some UNESCO/UNDP projects, IEA COMPED,TIMSS and LES projects, some EC projects, etc.
iii) The professional development of the project team as well as the quality of teacher training and pupils education.

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