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ASSESSMENT AND EVALUATION

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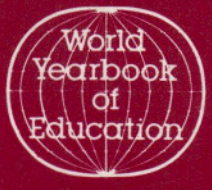

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4. Educational change and assessment in the age of information technology

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Summary: The development of the educational system in Bulgaria is closely linked to, and determined by, the dynamic socio-economic and cultural development in the country as well as by the on-going revolution in science and technology. Correspondingly two basic trends emerge:

- close interdependence between the high school education system and the demands for highly qualified specialists in the sphere of economy, science and culture; need for a most up-to-date professional training on a broad polytechnic basis;
- correspondence between content and methods of education and the modern achievements in science and technology.

The educational system in Bulgaria is founded upon, and functions according to, the following principles:

- democratism: equal opportunities for general, polytechnic and professional education for all young people; accordingly education in Bulgaria is free and available to all;
- polytechnic character of education which determines both the general outlook of educational training and the professional orientation and training;
- attainment of high professional skills according to the demands of modern economy, science, culture, art and the interests of the individual.

According to the decisions of the Central Committee of the Bulgarian Communist Party (1979) reforms in education are being carried out in two directions:

- perfection of the existing system, a so-called 'transition period';
- building up a new system of high school education.

The main characteristics during the transition period are:

- a single type of education exists for the first seven grades (I–VII), except for the 29 schools of the Research Group of Education;
- partial admission of six-year-old pupils to the first grade has been started;
- the instructional contents of the general education subjects is unique for all kinds of high schools (5 years polytechnic high schools and technical high schools, and 4 years professional vocational schools);
- differentiation in instruction is introduced by optional disciplines and extra-curricular activities.

In parallel with the transition-period, work has been started on the realization of the new unitary polytechnic schools, with three levels of instruction within a 10 to 12 year course of education. This system also includes new two years post-high-school technical schools, special schools for care and training of handicapped children, three years only professional vocational schools (VIII–X grades) etc.

Introduction

In 1979 the Bulgarian Academy of Sciences and the former Ministry of

Education established the Research Group of Education (RGE). The main goal of this experiment has been to prepare the ground in schools for the wider use of information technology (Sendov 1987). Twenty-nine schools were attached to the RGE. The main intention is not so much the use of computers as instruments of school training, or information about and instruction for work with computers; rather, the goal is the thorough reorganization of educational curricula and methods through the constant and general use of computers in everyday life: in other words a man-computer symbiosis.

The basic hypothesis on which we are building our educational strategy in the information age is that the object of education has changed. What do we mean by this? We view the computer as an extension of the human mind. This concept is widely accepted and is realistic. It upholds the unique status of the human personality and removes any contradiction between man and computer.

From the concept of the computer being an extension of the human mind it follows that the aim of education in an information age is the training of children and young people who are equipped to use computers. Since education is basically dealing with the mind of the person being trained, it cannot itself remain unchanged as this mind is extended by the computer. In this sense the object of education has changed.

An analysis of the character of computers used in education shows that three main tendencies may be distinguished:

- ☐ the computer as an object of study;
- ☐ the computer as a training device;
- ☐ the computer as an extension of the human mind.

All three trends have their place and future development in education, but the third will lead to the most profound and essential changes.

What are the major effects of such changes in an information age? It is natural to expect a basic change in the methods, as well as in the content of education. Analysis shows that the change in school curricula is particularly significant. But this change cannot be carried out easily, let alone immediately. The reasons lie mainly in the traditional conservatism of the educational system (which also has its positive side), as well as in the constant and still fairly rapid improvement in computers. We do not mean that the object of education has already changed; it is still doing so. This means that adequate school training in an information age will develop as the result of a long and difficult process.

A great influence on the modern principles of curriculum development is exerted by the so-called Bloom's taxonomy concerning the hierarchic aims of education (Gronlund, 1976). The latter can be grouped together in three main domains:

- ☐ the cognitive domain, concerned with knowledge and its application;
- ☐ the affective domain, concerned with the emotional responses and values that are taught;
- ☐ the psychomotor domain, concerned with physical and manipulative skills.

As far as changes in education appropriate to an information age are concerned, the process will affect most substantially the first domain of Bloom's taxonomy. The second and third domains will undergo less significant changes. However, manipulative skills will probably change considerably.

From the history of pedagogy, we learn of the long and varied development of educational systems as they adjust to serve a particular society. The educational systems in all countries are strongly influenced by the historical and political development of the country. There are, nevertheless, universal trends and developments that may serve as a basis for international cooperation. The basic principle of the RGE is the integrity of knowledge. The principle of integrity, or wholeness, of education is not a new one. The idea of studying objects and phenomena from different points of view, involving knowledge of different school subjects, is a well-known approach, particularly in primary education. The very integrity of knowledge itself can have different characteristics. We may take account of the special features of the various subjects, while at the same time investigating and emphasizing their interconnections. Another approach is integration on the basis of fundamental ideas from different fields. Methods using projects are well-known, and achieved great popularity in the twenties and thirties in the USA, as did the method of complex training in the twenties in the USSR. These could both be considered as variants of an integrated approach in education.

The integrated approach of the RGE is of a particular nature and differs in principle from other methods of education quoted as integral methods. The basic difference lies in the emphasis placed on the need for the integration of knowledge as a consequence of a qualitatively new situation: the emergence of new information technologies. This new situation can be characterized by the following developments.

The school is no longer the sole nor most attractive source of knowledge. The availability and rapid development of the information technologies (radio, TV, computer networks, satellite communications etc) provide for the quick and unhindered acquisition of knowledge in a pleasant atmosphere. These sources therefore prove to be strong competition for the school. However there is one aspect of school education that cannot be challenged by other sources of information. This is the unique commitment and capacity of the school to provide systematized and well-structured knowledge. Hence in the age of highly advanced technologies the main preoccupation of the school should be the systematization and structuring of knowledge whereby emphasis is laid on fundamental and universally valid principles. In this sense, the integration of knowledge acquires a special significance. The purpose of the integral approach to education is not to continue the learning in different spheres of a certain body of facts needed to carry out a definite practical job, or to develop a project. What we have in mind is just the opposite. It is to have the attention of the student concentrated upon basic and valid principles from the viewpoint of a large number of scientific subjects, making possible further independent study and the utilization of specific information through the information technologies.

It is easy enough to formulate this requirement in principle, but it is rather more difficult to implement it as a particular learning process incorporating curricula, textbooks and study aids. The school is not in a position to provide sufficient knowledge for the entire range of man's working life. The amount of change that man will experience during his lifetime in the world about him is likely to increase enormously in the future, and this means that it will be no longer possible for a school to equip the future citizen with enough skills to serve

a lifetime. There is no doubt that such a citizen will be compelled to study all their life.

So the main task facing the school of today is, above all, to teach the students how to learn. In this respect the integrated approach has indisputable advantages; it enables the student to observe natural and social phenomena from a different angle and cultivates the need for a constant search for new relationships and facts. According to the system adopted by the RGE, the entire period of schooling should be divided into four cycles:

- ☐ primary (4 years; age 6–9);
- ☐ junior secondary (3 years; age 10–12);
- ☐ senior secondary (4 years; age 13–16);
- ☐ terminal (one year; age 17–18).

It is the primary and junior secondary cycles for which the RGE has developed a more or less final version of its teaching materials and has amassed the greatest experience in implementation and evaluation.

The system of textbooks starts with a primer for use during the first semester of the first year. There is no other textbook during this time (use of a single textbook at any one time is characteristic of the entire primary cycle), and the primer is used in school rather than taken home. The main objectives of this first book are elementary reading, writing with block letters and digits, and adding and subtracting numbers up to 20.

Although there is only one textbook, we differentiate among eight activities: reading, writing, calculating; singing and instrument playing, concert visiting; drawing and modelling; design and construction; sports; reading books; studying one's homeland; and excursions. The first item represents the 'hard' studies (10 lessons per week) and all other items – the 'soft' (altogether 25 lessons per week). In grades 2–4 the schedule remains essentially the same.

The primary cycle has, as its objective, providing initial, non-systematic knowledge about the child's environment, and achieving a basic literacy in Bulgarian and Russian (the latter starting in the third grade). An attempt is made to reach this goal through an integrated approach and a relaxed atmosphere to stimulate the child's activity. Neither grading marks, nor homework are given. All the teaching materials (books, slides, tapes, etc) remain in school and are not taken home. Time at home, after a whole 'working day', belongs to the family. Every class is assigned to teachers: one senior teacher, who typically takes over the 'hard' lessons, and a junior teacher, who is responsible for the rest. There is usually a professional sports teacher available at most of the schools. In the junior secondary cycle emerges the first differentiation of disciplines, although the system still remains integrated horizontally among disciplines and vertically among grades. The next important feature is the advent of a second foreign language, English. The main disciplines (the 'hard' ones) are 'language and mathematics', 'Nature' and 'Society'. 'Language and mathematics' is a most unusual discipline and is intended as an amalgam of general and comparative linguistics, and mathematics. Linguistics (not just the native language) through phonetics, morphology and syntax, logically comes first, and an attempt is made to use simple mathematical tools to describe linguistic phenomena. This was the most difficult book to conceive, and it has not yet reached its final form.

(Incidentally, the same applies to a lesser degree to all our teaching materials, which were planned to be continually revised.)

A great difficulty to overcome was that the language and literature teachers on the one hand and maths teachers on the other usually form somewhat distinct groups and it is not at all easy to find and convince the same person to teach according to such a hybrid textbook. In practice, two teachers enter the class and team-teach, hopefully in a concerted way. Linguistics should be comparative, in view of the synchronized study of Bulgarian, Russian, English and some programming languages. The next discipline, 'Nature', deals with the sciences. It includes topics from physics, chemistry, biology, ecology, medicine, and related areas, in a more or less unified, systematic way, according to the increasing complexity of natural phenomena.

Broadly speaking, the third discipline, 'Society', represents the humanities, but it is in fact a history of civilization. The backbone of this discipline is history, the main emphasis is on the development of human society, its productive forces, the history of social formations and relations, the history of ideas, and especially the history of arts. 'Society' has as its objective the development of an open-minded citizen, respectful of other civilizations and cultures, and ready to live in a peaceful pluralistic world. Some other features are also characteristic of the junior secondary cycle. First of all, a computer-oriented approach is being attempted in all disciplines, but initially in 'Language and mathematics' and in 'Nature'. While in the primary cycle the only information technology equipment used is calculators, in the secondary cycle personal microcomputers are playing a more and more substantial role. Although we are at the beginning of such an approach, three textbooks on LOGO are already in use in the junior secondary cycle.

In addition to the three 'hard' disciplines we have discussed, several related optional activities are available. There are also two other important disciplines with their own textbooks: 'Daily life' and 'Manufacturing'. The first deals with home economics, especially cooking; the second covers simple crafts and agriculture.

To sum up, the junior secondary cycle is a closed one from a logical point of view, as well as from a chronological one. It is assumed that a subsequent cycle, on a higher level, will follow in the senior secondary cycle. The first clustering of concepts and phenomena arises in the junior cycle, elements of proofs emerge, and a first broad overview of human history adapted to this age is presented. Individual inclinations are given a first opportunity of appearing and developing.

A recent evaluation by an independent government educational laboratory has shown that the students of the RGE perform no worse than the average student, and yet have broader interests, are not afraid of school, are not intimidated and are more self-confident.

Independently of these results we are trying at the RGE to build up our own evaluation system. Objectivity should be an important characteristic of this system. Moreover, computers have been introduced in the RGE schools as a training device. Therefore it is quite natural to try using computers as an assessment tool. A stepwise approach has been devised to this end. Objective tests of multiple choice (MC) type have been chosen as an appropriate way of evaluation. Then a computer assisted testing system has been selected. This system, TEST, has been designed at the Institute of Mathematics (Bulgarian

Academy of Sciences). A very concise description of TEST follows.

From the viewpoint of the examined student, TEST may be described as follows: the student sits in front of the microcomputer, receives brief instructions (several sentences on the screen) and is offered a test, consisting of multiple-choice test items. The test item consists of a text whose answers are 3, 4 or 5, one of which is correct while the others are distractors. The answers consist of text and (optionally) colour pictures. The student is supposed to select the correct answer (answering with a digit). When no more test items are available, the results are stored in a file, which is further accessible to the examiner.

Database maintenance techniques are available to the examiner. Text and graphics are stored separately and supported in different ways. The textbase maintenance tools (text editor) represents an elementary menu and no preliminary knowledge is necessary to correct, update or delete text. The graphics base maintenance tools (graphics editor) enable the easy creation of various colour figures, which occupy minimal memory space, and are executed quickly. It is not hard to learn how to use the graphics editor. The examiner is able to require the generation of a test (using the data base) with particular characteristics – number of test items per test, subject area, global difficulty, time for test solution etc. Each test item is characterized by 'difficulty weight' and belongs to a certain subject area. Since the test items are selected within each subject area by a random generator, practically an unlimited number of distinct tests are produced if the data base is large enough. As mentioned before, the results of each examination are registered and generalized and can be printed as various reports on request.

TEST consist internally of 4 subsystems:

- ☐ text base maintenance (text editor);
- ☐ graphics base maintenance (graphics editor);
- ☐ test generation and examination;
- ☐ results processing.

A minimal hardware support is required – an Apple II (or compatible) with one diskette drive for each student to be examined.

After a 12 hour course with several RGE teachers, comprising general concepts of educational measurement, creation of MC test items and use of the TEST system (without the graphics editors), two of them volunteered to participate in our first experiment. They passed an additional 6 hours' instruction on the TEST graphics editor and were ready to start the experiment in their respective RCE schools in Sofia and Plovdiv. The main objectives were:

- ☐ to establish to what extent teachers are able to create an appropriate set of test items, using the TEST system;
- ☐ to investigate the students' reaction to a new and unusual way of examination;
- ☐ to compare examination results obtained by computer testing with results obtained by usual examination;
- ☐ to try finding out a general assessment scheme, based on computer assisted testing and appropriate results interpretation.

It should be taken into account that objective testing in Bulgaria is still applied

in very rare and special cases, particularly in schools; that although the TEST system had been financed by the Sofia district administration of education it has not been implemented in schools up until now. That's why the experiment has also stressed some initial procedures, as mentioned above.

The experiment was carried out with the material comprising LOGO and taught in the third year of the junior secondary cycle. The teachers created 106 MC test items with graphics to 44 of them.

A first test was administered to 27 students in the Plovdiv school and 19 students in the Sofia school. Each test consisted of 10 MC test items, selected out of 20 available, the particular lesson 'word processing'. Each of the students received a different test.

A second test was administered to the same groups, this time comprising the whole second semester's material. 66 MC test items were available in the TEST data base and again 10 out of them were used to be randomly selected for each student immediately before examination. A last examination was carried out with a senior secondary cycle class.

The first conclusion is that the total instruction of 18 hours proved to be sufficient for both teachers. They created by themselves the hierarchic subject area classification scheme, needed by TEST in the stage of test item selection according to subjects. Only minor corrections were necessary in order to obtain final versions of the test items created by the teachers. Surprisingly fast the two teachers got familiar with the graphics editor and programmed, without further help, the graphics images for 44 of the test items. However, it should be taken into account they are teaching mathematics and informatics.

Information concerning the students' reaction was collected by direct observation and by interviews. The computer assisted test examination was met both with great interest and frustration. It should not be forgotten that there were two new aspects – test examination (almost new) and computer examination (entirely new). The majority of the students claimed to get a concrete mark immediately after the end of the examination and calculated by the computer itself. Some of them disapproved of the impossibility of correcting an answer after having once keyed it. (TEST allows temporarily skipping a test item, but does not allow corrections.)

Two evaluation procedures were completed. By the first one the teachers were allowed to intuitively establish an evaluation scale. The second was a standard criterion referenced scheme. The first one displayed an almost full match with the previous students' marks. The second positioned the test examination results (as an average) a little bit under the previous results.

What is not yet completed is the last point of our plan as mentioned above. But there is no doubt that RGE teachers are able to produce test items, to effectively use the TEST computer assisted system, to analyse the examination results obtained. It is also clear that students are ready to accept this examination approach.

References

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