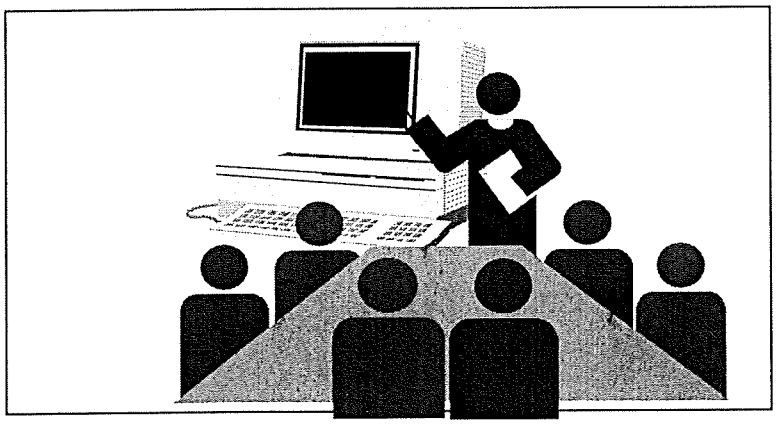
Production, delivery, updating and use		√		√
Capacity building				
- Pre-service teacher education		√		√
- Staff development		√		√
Support				
- Technical		√		√
- Pedagogical		√		√
- Media design		√		√
Technical infrastructure				
Hardware		√		√
Local-area networks		√		√
Wide-area networks (Internet)		√		√
Management				
- national level		√		√
- local level		√		√
- institutional level		√		√
Quality Assurance, Inspection		√		√
Research		√		√
Student assessment		√		√
Other, please, specify There is the development of theoretical pedagogic for informational education	√			√

Republic Tatarstan Ministry for education,
Fund " Republican Center of marketing researches,
consulting and training "

REPUBLIC TATARSTAN CONCEPT FOR EDUCATION INFORMATIZATION



Kazan — 2001

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Introduction
General Frame of Republic Tatarstan Concept for Education Informatization

There are major changes in the world community, in a life of our country, in a life of our republic. These changes are characterized first of all by the global informatization of all orbs of human activity, creation a new world economy as a new economy of a network type based on unknown earlier possibilities of telecommunication dialogue, of global information networks and etc.

In this connection there is an unprecedented role of education in postindustrial society or as it is more often named as an information society. Today education is not losing the traditional function to transfer social experience to growing up generations should execute a new function. This function is creation of postindustrial and high adaptive school. Here again the educational system should start from education informatization.

Speaking about problems of operating controls education is bound with solution of a problem of the education informatization in Republic Tatarstan, it is necessary first of all to have legible submission of this problem.

The global experience of education informatization is as particular area of professional activity; there is an appropriate Russian experience and our own experience at last. On this basis the frame of a problem of informatization is represented as following.

The Concept of education informatization of Republic Tatarstan (*further in the text is the Concept*) of republican educational orb is a core of an informatization process containing the following basic items:

1. The quintessence of the ideological unit consists, at first, in orientation of process of informatization to support of a free access to modern means of information interaction for each citizen of Republic Tatarstan; secondly in a creation the status of the substantial subject of economy of republic for the educational system of Republic Tatarstan.

2. The cognitive unit. In this block is defined, what the regional standards should be of general education information and education information at professional school of Republic Tatarstan.

3. Methodological unit. This unit is the description of principles and technologies the information environment of republican education as a departmental multilevel hierarchical system is integrated in a global information networks.

4. The educational -personnel unit has a trial function is a personnel support of the education informatization RT process. The speech goes about creation of the preparation system and the improvement system of the professional skill on three specialties: there are a modern teacher of computer science in a comprehensive school

of republic, a modern teacher of computer science and information technologies at the professional school of republic and a system manager of the departmental information system.

5. Organizational -administrative unit is deciding practical problems of informatization of republic. There are a material support, monitoring and a management of an informatization processes, the adjustment of realizable programs of the Concept and etc.

The integrated approach of the Concept stipulates the variant of programs, which are realizing the Concept. For executing primal problems on which the Concept orients activity of the educational system of Republic Tatarstan, it is necessary to create the parcel of realizable programs on various directions of pedagogical designing, system integration of the republican educational system and organizational activity. The base of these programs is following:

1. The program of organizational and material support the realization of the Concept.

2. The cognitive program of support realization of the Concept.

Now the determination of the contents of training to a computer science is the most actual problem of education informatization in a comprehensive school and contents of training to information technologies at professional school. The speech goes about a creation of a new paradigm of information education is oriented to preparation competent user of information networks and information technologies which not «would be "brought" on automatic usage of those or other software products and possessing base concepts of the theory of new information technologies and all possibilities of the intellectual interface would be realized. Apparently this is the orientation educational paradigm is interlinked with creation of the educational standards, of educational plans and educational programs of a new generation both in the plan of general information education and in the plan of training to information technologies at professional school.

3. Program of personnel support of realization of the Concept.

It is necessary to mark the separation of zones and levels of responsibility for realization programs should contain in this program as the basic corrective actions.

The frame should be arisen by means of creating the parcel programs for accomplishment of three basic processes of education informatization RT. The first process is an informatization of educational management. There are a republican level, a region level, a level of an educational institution. It will be possible to consider process of informatization as substantially controlled process only in the event if at each level of an education management the knowledge base is created and developed. The second level is informatization of educational process. The purpose of this process is the collective creation a new pedagogical technologies based on modern methods of operation with the information and creation of information comfort for training.

The third process is the informatization of a spiritual and physical training. This process requires connection of all subdividing of central means of the ministry, region and urban operating controls, chiefs of all educational establishments and effective interdepartmental cooperation.
Each of these processes should be provided with the appropriate realizable program on near-term (2001 – 2002 y.) and intermediate term (2001 - 2005 y.) perspective. In turn, in each of realizable programs will be selected the levels of responsibility for duly effective realization of the program. There is a level of responsibility of a central means of Ministry of education RT, a level of responsibility of a region (urban) operating controls by education, a level of responsibility of the chiefs of educational institutions.
At last, it is very important to understand as the Concept as a whole, and its realizable programs should be developed and introduced with allowance for Law RT is « About the state languages of Republic Tatarstan ». It is dictated first of all by condition of a free access to modern means of information interaction for each citizen of republic. Besides any of blocks of the Concept cannot be valuably embodied without the substantial account of a state bilingualism. Language is dead language, if it is not included in computer technologies, which is not language of accruing, processing and transfer of the information. The problem of introduction of tatar language in computers means problem of life for language and accordingly life of nation. It is not the fulfillment of the Law of republic. It is even not simply anyone's whimsy. For tatar language it is necessary to achieve the same situation as for English and Russian languages, when the user does not feel a problem "tatarization". And such is possible if only the manufacturers firms even before realization of computer facilities will install base programs of the tatar localization.
Such solution is attractive and rather effective also because tatar language is supported initially, before computer techniques have received by users. It will be possible when the programs of tatar localization are installed already at a factory stage, conveyor production and they are providing maximum operation on tatar and Russian languages with the text operations. Thus, the possibility of fulfillment of the Law about languages of the peoples RT will be realized by simple and effective guarantee in computer technologies.
In more detail contents of primal problems on realization of the Concept is stated in below-mentioned sections.

Section I. Ideological Unit of the Concept

Freedom of access to information resources is recognized in the world community as a major indicator of civilization in a country, and sufficient information support as one

of the three components of the integral living standard index. The experience of the developed countries shows that efficiency and social justice of informatization processes directly depend on the degree of public authorities' involvement in these processes. These are primarily the structures associated with wide layers of population by the nature of their functions performed. Especially indicative in this aspect is the experience of such countries as Japan and the USA (for example, American system of information support for the farmers – the so-called extension system).
In our context, alongside with Tatarstan Ministry for Education, such comprehensive coverage of population is only provided by Tatarstan Ministry of Public Health, State Committee of the Republic of Tatarstan on Work and Employment and State Committee of the Republic of Tatarstan for Protection of Consumers' Rights. However, these institutions have well defined functions, and total informatization unfortunately lies outside their terms of reference. At the same time, educational infrastructure today is practically a non-alternative basis for creation of the first line of the Republic's system of comprehensive information support. In fact, in current conditions in Russia it is unreal to desire, at least within the next five years, that each manufacturer, and especially each consumer, would be involved in the information exchange, with a modern PC at his disposal. However, it would be made possible if we create a Republic's information support system based on the educational infrastructure as a departmental information system (DIS) (Fig. 1).
In enduing the educational institutions with functions of sectional and base information terminals, these institutions would become active participants of economic activities in the most promising market, the market of information services. As this takes place, their educational potential is not reduced; on the contrary, this results in the integration of educational process and actual entrepreneurial and other professional activities and offers new opportunities to implement one of the leading pedagogical principles, the principle of "training through activity". Such terminals would play a role of "activation centers" for entrepreneurial initiative and thus would be the "crystallization centers" of entrepreneurial activity. This would lead to a wide field of opportunities for raising the socio-adaptive potential of the teaching and educational process.

Moreover, such technology for creating the first line of the Republic's information support system would result in emergence of new, rather voluminous labor-market niche for a fundamentally new job conventionally called "system coordinator" (system administrator of departmental information network having marketing and pedagogical background). In the extracurricular time, when a computer classroom of an educational institution, being connected to information network systems of superior levels via the workstation, is operated as a terminal of global information system, this operation in the context of personnel should be supported by a system integrator, i.e. an expert who, except for handling information flows (system administrator functions), should

be competent enough as organizer, methodologist, and adviser.

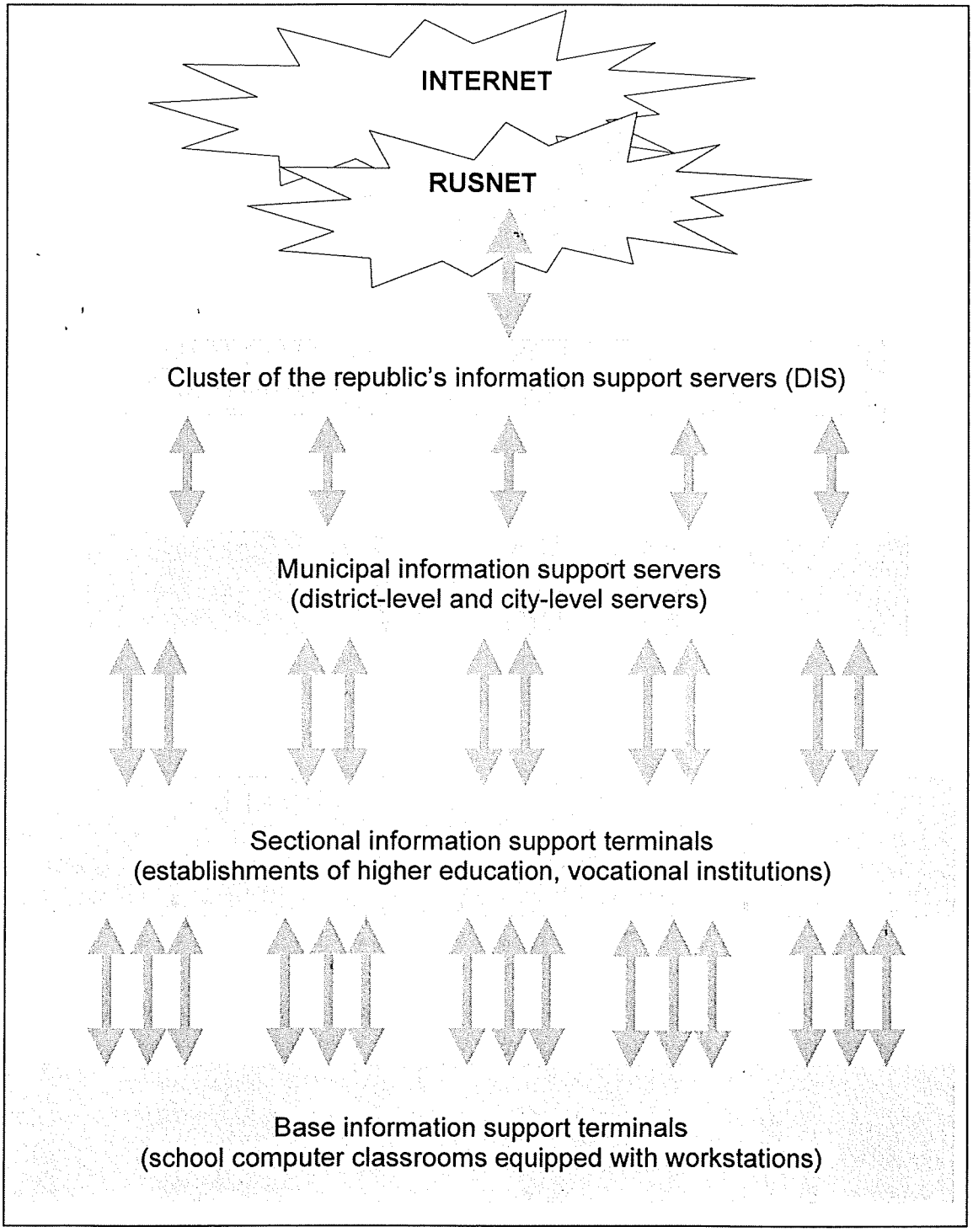

Fig. 1. Hierarchy of Information Support System

The capacity of this niche may be estimated as follows. In the Republic of Tatarstan alone (where educational system, except for the higher schools, includes some 2500 schools, 110 professional lyceums and colleges, and over 60 vocational institutions), the demand in such professionals would be 3,000 to 5,000 persons. For the entire Russian Federation (provided that the offered information system technology will be adopted throughout the Russia), the most discreet estimation is at least 150,000 persons. Furthermore, these specialists would generate around themselves a "field of professional employment" that may increase the above estimate tenfold. Taking into consideration the eventual prestige of such a profession, on the one hand, and the problem of employing ex-military men (which is a headache for all regions of the Russian Federation even now), on the other hand, one can rely, based on this alone, on positive social, psychological, and economic effects of the suggested technology. It is nevertheless obvious that irrespective of legal form under which such work of system integrators will be organized (from budget-related to private), there should be a public regulation system of this professional field formed as a subsystem of the public education management system.

Furthermore, consulting process, correctly planned and being efficiently implemented within the framework of the departmental information system, is also a multipurpose tool for public regulation in the field of (a) the use of investment resources, (b) the use of technical and technological potential of a region, and (c) state support of entrepreneurial initiative for all types of businesses (large, medium-size, and small), ensuring thereby the integrated (cluster) structure of regional economy instead of "scrappy" one.

From this standpoint, the methodology of both educational and consulting processes should equally take into consideration both pedagogical and economic aspects of the departmental information system operation. This is illustrated in the diagram in Fig. 2 (*hereinafter, "the Diagram"*). On the assumption that the suggested technology has been implemented, we shall simulate the following hypothetical situation based on a personal background, far from being most successful but being very typical.

A certain X (20-35 years of age, basic (elementary, secondary or higher) vocational education, in rather good health, potentially enterprising, but probably unaware of it, typical villager. Typical in the sense that not only does he see no socioeconomic niche for realization of his entrepreneurial initiative, but he also does not find any sufficiently comfortable niche of professional employment. Note that the category of such Xs is one of the most promising categories with respect to filling the elements 3 and 4 of the Diagram. Depending on the personal characteristics of subject X related to potential of his entrepreneurial initiative, the system referred to as DIS knowledge base in the Diagram seeks and suggests (trajectory 1 ↔ 6 ↔ 4 of the Diagram) a socioeconomic niche that may be promising for the subject X. Further, subject X

identifies his segment of consumer market in this niche in terms of the range of consumers' preferences, line of goods and/or commodity ideas corresponding to the range of consumers'

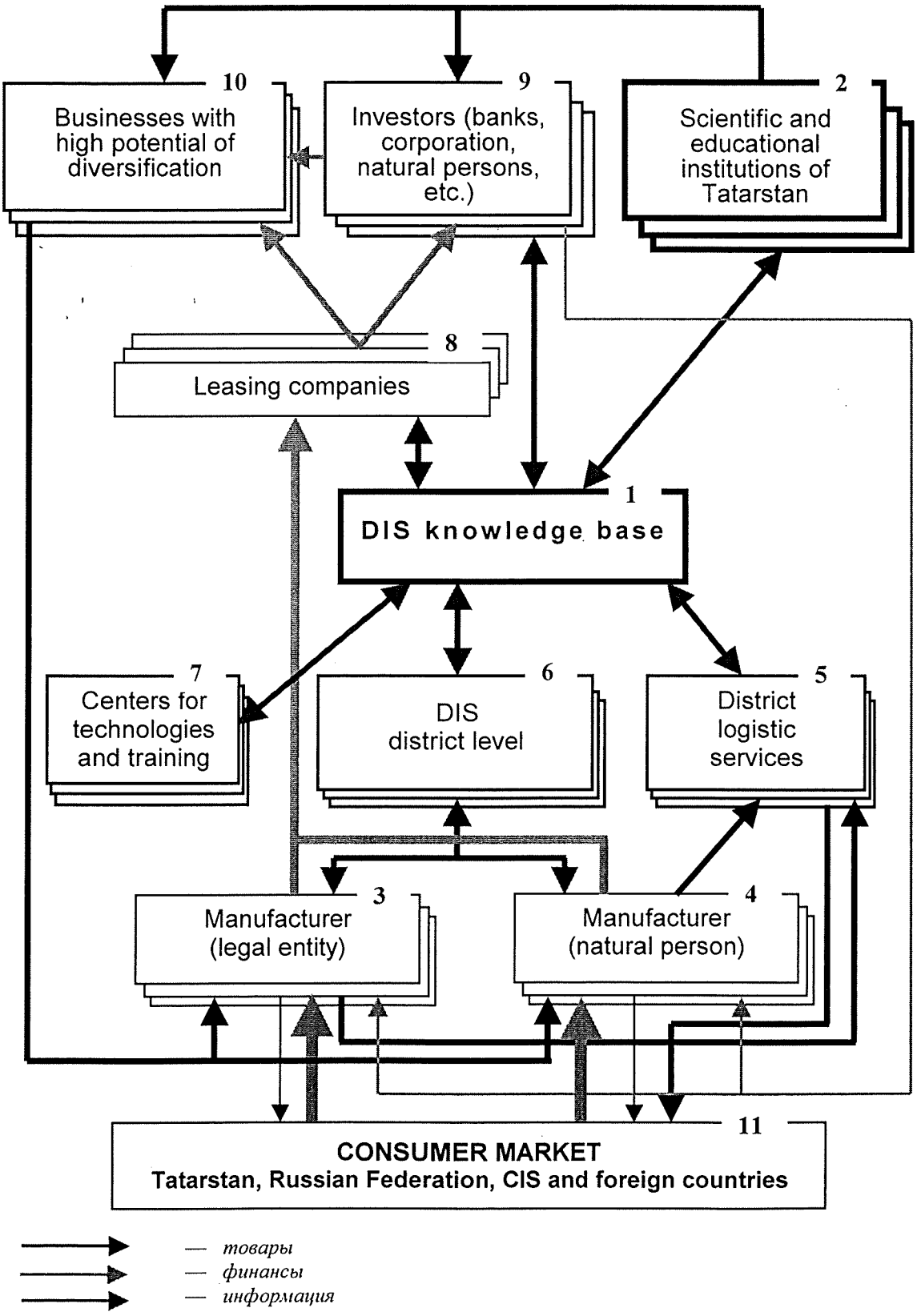

Fig. 2. Diagram of Educational and Consulting Interaction of Person and Community Within DIS

preferences, and the assumed capacity of this segment (trajectory 4 ↔ 6 ↔ 1 of the Diagram).

The next step of subject X is collection of information about production techniques in the desired niche and the holders of such techniques (trajectory 4 ↔ 6 ↔ 1 ↔ 8 of the Diagram), about the scope and location of professional knowledge necessary for mastering of these techniques (trajectory 4 ↔ 6 ↔ 1 ↔ 2 of the Diagram), about the holders of the appropriate process equipment (trajectory 4 ↔ 6 ↔ 1 ↔ 8 ↔ 10 of the Diagram), and about the logistics options and potential investors (trajectory 4 ↔ 6 ↔ 1 ↔ 9 of the Diagram).

Having received the professional retraining and possessing the information sufficient to make a business plan, subject X proceeds to pilot production taking advantage of necessary consulting support (trajectory 4 ↔ 6 ↔ 1 of the Diagram). The closing stage of this process is the entering into the desired segment of consumer market with trial consignment (trajectory 4 ↔ 5 ↔ 11 or trajectory 4 ↔ 11 of the Diagram). Successful outcome of previous (educational and productive) activity of subject X results in switchover to commercial production and targeted marketing. In other words, a transition of subject X from his initial status to the qualitatively new one, the status of professionally successful person.

While locking on individuals, initial teaching and consulting processes generate significant multiplication effect developing the economy of the region. In the above example, the demand of subject X in process equipment initiates a set of informational, investment, and production interactions between elements 2, 7, 8, 9, 10, and 11. As is well known both from the economic theory and from the experience of the economically developed countries, multiplication effect is considered one of the most serious development factors in economic scenarios.

Notwithstanding the abstract and hypothetical character of the above example, we believe it reasonable to close this section with the following conclusions:

1. Suggested methodological approach enables each citizen of the Republic of Tatarstan to exercise the right of free access to information resources.
2. Implementation of suggested technique for DIS design and implementation would provide the educational system of the republic with the status of real subject of

economy of the Republic of Tatarstan in the most promising direction, the market of information services.

Section II. Cognitive Unit of the Concept

II.1 *Traditional technology of computerized problem solving as an ideological foundation for existing curriculum of "Informatics" course.*

Development of computer aids and their wide introduction in the eventually all spheres of professional activity required respective changes in the educational paradigm. That is the reason why it was in the 1970s when the idea of compulsory computer literacy came into existence, virtually at the same time in all developed countries. Our country was not an exception in this context. Educational program titled "Informatics" was created and corresponding didactic support was developed. This program (slightly changed) is in force in the Russian Federation to present day, though the requirements imposed today on grounding in computers of the ordinary member of community having general secondary or elementary vocational education were changed essentially. To evaluate conformity of the acting program to the needs of social education, we should find out first of all, whether its ideological foundation (and this is what is called today the traditional information technology) meets the current situation of information interaction in professional and social spheres.

Traditional information technology basically represents the process of solving any problem in the human-machine system. The process of solving a problem in itself starts with initial formulation of the problem by the end user (a person using results of solving this problem). In the vast majority of cases, the problem arises in the process of task-oriented activity of the user in the field of the user's professional interests. The problem-solving process is generally reduced to the procedure of successive approximations. The initial formulation of a problem may bring results not satisfactory to the user, so the user should bring in necessary adjustments, obtain and evaluate new results, etc., until the knowledge necessary to continue the user's professional activity is obtained.

A precondition for this activity and correct problem formulation is that the user should have some professional knowledge based on which the user can analyze events occurring in the field of the user's activities, predict development of certain situations, and find necessary solutions. While possessing professional knowledge, the end user, as a rule, has no knowledge (at least such knowledge that may be of any practical help) of how to use computers for solution of desired problem. Intermediaries between the user and computer are systems analyst and programmer.

Basic scope of knowledge of a systems analyst is the knowledge of techniques for formulating various problems to be solved by means of computer. In addition, the analyst should have certain knowledge in the field of the user's professional activity to conduct a dialogue with the user, and should have an idea (even generalized) of the program-making process. During the dialogue with the user, systems analyst selects a technique adequate to the problem, determines data structure required by selected technique, and creates the scheme of solving the problem by means of computer.

Program development stage implemented either by programmer alone or in the dialogue with systems analyst takes place without participation of the end user.

A programmer should have knowledge sufficient for constructing programs implementing particular problem-solving schemes and certain knowledge of computerized problem-solving methods sufficient for the dialogue with systems analyst. Their dialogue is only aimed at development and optimization of the program. Errors, inaccuracies, and unpractical solutions made during the process of problem formulation and problem-solving scheme construction are almost impossible to reveal. Sometimes the optimization process may result in such changes in the problem-solving scheme that are not essential from the viewpoint of the systems analyst but seem intolerable to the user. After the programmer has carried out program debugging, the resulting finished product is completely "alienated" from its initiator, the end user.
The user may not be satisfied with obtained results, which necessitate making necessary corrections to its formulation, obtaining and evaluating new results, etc., until the knowledge necessary for exercising the user's professional activity is received.

However, making modifications under traditional technology require a new cycle of engaging programmers and systems analysts who have to make adjustments to the program. And this is usually a more difficult process than developing a new program. All this may require much time, especially if the programmer and analyst serve several users. Moreover, the extent to which the program can be modified is essentially bound by its tuning for specific application. The necessity of making modifications arises not only and not so much within the limits of solving a specific problem. In the majority of cases, it is a consequence of changes in industrial, economic, and other situations, changes in views of a user group during system use, and finally, it may result from misunderstanding of the end users' requirements by the producers. As a rule, applied software is build using rather independent program systems, with each system intended for solving certain class of problems. Due to obvious technical and economic reasons, these program systems are built as multipurpose systems within the

framework of problems they solve. For instance, if a program system is intended for solving problems of educational process administration (e.g., program for timetable scheduling), it should be acceptable both for typical secondary school, innovation-type schools, and for institutions of primary and secondary vocational education. To take proper account of specific application in designing a program system, adjustment (adaptation) facilities are also provided. Depending on the complexity of making the adjustments, these facilities are made user-oriented or programmer-oriented.

Upon development and presentation of the program system as a product, it is delivered to the end users. However, it does not mean that the work on the program was completed. Experience shows that any complex program system usually has faults not revealed at the debugging and testing stages. Similar faults can be introduced at any stage of the system creation. In particular, not uncommon are the cases when system design errors was due to the fact that developer either misunderstood problem formulation or specifications of the users or has not provided the system with necessary facilities to adjust it to specific application. Even more frequent are errors of technical realization manifested themselves as noncompliance of the software product to the support documentation or inoperability of the system in certain instances of its application. Correction of these and similar faults of which the developer is kept informed by the users, along with development of system functionality are called *program system support.*

If one can theoretically assume the existence of the "fault-free" program system (while this is extremely seldom the case in practice), then nevertheless it is merely impossible in most cases to foresee all subsequent changes in problem formulation and in requirements to problem solution, as they are changing during use of the system and partly as a result of its use. These changes are mainly due to natural development of application domain, conditions under which the problem is solved. This implies the necessity of continuing extension of system functionality.

Developer's work on correcting errors in a program system and extending its functionality is called *centralized system support.* In parallel, there is a constant need for local support of each user (or user organization). Main problem here is in adapting the system to the changing conditions of specific application. In doing so, the use is made of either the means of adjustment incorporated in the system or (when the means of adjustment are unhelpful) additional programs developed by supporting programmers. The support of the applied program system in traditional programming technology is thus provided during its entire life cycle.

Support process in traditional technology requires at least the same resources as

program development. The stronger is the natural tendency towards universalization of problems, the higher is the level of *support centralization*; and consequently, the farther is the end [illegible] is illustrated in Fig. 3.

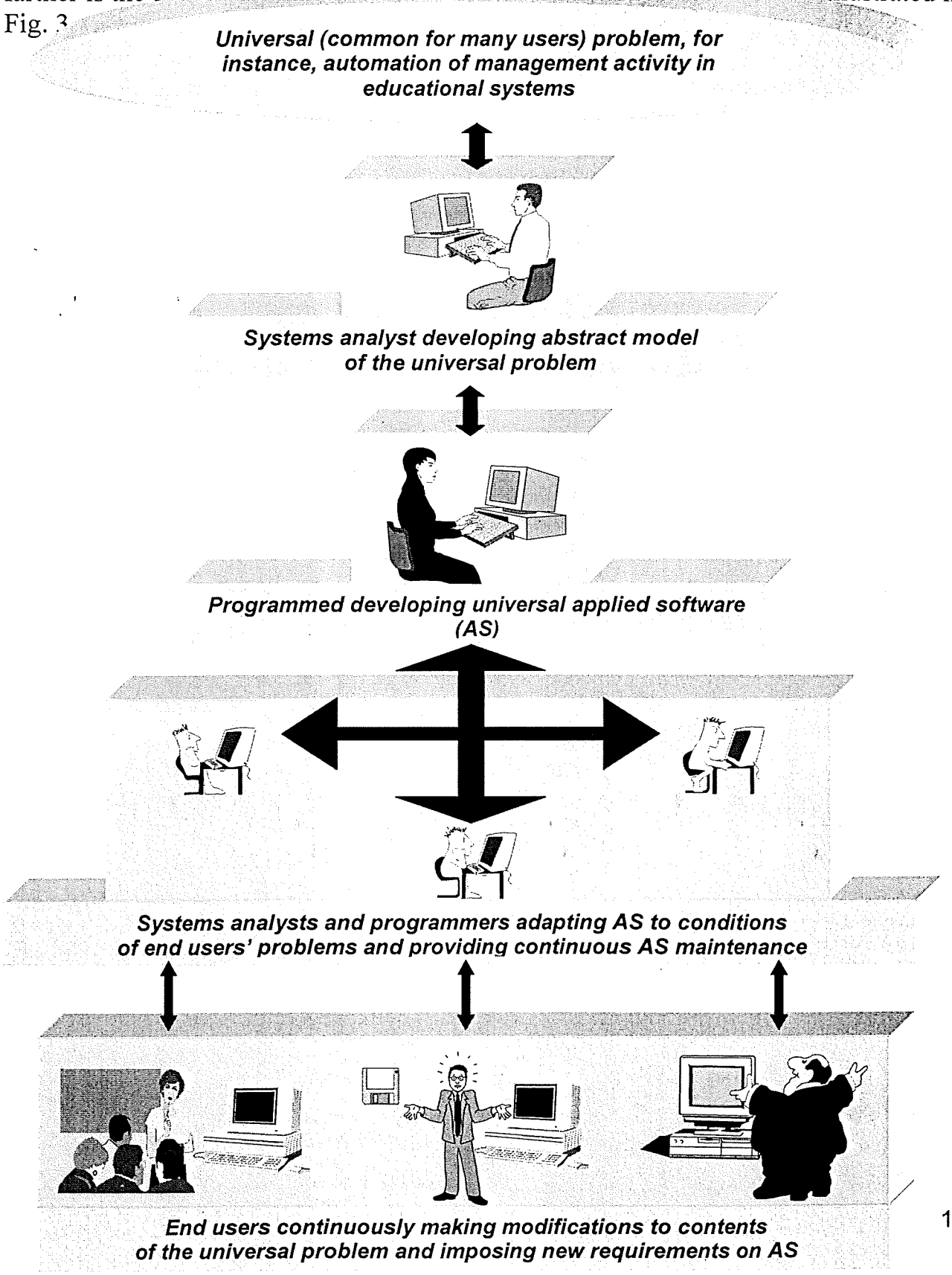

Fig.3 The structure of traditional information technology

Twenty years ago, the level of computerization in professional activity of an individual gave some reasons to hope that the distance between the end user and the initial stage of problem-solving process can be reduced, if any user would have certain level of computer literacy involving some knowledge and skills in the field of programming. This opinion has not been uncontested, but it was this standpoint that laid the ideological foundation on which the strategy of computer literacy was being built in our country. As a result, "Informatics" course focused on primary training of programmers within the framework of general secondary and primary vocational education based on programming languages that were created by the late 1970s (algorithmic language as a propaedeutical basis for formal logic thinking; BASIC, BASIC+ and those similar to them as working programming languages).

Both the syllabus of this course and its didactic and methodical support have been developed in keeping with such orientation. The same strategy has also determined curriculums for computer-science teachers in teachers' training institutions.
The basic cognitive units of the existing "Informatics" course are the following:

Introduction to evolution of computer aids;
Introduction to evolution of programming aids;
Acquisition of certain experience, knowledge and skills of programming at the level of programming aids existed in the late 1970s - early 1980s.

The advent of personal computers in the early 1980s resulted in today's PCs with dimensions allowing it to be freely placed atop a small desk, while in characteristics and functionality they largely outperform room-sized mainframes of 1960s and 1970s. In other words, computers became much more accessible for the users, and the sphere of its potential application has expanded essentially. Where the use of computers was earlier expensive and therefore ineffective, now it becomes expedient and desirable. However, since early 1980s the development of computer aids and their uses have been increasingly hampered by traditional technology of problem solving within the framework of the human-machine system. As shown above, the main reason for this is arrangement of computerized problem solving process and software life cycle existed within the framework of traditional information technology. So, what is a direction for further evolution of information technologies?

II.2 Artificial intelligence as a basis for creation of new information technologies.

Chronologically, the first stage of research in the field of *artificial intelligence* (AI) associated with development of programs solving problems on the basis of various heuristic methods dates back to mid-1950s. At that time, heuristic method of problem solving was considered as characteristic of human thinking "in general", inherent feature of which is "guesses" about ways of solving a problem followed by the check of these guesses. In the process of human intellectual activity, this corresponds to a heuristic level of the interior part of intellectual activity. This method was opposed to algorithmic method used in computers interpreted as mechanical implementation of the specified sequence of steps leading without fail to the right answer, which is analogous to the interior part of intellectual activity realized at the level of skills. Interpreting of heuristic methods in problem solving as a "human-only" activity has also resulted in emergence and propagation of the term "artificial intelligence". At about the same time, formed were research groups in the field of AI whose works rather related to formal mathematical representations. Problem solving methods in these researches were being developed based on extension of mathematical and symbolical logic, while simulation of human thinking was considered as being of secondary importance. The significance of these and other similar works resided in the fact that the focus in AI researches was shifted from development of techniques reproducing human thinking process in computers to development of computer-oriented techniques of problem solving. Due to this shift, definition of "artificial intelligence" has changed essentially. The purpose of AI-related researches came to be the development of programs capable of solving "human problems" rather than simulation of human modes of thought. One of the prominent AI researchers of that time, R. Banerjee, wrote in 1969, that area of researches conventionally termed as artificial intelligence could probably be represented as a collection of techniques and means for analysis and engineering of machines capable of fulfilling the tasks which only humans could cope with until recently, and the speed and efficiency of machines should be comparable to those of the humans.

This line of researches in artificial intelligence substantially persists to date, though even now a number of scientists, especially psychologists, are trying to assess the results of AI-related works from the standpoint of their correspondence to human thinking. Research proving grounds for development of AI techniques at the first stage were all kinds of games, puzzles, and mathematical problems. Some of these problems became classical in the literature related to artificial intelligence (problem of monkey and bananas, missionaries and man-eaters, Hanoi tower, game of Fifteen, etc.). The choice of such problems for researches was due to simplicity and clarity of the *problem environment* (application domain where certain problem should be solved), its relatively small volume, and opportunity of rather easy selection of options and even

artificial "tailoring" to suit a method. At the same time, such environments were appropriate for simulating rather complex solving processes and for investigating feasible solving strategies with relatively low human resources and computational burden. The peak of such researches dates back to the late 1960s followed by first attempts of applying these developed methods for problem solving in real, rather than artificial, problem environments. However, such attempts faced with great difficulties mainly caused by the necessity of simulating the outer world. These difficulties were associated with problems of describing the knowledge about the outer world, knowledge storage and satisfactorily efficient search, input of new knowledge and elimination of the out-of-date information (including automatic extraction of knowledge from the environment), checking the completeness and inconsistency of knowledge, etc. Even today, these problems are far from being solved completely, but as early as at that time it became increasingly obvious that their solution was a key to creation of efficient artificial intelligence systems.

The need to study artificial intelligence systems in the process of their operation in the real world has resulted in setting up a problem of creating integrated robots. Once the projects of such robots were developed, the use of the term "artificial intelligence" proved to be more justified. Instead of solving individual AI problems, investigated and implemented was necessary spectrum of "intellectual" functions, such as formation of goal-seeking behavior (analogous to creation of action plan in the psychological theory of activity), perception of information about external environment and about the changes that occur in this environment as affected by operations performed by integrated robot (analogous to operational activity of humans and analysis of this activity in the psychological theory of activity), etc.

Therefore, in order to form the goal-seeking behavior, i.e. create a program of solving a certain external problem, integrated robot should have the necessary set of knowledge about the real world where this robot is functioning. This knowledge should be incorporated in the robot in the form of the outer world model or, more precisely, the model of the problem environment, i.e. certain part of the outer world that is essential for solving the problems presented to robot. The model of problem environment for the integrated robot is a totality of interrelated data that are necessary and sufficient for solving the appropriate class of problems, including the data on possible methods of influencing the environment and on the changes that these methods cause in this environment. Knowledge system of the robot should have algorithms which enables the robot to reproduce "mental" transformations of the environment and, based on this, to build a plan of solving the next problem, along with algorithms ensuring fulfillment of this plan and making the control comparison of expected and actual results of planned operations.

The works related to creation of integrated robots may be considered as the second stage of researches in artificial intelligence. Experimental robots functioning under laboratory conditions were developed in Stanford University, Stanford Research Institute and some other institutions. The performance of these experiments has shown the necessity of solving fundamental questions related to the problem of representation of knowledge about operating environment and, at the same time, has revealed inadequate investigation of some problems such as visual perception, construction of complex behavioral models for dynamic environments, and dialogue with robots in the non-machine language.

These problems were rather clearly formulated and presented to the researchers in the mid-1970s, which marked the third stage of researches in the field of AI systems. Characteristic feature of that stage was that researchers changed over from creation of autonomously functioning systems that solve problems in the real environment independently (or under conditions of limited dialogue with human) to creation of human-machine systems integrating human intelligence and capabilities of computers into a cohesive whole to achieve the common goal, solution of a problem presented to the integral human-machine solving system. Such changeover was caused by two reasons:
It has been found by that time, that even the problems seeming simple at first glance which an integrated robot faces in the process of its operation in the real world (for example, motion across rough terrain, pattern recognition against composite background with natural lighting, organization of complex behavior, etc.) cannot be solved using the methods developed for experimental problems in the specially created problem environments;

It became obvious that combination of complementary man-machine capabilities made it possible to avoid bottlenecks by shifting onto humans' shoulders the functions that was as yet beyond the reach of computers. Computer system, for its part, is able to process large volume of information, repeatedly review various ways of solution proposed by man, and provide the man with every possible reference information.

Development of isolated methods of machine problem solving was giving way to development of the methods and aids which would ensure close interaction of man and computer system during the entire problem-solving process while enabling the man to introduce corrections during the process.

This trend of AI researches was also due to the drastic increase in production of computer aids and the great drop in their prices making them potentially available for

much wider circle of users. However, this availability actually remained potential for the majority of users, since it required mastering the large amounts of special knowledge in the use of computers.

All this taken together contributed to the current situation that intellectualization of computers is now considered to mean basically the development of their capabilities towards ensuring problem solving jointly with the user, simplifying human-machine dialogue in the solving process, and continuously increasing the computer's contribution to the joint man-machine problem-solving activity. Thus, the evolution of information technologies is vectored towards changeover from two-component "human – PC" system to the three-component one, "human – AI – PC".
So, how the above changeover was realized?

II.3 Requirements to the contents of "Informatics" course imposed by new information technology.

This was made by means of engaging the users to the problem-solving processes and program system support. To do this, radical changes were required, first, in the application software organizational principles existed within the framework of traditional technology, and second, in the process of users' preparation to work under conditions of new information technology.

As far as the first problem is concerned, the today's program systems are constructed in such a way as to simplify essentially the processes of their operation and support. The nature of user's difficulties when interacting with computer in traditional technology is determined by the fact that the program system is usually based on the formal problem-solving model. As a rule, the set of concepts and terms used to formulate and describe the problem for program application is minimal and is associated with mathematical model rather than with specific field of application. As shown above, this situation results from the tendency towards universalization of program systems, i.e. towards possibility of wide extension of each such system to cover various application domains. At the same time, each application domain is characterized by the system of concepts operated by the user in solving a problem. Thus, in traditional technology, the system of concepts in application domain and that in the formal model taken as a basis of the program, do not generally coincide. This difference is the main reason of difficulties occurring in interaction of the user with computer during problem-solving process. To use a program, the user should convert the problem formulation expressed in the terms of application domain to the formulation expressed in the terms of formal model. The conversion from one system of concepts to the other is termed *interpretation*. When the results of problem solution have been obtained, the

user should also make reverse interpretation.
Interpretation process is associated with a number of difficulties depending on the capacity, complexity, and versatility of the program system. The techniques of solving the interpretation problem within the framework of traditional technology can be divided arbitrarily into two groups: particular and systematic.

Particular techniques improve the process of user-computer interaction in specific aspects only. Examples of these are efficient methods of program systems documenting, various user help systems, etc.

The main principle of *systematic techniques* for simplification of interaction process is to ensure the interaction of the user and developers based on the system of application domain concepts.

In traditional technology, systematic techniques are primarily supported by the use of various dialogue systems with menu architecture. These systems are widespread and progressing rapidly during the last fifteen years. However, they all have one inherent disadvantage, that is, the necessity of regular program support for each end user. Such necessity is due to the continuous change in parameters of the problems being solved using this program, which resulted in the inadequacy of menu structure to new situation.

The objective of the new information technology is to ensure the simple process of user-computer interaction based on eliminating the necessity of regular support. The main idea of the new information technology is to consider the system of application domain concepts and the correspondence between this system and the system of formal model concepts as certain source information for systems analysts and, later, developers.

Ideally, this approach should provide the user with the opportunity to change the system of application domain concepts and define new concepts in terms of concepts "familiar" to the system. Even today, the user has an opportunity to formulate his vision of the application domain, to select objects and interrelations that are essential to solve a problem and convenient for reasoning in the process of solution. This results in the intellectual interface, a system of software and hardware enabling end user without special training in the field of computer science to solve problems in the field of its professional activity with the aid of computer, either without mediation of programmers or with their little help.

Intellectual interface functioning is based on the advanced methods of handling

knowledge: its representation, storage, transformation, etc. Here, the term *knowledge* is used in reference to the totality of information necessary to solve a problem. Indispensable part in this collection is the following information:

System of concepts of the application domain where the problems are solved;
System of concepts of formal models based on which the problems are solved;
Correspondence of the above systems of concepts;
Current status of application domain;
Problem-solving techniques.

In this case, the system of knowledge is *integral* and is structured in computer in such a way as to ensure interaction of the intellectual interface with the user in the system of concepts and terms of application domain. Under new technology, coordinated forms of representing all kinds of information exchanged by the user and intellectual interface are provided, depending on the type of problem solved.

It means that support tools of new technology provide representation of information in the user-friendly form – texts in natural language, hand-drafted images (including tables, graphs, and hand-written characters), voice messages, various mathematical expressions, and other representations in the user's professional dialects. Under new information technology, the end user has to spend much less time on training. Training is basically reduced to three things: getting the general idea of the structure and functions of the intellectual interface, learning how to work with its hardware: "how to know", "what to push", "where to say", "where to look", and familiarizing with system functionalities. As this takes place, the user gets help from the system as may be required to overcome emerging difficulties.

For the end user regularly employing computer in his activity, wider system of training should be developed, i.e. new information technology should also support the principle "the more you know, the more you can get".

The main requirement to the human-machine system determining new information technology of computerized problem solving and generalizing other requirements is transformation of the computer, by means of intellectual interface, to a friendly partner of the end user in solving problems arising in the course of his professional activity. User friendliness of the software product is generally more important than computer capability.

Intellectual interface ensuring direct interaction in problem solving between the end user and the computer in the structure of combined human-machine information

system performs four groups of functions:

Enabling the user to formulate a problem for the computer by specifying only the problem conditions and not specifying the solution program;
Enabling the user to form the problem solving operational environment by himself using solely the terms and concepts from the field of the user's professional activity;
Providing the user with the user-natural forms of information representation for exchange with information system in the problem-solving process, and choosing the user-acceptable dialogue techniques during this exchange;
Ensuring the opportunity of changing dialogue structure at user's option; in doing so, the range of feasible changes should include menu-type dialogue, various questionnaire forms, and exchange of arbitrary (i.e., not previously specified) messages.

Content analysis of the above-described main points of new information technology allows formulating requirements to the computer-science course for comprehensive and elementary vocational schools:

Firstly, computer-science education curriculum needs differentiation: there should be a course for pre-professional training of programmers focused upon a small percent of highly gifted students, and a program for mass training of qualified users.

Secondly, the user's competence should be ensured with the following cognitive units in the program:
Introduction to evolution of computer aids;
Introduction to evolution of programming aids;
Formation of certain knowledge in the field of psychological theory of subject activity;
Introduction to evolution of the artificial intelligence theory and practice;
Formation of certain knowledge in the field of information technologies, both traditional ones and those based on the use of artificial intelligence;
Formation of certain knowledge and skills in the field of formal logic;
Formation of certain knowledge and skills in the use of software products created under new information technology.

The above list shows that in today's conditions the general computer-science education should not be built by means of educational mono-discipline, but it should be based on the integrated general education cycle, including:

Course in formal logic aimed at formation of necessary dynamic stereotypes of intellectual activity based, in turn, on the use of predicate calculation techniques (2nd to

9th grades);
Two-level programming course. The first level (2nd to 9th grades) is a basic course in programming aimed at formation of algorithmic thinking and necessary knowledge and skills in the field of programming. The second level (9th to 11th grades) is a programmers' pre-professional training course aimed at small percent of highly gifted students;
Two-level course of qualified users' mass training. The first level (2nd to 9th grades) is a basic course to train qualified users intended to prepare a student for unassisted work with intellectual interface. The second level (9th to 11th grades) is a course for pre-professional training of qualified users majoring in:

The humanities and economics;
Natural sciences (physics, chemistry, and biology);
Mathematics.

Conclusion:
Top-priority directions for reforming general computer-science education in the Republic of Tatarstan should be formulated as follows:
Development of the set of educational programs in the courses of formal logic, programming, and qualified users' preparation divided into following levels: primary (2nd to 4th grades); secondary (5th to 9th grades); and senior (9th to 11th grades and institutions of primary and secondary vocational education);
Development of didactic support for the said educational programs;
Development of methodical support for the said educational programs;
Testing of the said educational programs and their didactic and methodical support by means of representative pedagogical experiment.

Section III. Methodological Unit of the Concept

One of the most essential aspects in implementing the Concept is the methodological justification of the chosen technique for DIS designing. There are two main questions to be solved. Firstly, what should be the DIS structure to ensure the up-to-date information exchange? Secondly, to what software should we orient ourselves so that DIS-based information systems could smoothly be integrated into global information networks?

The information system meeting requirements of the new information technology is comprised of three sets of tools joined as presented in Fig. 4.
Set 1 is a totality of tools (support system) running programs and designed for efficient solution of problems.

Set 2 is a totality of intellectual interface tools with flexible structure that provides adaptation to a wide range of the end users' interests.
Set 3 is a knowledge base assisted to interaction of the first two sets.
Let us consider each of these sets.

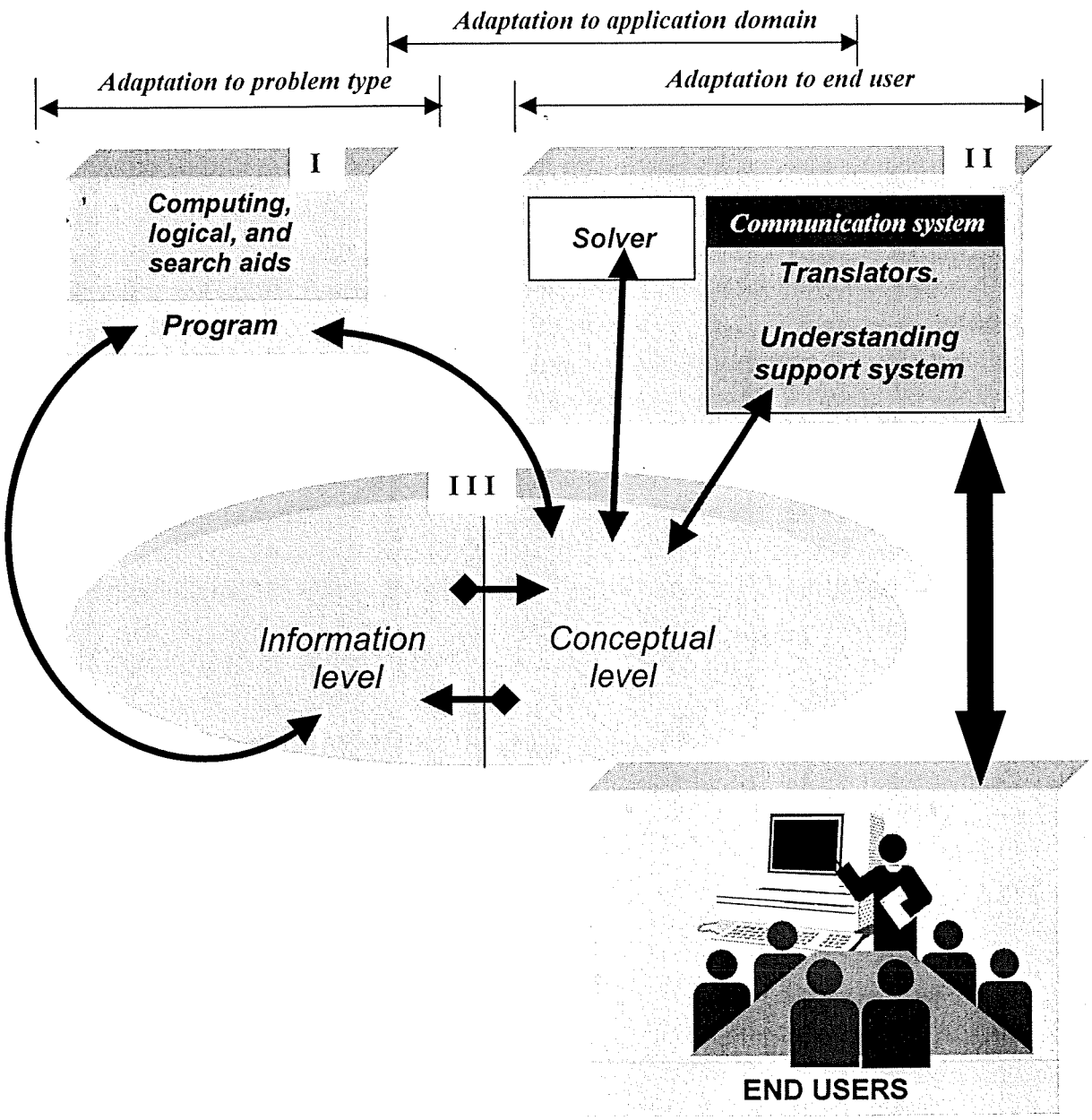

Fig.4 Structure of computing system in new information technology

Support system (SS) unites the totality of tools intended for execution of the formulated program. Among these are programs performing any computations, programs of information retrieval in knowledge bases, inference engines, and the entire set of hardware supporting these programs.

For SS tools, use can be made of both the tools either available to date or to be developed in the near future and special tools which should be created from the standpoint of from their use under new technology of computerized information processing.

Knowledge base (KB) is central in relation to other components of the information system as a whole; all tools participating in problem solving interact through KB.

Translators make translations from any languages of dialogue between the user and the system into the *knowledge representation language* (KRL) of KB.

KB contains knowledge system (KS) and techniques for working with this knowledge. *Knowledge system* is the knowledge about the problem environment as a part of the objective world; it reflects the environment as an integral phenomenon with all interrelations that exist between its components and time history of these elements. The system should feature entirety, i.e. it should contain all knowledge necessary to solve the classes of problems, for which the information system is designed. In the broad sense, formation of such system of knowledge is also a part of a problem-solving process; i.e. the knowledge to be incorporated into this system should be selected purposefully. When forming the system of knowledge, a foundation for solution of a certain set (class) of problems is created, and its use in each specific case provides solution of an individual problem.

There are two groups of requirements to representation and structuring of knowledge in KB. The first group of requirements is common both in traditional and in new technology of computerized information processing. Among these are ensuring necessary expressiveness of representation language for the entire range of problems being solved, ensuring necessary efficiency when solving these problems, and ensuring versatility and openness of the selected knowledge representation system combined with its ability to be adapted to various application domains.

The second group of requirements basically refers to use of the new information technology. These requirements include necessity of adequate and exact mapping of the problem environment in the knowledge base and necessity of creating a method for humanly natural environment description. Adequacy here is taken to mean the

potential of constructing the mapping that would ensure simulation of any processes occurring in the problem environment. The necessity of a humanly natural method of environment description arises from the close contact of the end user and computer during problem solving. It means that knowledge representation language in KB should have the structure close to that of a user's natural language (which does not imply similarity of their grammars).

Under new technology of information processing, knowledge base extends and develops functions performed by database under traditional technology while inheriting its basic properties – independence of data from processing programs and integrity. Here, database is considered as a particular case of KB.

Requirements imposed on knowledge structuring in KB should meet the following criterion: evolution of databases into knowledge bases is a process of continuously increasing independence of knowledge contained in the bases from processing programs (that includes independence of their integration into the problem environment!) and their integrity. This gradually transforms a database into the complete (in relation to the class of problems being solved), integral, and independent model of the problem environment, i.e. knowledge base.

Knowledge base for computing systems that are intended for new technology of information processing is built as a two-level structure comprised of two components: *conceptual knowledge base* (right, conceptual level) and *database* (left, information level or factual level). Conceptual knowledge base contains information on the structure of application domain and basic relations between concepts in the domain.

The use of database as an integral component of the knowledge base allows using up-to-date *database management systems* (DBMS) for description of interrelations between objects in the problem environment at the level of particular facts. It is these interrelations that, as a rule, make the bulk of data about the environment and are searched during problem solving process. The freeing of conceptual level from such facts allows using a generic description of the environment irrespective of its specific status. Moreover, isolation of the conceptual level ensures the representation of *metaknowledge*, i.e. the knowledge about the knowledge base structure and techniques of manipulating knowledge stored in it; in other words, the knowledge of the system about itself.

At each level of KB, knowledge representation is performed through the mediation of certain knowledge representation language. *Knowledge representation language* (KRL) is understood as a specific method of describing the problem environment

specified by syntax of the description, rules of correlation of language expressions with mapped objects of the problem environment, and specific word structure of the language.

Each programming language is a knowledge representation language. However, traditional programming languages were basically constructed as "process-oriented" languages. Their structure was intended for construction of complex programs and efficient execution of these programs. The data in such languages appeared as certain environment of the program playing a somewhat supporting role. While rather advanced knowledge representation systems, generally speaking, could be built based on such languages, implementation of this would be too sophisticated and laborious, and the overall performance of such systems would be low. As the proverb says in such cases, it not worth powder and shot. For this reason, developed were special languages intended for data and structural interrelations between them. Such languages were termed *logic programming languages* (Lisp, Prolog, etc.).

Intellectual interface includes all user-level tools maintaining interaction between the end user and the information system during the problem-solving process. Intellectual interface can be divided into *solver*, a totality of tools that provide automatic creation of a problem-solving program in the dialogue with the user, and *communication system*, a totality of translators making translations from the user language into the knowledge representation language in KB and vice versa. Let us consider how it happens.

In automatic creation of the problem-solving program, input information is a request to obtain some knowledge and, if needed, reporting of some additional information associated with this problem (or this request). Based on the knowledge contained in KB regarding the capabilities of various programs (subtasks which they intend to solve and knowledge required for this solution), solver forms a sequence of these programs which makes it possible to obtain the required solution based on the source data inputted to the information system.

Thus, *solver* is a component in the information system that, strictly speaking, solves a problem, i.e. analyze its conditions, select subtasks having standard solutions, and combine these solutions into the integral program. System incorporating the solver can be operated either in the compilation mode or in the interpretation mode. In the second case, the solver solves a problem so to speak "stage-by-stage", by taking into account the results of the previous stage at every step.

Other function that is provided by intellectual interface is *communication* between the

end user and the information system using the humanly natural forms of information representation (texts, images, and speech) and any combinations of these forms. Depending on the functions performed, communication facilities can be subdivided into two groups: *translation facilities* and *understanding support facilities*.

In the dialogue process, translation facilities perform translation from the user's language into the knowledge representation language of the information system and vice versa – from the knowledge representation language into the user's language. In doing so, they should meet the following requirements:

a) Operability under conditions of distortions, interference, and various user errors, having in mind that these facilities are intended for an ordinary user with minimum of training;
b) Adaptability, since they was developed for a narrow group of users;
c) Openness, because it is impossible to predict all changing interests of users during the design life of these facilities;
d) Independence from incorporation into different configurations of specific information systems.

Understanding support facilities, in their essence, are multipurpose and independent both of the dialogue language and of the problem environment. The set of these facilities should provide the reliable and unambiguously understood dialogue between any parts of the human-machine system.

When considering the structure of the information system meeting the requirements of new information technology, it becomes evident, how important is the concept of database. The importance of this concept is determined by the following. To be implemented in a computer, a method of knowledge representation should be formal. In other words, it should be described by a finite set of sharply defined rules. It is well known from the logic theory, that any such formal method is bounded by the knowledge representation abilities (i.e. by expressiveness). It means that for any method of knowledge representation one can indicate (or construct artificially) an application domain and a knowledge about it that cannot be represented. An exit from this deadlock is that at the same time for any specific application domain and a set of applied problems solved in it, one can construct a formal method, which enables representation of all necessary knowledge. The expressiveness of the up-to-date methods of knowledge representation is determined by the complexity of applied problems being solved nowadays. One of the most important directions to develop these methods – increasing their expressiveness – is associated with practical needs of solving increasingly complex problems.

How the diverse knowledge about an application domain can be formally represented?

Knowledge representation is expressing in a certain formal language, termed the knowledge representation language, the properties of various objects and regularities that are important for the solution of applied problems and organization of interaction between the user and the computer. It may be the objects and regularities in application domain, computing environment, etc. The fact that language, on which the knowledge is recorded, is formal ensures the unambiguous interpretation of the recorded information. In just the same way, for example, the formal language of designer drawings ensures identity of structures built on the basis of the same drawing by different persons.

The totality of knowledge stored in the information system and required for solution of the set of applied problems is termed the system of knowledge. The information on what knowledge is contained in the system may be required by the user (and he should have an opportunity of acquiring it), but organized knowledge is primarily necessary for the information system to maintain the process of interaction with the user and to solve the required problems. In other words, knowledge ensures operation of the system.

Information system employs the system of knowledge by carrying out various actions (operations) with it, such as search of required information, its updating, interpretation of knowledge, deriving new knowledge from the existing one, etc. Algorithms to perform these operations essentially depend on the features of knowledge representation language and on how the system of knowledge is represented in the information system. Accordingly, KRL should allow for both formal recording of necessary knowledge and manipulating with these records. In this context, for any knowledge representation method, certain basic operations (*primitives*) are naturally selected to form the more complicated procedures if necessary.

The conceptions of database and database management system (DBMS) made their appearance and were given development in early 1960s in connection with the idea of data centralization in *data processing systems* (DPS).

The main idea of "*database*" concept is that, being a data set both logically and physically (on the data carriers), the base is inseparable from the tools (as a rule, software tools) performing generation and support of the database, and extraction of data requested by application programs. Once implemented, the set of such tools called database management system (DBMS) makes it possible to generate and maintain

databases for various data domains differed in contents and filling. Thus, DBMS is a multipurpose tool of centralized data organization in the data processing system (DPS). A database can be defined as a centralized data collection in DPS supported by any DBMS.

The main advantages of the centralized data organization principle are associated with opportunity of relatively independent development of databases and application programs termed *data independence*. Data independence is extremely important for DPS, since it ensures stability of DPS in relation to its development. Any intensively used data processing system is developing dynamically: new applied problems to be solved by this system come into being, views on the problems being solved are changed, etc. When data independence in DPS is not ensured, DPS applications are directly linked to processed data, and any changes in data structure and organization induced by the needs of development necessitate reworking of corresponding programs. Thus, the progress of DPS where data independence is not ensured is practically resulted in almost total reworking of DPS at each stage.

There exists a common mechanism of ensuring data independence realizable for any DBMS as diagrammatically presented in Fig. 5.

The main idea of this mechanism is as follows. For provision of data search functions, specialized software is selected, which is independent of specific data structure, certain problem chosen for solution, and type of retrieval requests sent by any user program. Organization of data being accessed is described with the level of refinement that is required to maintain search functions. The description of data organization is stored separately from the data itself and from specialized search tools and user programs. To serve a retrieval request, user program queries specialized data search tools. The request is processed by an interpreter identifying data items indicated in *search criterion* (conditions of retrieval). Data description interpreter helps identify retrieval procedures that should be activated to find the data matching search criterion. Selected procedures are executed, and the results of their operation (data matching the request) are returned to the user program. This description is a simplified sketch of the mechanism of ensuring data independence. Some of the data search software components described above can actually be absent in a specific DBMS and corresponding functions can be combined in one component, or conversely, they can be distributed among much more components than indicated above.

Nevertheless, this diagram is useful for understanding of the main elements comprising DBMS when they are considered as the tools for ensuring data independence. Main components of this system are separately stored *description of*

data organization and independent specialized *data search software*. The above-represented structure of search tools shows how the description of data organization is used to conduct search.

Different systems employ different methods to specify the retrieval request from user program to DBMS. A common approach is the use of special language aids called *data language* (DL). Though DL, as a rule, is not a programming language in the strict sense of this term, it is used in programming and is characterized by unambiguous interpretation of its language constructions.

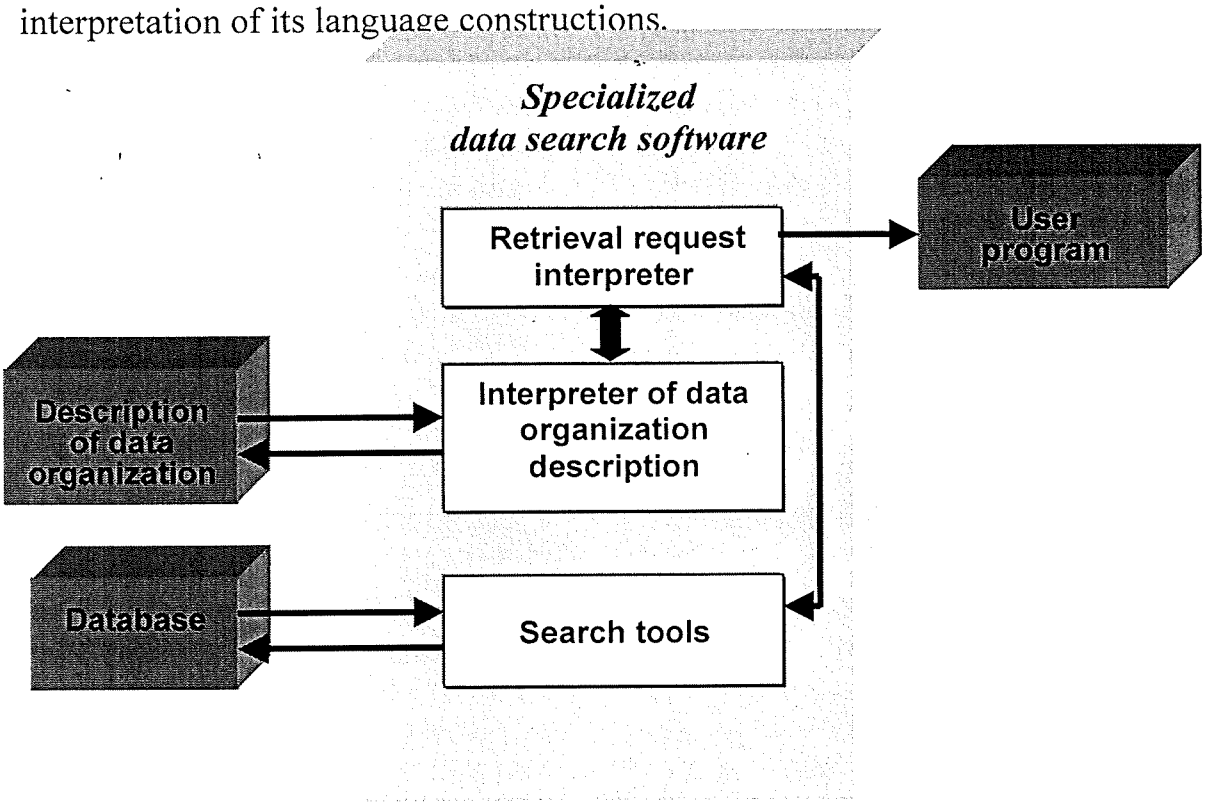

Fig. 5. Structure of data search tools

Data language specifies rules for definition of search criterion and identification of data items, values of which should be obtained as a result of search. In case when a retrieval request can not be satisfied with one DL sentence because of DL limitations or for any other reason, it should be known how to realize this request in the user program. It can be made using several DL sentences and, probably, certain program fragments receiving intermediate data from previous sentences and performing their analysis, processing, and transfer to the next sentences.

Therefore, any DL suggests certain data structuring. It should be strictly defined, in what data sets the search initiated by a particular DL sentence should be made, what

data collections results from the search, and what data items can be specified in the formulation of search criterion. Such definition actually describes a method of logical data structuring, closely coupled with specific DL and DBMS that realize it.

The method of logical data structuring is independent of application domain, for which it is used. In relation to the data taken from any area, it specifies the rules, according to which these data can be (and should be) organized. At the same time, a particular data structure meeting certain method of logical data structuring is closely coupled to application domain, to which these data are related. In creating a database, logical structure is specified in the DBMS data language to form a basis for description of data organization used by the system when solving the query from application programs. Thus, any data language has the means for description of logical data structure (*data definition facilities*) and means for description of actions that should be performed with these data (*data manipulation facilities*).

The combination of technique for logical data structuring and functionalities of data manipulation, i.e. specific features of DL without regard for its syntax, is termed *data model.*

There is a direct analogy between the concept of data model used in database technology and the concept of knowledge representation method in the field of artificial intelligence.

Thus, description of data organization and data stored in the base is a formal record of knowledge jointly forming certain system. The method of logical data structuring corresponds to a set of formal knowledge-recording rules, and functionalities of data manipulation correspond to knowledge manipulation primitives. Traditionally, there are two groups of knowledge representation methods: declarative and procedural.

In declarative methods, knowledge (after its transformation from KRL sentences into machine representation) is data structured in one way or another. Interpretation of structures and performance of operations on these structures is a function of software supporting the method. These facilities are independent of a specific knowledge system and are completely defined by KRL syntax and semantics.

In procedural methods, knowledge is also represented in the computer as data structures, but elements of structures have linked (associated) with them the executive functions – the procedures. In fact, knowledge base in procedural methods represents a totality of data structures and associated procedures developed by knowledge base designer in a particular programming language. Here, the basic operations on the

knowledge system, as a rule, are easier than in declarative methods, but the results of these operations are not completely determined by the software implementing the method. For this reason, purely procedural methods of knowledge representation are little used, though some elements of procedural approach are successfully employed in declarative methods.

The group of declarative knowledge representation methods is divided into logical methods and those based on the apparatus of semantic networks.

The main idea of the logical approach is to consider the entire knowledge system that is necessary for solving applied problems and for organizing user-computer interaction as a collection of facts (statements).

The facts are represented as logical formulas, and knowledge system is a collection of such formulas. When represented in the information system, knowledge system forms the knowledge base. The formulas are indivisible, and can only be added or deleted when the knowledge base is updated.

Logical methods provide the advanced apparatus for inference of new facts from those explicitly represented in the knowledge base. The basic primitive of knowledge manipulation is the inference operation. This dictates the intensive use of logical methods when creating expert systems and problem solvers. Other application of this apparatus, being important for any intellectual systems, is ability to control the logical integrity of the knowledge base, i.e. its consistency and compliance with certain predetermined rules (integrity constraints).

Logical methods of knowledge representation ensure simple and clear facts-recording system having well-defined semantics. Each fact is represented in the knowledge base only once, irrespective of its future use. Knowledge base developed with the use of logical methods is generally rather comprehensible.

Major drawback of logical methods is that they lack well-defined principles of organizing facts in the knowledge base. When these principles are not identified and continuously implemented, large model turns into a poorly observable conglomerate of independent facts that are difficult to analyze and handle. This drawback seems to be one of the reasons that, until early 1980s, logical methods were mainly used in the fields where knowledge systems are small in volume and rather simple in structure.

The main idea of knowledge representation approach based on the apparatus of semantic networks is to consider the problem environment as a totality of objects

(entities) and connections (relations) between them.

The entities are represented as named vertexes, and relations are represented as named directed edges. The knowledge system is thus mapped by a semantic network, i.e. a directed graph that is composed of named vertexes and edges, or a set of such networks. The names given to vertexes and edges usually coincide with the names of corresponding entities and relations used in natural language. An edge and the vertexes linked by it form a section graph of the semantic network bearing minimum of information from the standpoint of the knowledge systems – a mere fact that certain type of association is available between corresponding objects. More complicated section graphs of semantic network relate to more complicated facts. In the design of information systems (knowledge bases, in particular), use is made both of logical methods and methods based on semantic networks, and for different information systems entirely different knowledge representation languages and specific programming languages may be applied. The integration of such systems is facing a problem of software compatibility, which now became of global importance with the advent of World Wide Web where to the DIS should be integrated.

Web is not a certain static system with "stable rules of play". It is exposed to strong external processes, largely stimulated by its very presence and associated with a new tendency in development of information systems that is progressing rapidly in recent years – with integration of database technologies, text (documentary) systems, Java technologies, Web technologies, and COBRA technology of multivendor distributed object environments, based on different approaches. The reasons of this tendency are in endeavor both to extend functionalities of currently created large systems and to integrate (including integration at the semantic level) heterogeneous information resources created and supported by means of different technologies.

Changes occurring nowadays in Web have impact on rather wide range of information systems and necessitate development of bridgeware to provide compatibility of all currently existed Web standards. In this context, the language termed XML seems to be most promising.

The discussion of XML capabilities and prospects for its use is obviously important, since this language, together with W3C set of standards forming its infrastructure, already became the “de facto standard”. Moreover, the range of its application is increasingly expanding beyond pure Web technologies to some adjacent areas of information technologies depended on Web as an environment that grants remote access to very different kind of resources and ensure information exchange between systems based on other technologies.

In parallel with creation of this language standard, World Wide Web Consortium forming technological policy of Web evolution and making standardized specifications for this environment is actually creating a new, XML-based, platform. The functionality of this platform is determined by the entire set of interrelated standards, of which one part is adopted by W3C, while the other are in the development stage.

With rare exception, developers consider other standards of XML platform as XML applications, mainly because their specifications use XML syntax. However, almost equally important is the fact that new capabilities of these standards are made possible through specialization of meaning and functionality of some XML syntactical components. In other words, XML specifications and some other standards of the platform have a number of "open points" ensuring the natural way of extending XML functionalities in various aspects. Specification of some of these extensions is defined by a number of XML platform standards.

Schematically, the following approach is used. Main "open point of language" is described by the fact that XML is a metalanguage as was its predecessor SGML. In contrast to HTML, its specification fixes neither functional specialization of elements in XML documents nor their attributes, nor semantics of attribute values. It is specialization of functionality and syntax of elements in XML documents that makes it possible to extend XML functionality. Second "open point" in XML is an opportunity to use the so-called namespaces, predefined denominate sets of names used as names of element types and element attributes in XML documents. Namespace determination also makes it possible to associate, explicitly or implicitly, attribute names with sets of legitimate values of these attributes. It is thus assumed that certain semantics, defined by default or explicitly, corresponds to each name that belongs to this namespace, as well as it corresponds to values of attributes. In so assuming, the method for definition of semantics is not fixed al all in the Namespaces in XML. These definitions may be based on other standards or methods required for any specific application.

The standards of XML platform extending functionality of the language are constructed in accordance with this very principle: a namespace with reserved name is introduced to define names of the special types of elements in XML documents and their attributes. Semantics of these elements and their attributes, and syntactic agreements are defined in the specifications of these additional standards. The names belonging to this space are considered generally accepted.

An example of employing the above mechanism of XML extension is the XLink standard that allows special kind of reference elements to be used in the XML

documents to make various hyperlinks between XML documents.

Conclusions:

1. DIS should be structured as an information system where central part is the knowledge base.
2. The knowledge base for DIS is created as a two-level structure incorporating two components: the conceptual knowledge base (conceptual level) and database (informational or factual level) where the conceptual part contains all necessary information on the structure of application domain and basic relations between its concepts.
3. The most promising directions of DIS software development are XML language and standards of XML platform.

Section IV. Educational and Personnel Unit of the Concept

Let us begin with several facts. In 1999, losses in Russia incurred due to "cracking" of various computer systems and information network systems totaled 34 billion Rubles, while in the USA they exceeded US$ 100 billion. Book sections of flea markets are creamed with "educational" literature under the titles "How to write a computer virus", "How to become a hacker", "How to crack a program", etc. This list may be continued endlessly. The essence is that the world's pedagogy has "missed" a major socio-pedagogical process, which may be defined as the process of forming "information anti-pedagogy", with such a destructive effect on the moral principles of the younger generations that can be well predicted but cannot be overestimated. In this context, one should understand, firstly, that the need of educational system's intervention in this process is exigent now; secondly, that adequate informatization of education is an extremely complicated process. Here is one of the arguments for this assertion. Computerized educational process is a complex teaching-and-educational activity under conditions of a human-machine system. It is common knowledge that human-machine systems are subject of human engineering. However, classical human engineering has leaned so far on the outdated two-component model "man ↔ computer", while the three-component model "man ↔ artificial intelligence ↔ computer" is still under development. What should do a schoolteacher coming to the computer classroom? After all, he should have a perfect command of pedagogical human engineering being based on the three-component model "man ↔ artificial intelligence ↔ computer". Nevertheless, psychologists and educationalists still have no idea about development of integral theory of such kind. At the same time, it is obvious that there is a pressing need in such a theory.

What amount of knowledge should today be included (in addition to traditional training) in the professional standards of "the teacher of computer science in comprehensive school" and "the teacher of computer science and information technologies in vocational school"?

At present, pedagogical paradigm in general computer-science education undergoes essential changes. Some thirty years ago, technology of solving problems by means of large electronic computers of earlier generations has resulted in the focus of general computer-science education on pre-professional training of programmers, which was considered the optimal pedagogical paradigm. The assumption, that programming skills acquired by a high school graduate would enable him to perform all operations of computerized problem-solving process was perfectly justified at that time. It was associated with relatively low development level of programming languages, on the one hand, and very labor-intensive process of supporting the computerized problem solving under conditions of traditional technology, on the other. The today's situation is fundamentally different. Training of programmer to work (i.e. to create application software) with up-to-date computers, and especially with computers integrated into information network systems, can only be implemented under conditions of higher education. In contrast, the task of general computer-science education is training of the qualified user to be capable of using available application software for problem solving in his professional activity. Therefore, the today's pedagogical paradigm in this field should be to focus general computer-science education on mass training of qualified users. Then, based on this, to search and select a small number of young people especially gifted in the art of programming, and to provide them with corresponding vocational guidance. This should be done on an optional basis and in conditions of hobby groups and clubs, while the first and foremost part of this task to be carried out by comprehensive school is radical reform of general computer-science education as a system of training of qualified users. This task, in contrast to the task of training programmers, can be and should be decided within the framework of comprehensive secondary education. However, it should be understood that solution of this task is a multi-aspect pedagogical problem. In particular, one of the main aspects of this task is training of teacher prepared for organization and realization of the proper learning and educational activities.

What basic items should be included in the training of such teacher?

Firstly, the teacher's psychological and pedagogical training should be extended, in comparison to traditional one, by including necessary knowledge about human engineering and psychology of subject activity. After all, a "typical" user today is a human component of the three-component man-machine system "man ↔ artificial

intelligence ↔ computer". Competent organization and adequate support of educational activity can be performed by the teacher only if based on the good knowledge of the fundamentals of subject activity psychology, along with mechanisms of physiological and psycho-emotional balances in human organism and corresponding mechanisms of self-regulation under condition of the man-machine system.

Secondly, competent arrangement and implementation of teaching activity require of the teacher the good knowledge of all elements of the man-machine system. Therefore, basic concepts of artificial intelligence (AI), its evolution, its current state-of-the-art, and its role in socioeconomic interactions of people are also an integral part in training of such teacher.

Thirdly, parameters of pedagogical technology are changing essentially. Both the teacher and the student are acquiring fundamentally new means of communication and knowledge search and formation. Based on this, possible are new efficient techniques of teaching and learning activities and they should be realized. This will eventually result in creation of information-type technologies for learning and teaching, more efficient as compared to traditional ones. It means, however, that the level of creative work will increase both in teaching and in learning activities, which makes creative psychology a compulsory and very important component of modern computer-science teacher training.

Fourthly, one of the important objectives of comprehensive school is socialization of the students, i.e. the smoothest possible adaptation of the graduates to socioeconomic conditions of the community to which these graduates enter as self-dependent persons. Future social prospects in our country in the long term are determined by transition to global standards of market economy. One of these standards is high level of communication based on the up-to-date culture of marketing and information capabilities of the world community. That is why in solving the problem of students' socialization, the "Informatics" course plays nowadays, at least, as important role as the humanities. Consequently, training curriculum of computer-science teacher should contain a unit devoted to techniques of introducing the students in the field of the up-to-date communications.

The above listed points of computer-science teacher training should be based both on the adequate common pedagogical and psychological foundation and on the learning and mastering of experience of the teachers-experimenters realizing new paradigm of general computer-science education.
With this in mind, educational program of the "Informatics" course should be implemented in various forms and methods of study: lectures, discussions, seminars,

analysis and solution of situational problems related to arrangement of teaching and learning activities under conditions of the system "man ↔ artificial intelligence ↔ computer", and writing and defending essays and/or term papers. Special role is given to collective analysis of creative experience within the frameworks of local, sectional, regional and republic's seminars and applied scientific conferences.

Given the dynamic development of information technologies, basic methodological and methodical guidelines should be reviewed at the beginning of each academic year, along with the contents of the special part in the "Informatics" course with the purpose of achieving the compliance of the program with requirements to professional competence of the computer-science teacher.

MA

AZERBAIJAN

Notes for summarizing

Main aspects	Core ~~problems~~ principles	Main problems and "bottle necks"	Ways of overcoming, success practice	Recommendations	Other comments
Political, economic and social conditions for integrating ICTs into education	No governmental funding decision yet				Home work was done very honestly!
Technological conditions for integrating ICTs into education					
Pedagogical aspects Software	Some activity in primary schools CS in seconders some from Turkey?	not sure about curr. as a whole			
Ethical aspects					
Teacher aspects					
Funding and fundraising					
International and cross-national co-operation	Proposed collaboration in software production				
Other aspects					

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: Azerbaijan

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims	√		√	
Objectives	√		√	
Methods of implementation	√		√	
Funding plan	√		√	
Quality Assurance and Evaluation, Indicators	√		√	
Focus on primary phase	√		√	
Focus on secondary phase		√	√	
Focus on tertiary phase		√		√
Focus on adult education	√		√	
Special needs	√		√	
Curriculum & pedagogical development				
ICT as a subject		√		
ICT across the curriculum		√		
Vocational ICT training		√		√

Software		√	√	
Generic software tools	√		√	
Subject specific software and digital materials		√		√
Localising, versioning, licensing	√		√	
Production, delivery, updating and use	√		√	
Capacity building				
- Pre-service teacher education	√		√	
- Staff development	√		√	
Support				
- Technical	√		√	
- Pedagogical	√		√	
- Media design	√		√	
Technical infrastructure		√	√	
Hardware		√	√	
Local-area networks		√		√
Wide-area networks (Internet)		√		√

Management				
- national level	√		√	
- local level	√		√	
- institutional level	√		√	
Quality Assurance, Inspection	√		√	
Research	√		√	
Student assessment	√		√	
Other, please, specify				

AZERBAIJAN REPUBLIC. Comments the table.

General remarks.

First of all we shall note, that in each of 4 columns it is possible to be in various conditions. That's why we have decided to determine the condition in a column according to 10 point system and to specify type of plans - 1 or 2, and number of a column 1 or 2 below for each point. So the column "Revision" in type " Short-term plans " will have number 1.2. And the general remark on a condition in Republic on introduction of ICT in education. Now in Republics there is a revision and together with donors (World bank, Islamic Bank, the Project Harmony) new technologies take root etc. In July, 2001 the presidential program of information of the Society in which the important role is allocated to education should be accepted. So the situation varies very quickly and the table is true to within one month.

The description of Items of the table.

Rationale and Aims, Objectives, Methods of implementation, Quality Assurance and Evaluation, Indicators.

These 4 items concern items of any project, in which purpose it that is reached in infinity, one task for each concrete project, the list of actions for performance of a task in view and indicators. While writing the national program of Information of education the list of projects with the tasks and ways of realizations will be determined. In our case there is no Presidential program and from it forms of state financing. In our opinion we are ready to write the National Program of Information of Republic. Proceeding from this we have put "ticks" in all 4 columns.

Funding plan. (3 - column 1.1, 1 - column 2.1) - As it was told above, an economic condition of republic now does not allow to plan an expense for introduction of ICT in education. However, during the nearest 2-3 months the program of information of all society (the Wish and the recommendation of world bank should be accepted. The purposes are already determined, tasks and the basic actions and in this program the section concerning education is stipulated. Therefore, it is possible to tell, that the plan of financing is at a stage of development, both in short-term, and in long-term plans. However on some items of introduction of ICT we are at a stage of perfection. These points will be further.

Focus on primary phase (5 - column 1.1, 5 - column 2.1). Experiments with introduction of computer Science in elementary grades have begun to be carried out at us 5 years ago. Experiments in kindergarten were carried out. From only games on a computer, drawing in the graphic editor, creations of fairy tales such as cartoon films (classes PS 2), typing in LEXICON till work with objects and researches of some dependences between objects, and also development of elementary algorithms. Were authorized the program of experiment for single schools, but this process could not receive the further development because of absence of specifications, and in an elementary school without computer

support we have not reached teaching yet. This educational year of 30 schools have received computer classes and the decision in 10 of them to begin regular application of ICT since 1-st class was accepted. The program (the end of June, 2001) is already developed And at the end of August training of teachers of 1 classes and teachers of computer science of these schools (teachers of computer science in order to have at school the adviser for application of ICT in 1-st class) will be carried out.

Focus on secondary phase (5 - column 1.2, 5 - column 2.2). As well as in all the former Union, the computer science was entered at school at 1985. The project "Pilot schools" was introduced at 1989 in high schools together with firm IBM. Because of a computer condition of schools - from full absence of engineering till presence of classes with the allocated Internet, at schools various programs were applied. At some schools in general practically the computer science was not teached. In June, 2001 the decision was accepted: at schools which are equipped with computer classes, teaching of computer science begins at 5-th class. Such schools - 20 Pilot schools under the project of World bank and other 40. Two programs are accordingly developed. At schools where there is an allocated Internet, the variant of the program which is taking into account presence the Internet is entered. For schoolboys the WEB-site on realization of Olympiads on computer science is created, at Baku State University " the Computer University of the Schoolboy " is open. So, importance of introduction of computer science at school is quite realized. If ICT in a subject "the computer science" takes root successfully ICT in other subjects is at the initial stage: there is no program support, no teachers, but everyone understands, that something shoul be done.

Focus on tertiary phase (5 - column 1.2, 5 - column 2.2). Initial position in Higher education was much better, than at schools. Almost in each institution there was " a big COMPUTER " and in everyone programming was teached, at least, on BASIC. With Arrival of personal computers and " the big COMPUTER " problem in HIGH SCHOOLS with computer equipment became much worse. Private HIGH SCHOOLS are equipped very well. The state HIGH SCHOOLS all over again were equipped is centralized order by the Ministry of Education, and then went on self-maintenance. During Last 3 years began to be created actively University Internet -Centres by the various organizations (Institute the Open Society, IATP). In HIGH SCHOOLS for all specialities the course on computer science is entered, new programs now affirm. In leading HIGH SCHOOLS of Republic training on computer sciences is held and since September, 2001 in Baku State University the new speciality "Computer science" is entered.

Focus on adult education (1 - column 1.1, 5 - column 2.1). The plan of education for adults practically is not present. This role is carried out by various numerous private courses. This year at Institute of pedagogical Researches by the decree of the president

of republic the centre of Information technologies was created and the organization of the appropriate training in this Centre is planned. The special attention will be given by the refugees.
Special needs (1 - column 1.1, 1 - column 2.1). In this question there are only general reasons and ideas how to help people of this category.
Curriculum and pedagogical development
ICT as a subject (2 - column 1.2, 5 - column 2.2). In compulsory school pupils already pass elements of ICT. In HIGH SCHOOLS for all specialities the subject anyhow concerning ICT is entered. But absence of precise understanding of this question, insufficient quantity of teachers - lecturers does not enable to plan sharp increase of qualities and quantities of courses in the nearest 1-2 years. However in distant plans of 3-5 years qualitative improvement is probable.

ICT across the curriculum (2 - column 1.2, 5 - column 2.2). This question is similar to previous and consequently it has the same points.
Vocational ICT training (5 - column 1.2, 7 - column 2.2). As it was told above, in many HIGH SCHOOLS of Republic computer specialities are entered. In Baku State University since September of this year the new speciality is entered. Specialization on ICT is entered not only in preparation of bachelors, but also basically in magistracy. Students of the high SCHOOLS of the appropriate specialities already from 2-nd course are inlisted by various computer and about computer firms for work: programmers, system administrators, it means that the preparation is held in an industrial mode. To tell the truth, here except for positive there are also negative sides. Besides HIGH SCHOOLS various computer firms and societies take part in the preparation of specialists, which not only will carry out training but also certification (Microsoft, Oracle etc.). And all these processes are taken into account in near and far planning.

Software (5 - column 1.2, 7 - column 2.2).

Generic software tools (1 - column 1.1, 1 - column 2.1). There are only general reasons about the unspecialized software and there are no appropriate firms which would develop them. And, in addition, there is no clearness in necessity for development of such type of programs.
Subject specific software and digital materials (7 - column 1.1, 7 - column 2.2). A plenty of the specialized programs was developed for machines of "old" generation. With arrival of new computers many programs were altered for them. Sharp necessity for such programs is felt: both at school and in HIGH SCHOOL. Especially sharply there is a question of school. Therefore this question stands in the nearest plans at the first place. Many educational materials are translated in a digital format for their inclusion on the appropriate sites. It is planned to place in the nearest 3-5 years a plenty of an educational material in the Internet and on servers of a computer network of education of Republic.

Localising, versioning, licensing (1 - column 1.1, 1 - column 2.1).
Though these questions are regularly discussed also they are for us sore points, no obvious way of their sanction exists. To buy the English or Russian versions, and then them to adapt - costs a lot. If it was possible to buy a semifinished item and our programmers will finish it, it would be cheaper. Or to get program tools for development of the appropriate programs. It is possible to create the commission from representatives of the interested countries with coordination in IITE and to determine either preparations of programs or necessary program tools and to develop them and to transfer and receive products in use. Expenses of everyone will be immeasurably less. Inflow of new programs in Republic occurs or through the appropriate computer firms or through the Internet, together with as gift of other countries. So, for example the Turkish Liceum has presented 20 CDs with training programs.

Production, delivery, updating and use (2 - column 1.2, 2 - column 2.2).
The general software is delivered by various computer firms, they and make their updating. In plans, both the nearest, and far this question does not take the big place.
Capacity building Pre-service teacher education (5 - column 1.2, 5 - column 2.2). As the teacher is the basic character during use of ICT in education in our plans the significant attention is paid it. A problem that HIGH SCHOOLS have not time understand speeds of change IT. Each year new programs of training of teachers are accepted, but student ending HIGH SCHOOL already has lagged behind the appropriate technologies. In plans to enter for the students ending HIGH SCHOOL, special courses, and for teachers of the high SCHOOLS preparing teachers, special trainings.

Staff development (2 - column 1.1, 2 - column 2.1). Improvement of professional skill of the personnel up to the mark can not be carried out from for the limited financial opportunities. Therefore weak planning of this process. Institutes of improvement of professional skill have no enough qualified personnel and appropriate engineering. There is only a hope on trainings which will carry out the various Centres (the Internet the Centres of high SCHOOLS, the Resource Centre etc.) In the Centre of Information Technologies of the Ministry of Education is present the plan of retraining of school teachers, but these plans are small and are not main.

Support

Technical (1 - column 1.1, 1 - column 2.1).

The question on technical support stands more than 10 years and can not be solved. Each time there are local decisions. Mostly everyone leaves position as can. On the expiration of a guarantee, tortures with engineering begin. And, for example, 300 computers received as a gift from the Chinese Government at all have no guarantee and already now there are problems with their operation. In planning, neither in the nearest, nor in long-term this question almost does not stand, as there is no appropriate financing.
Pedagogical (5 - column 1.1, 5 - column 2.2).
Media design (1 - column 1.1, 1 - column 2.1). This question started to rise just now and in plans it yet does not occupy a due place so while there is no understanding of importance of the decision of this question in the future.

Technical infrastructure (5 - column 1.1, 5 - column 2.1). Value of an optimum technical infrastructure gradually becomes clear. The network connecting Universities (9) in 3 regions of Republic is already created. On turn a network connecting establishments of education and school (20 schools). Then connection to these networks of other HIGH SCHOOLS and schools, connection of these networks with each other etc. But as these networks are done on financing by sponsors, though and it is known that it is necessary to make but to plan expenses of sponsors it is not obviously possible.
Hardware (5 - column 1.1, 5 - column 2.1). This question is completely similar to previous. Plans of equipment by the computer equipment of schools completely depend on sponsors. In the best position there are HIGH SCHOOLS. Many HIGH SCHOOLS have the own finance (paid students) and, therefore, can plan the computer equipment. So, for example, Baku University have created local networks, other Universities plan to create local networks. However any of HIGH SCHOOLS has no sufficient resources to satisfy the needs.

Local-area networks (5 - column 1.1, 5 - column 2.1). As it was told in the previous item local networks are created at several Universities. In them their improvement is planned. In other HIGH SCHOOLS their creation only is planned. Under new projects (World Bank)the network equipment are delivered in school. From the computers received from China, it is planned to create local school networks. In short-term plans - creation of a local network of the Ministry of Education.
Wide-area networks (Internet) (5 - column 1.2, 7 - column 2.2). In the nearest plans - expansion and improvement of the created network connecting Universities. In long-term plans - expansion of geography of a network, to create conditions for high-grade application of ICT at rural schools. Connection to a network new providers for granting to each member of a network not less 128KB/s. Creation of the Educational portal. Creation of Virtual University.

Management

national level , local level (2 - column 1.1, 2 - column 2.1).
These two levels can be united. Clearly, that management of process of introduction of ICT, ICT use in education is necessary. Yet the understanding of principles of such management has not come as all architecture of system is not visible and principles of management in the network environment are absolutely not known. And the main thing is not present methodical studies and there is no enough of experts for this work.
institutional level (6 - column 1.2, 5 - column 2.2). With this item business is better, than with previous. There is rather full representation about ways of management, for example, University in the network environment. So Baku university participates together with French and Belgian Universities in the European project on use of ICT in management of University.

Quality Assurance, Inspection ,
Student assessment (5 - column 1.1, 5 - column 2.1).
Now systems of parameters and a set of indicators for an estimation of quality of introduction and use of ICT are prepared. There is a understanding as it is possible to estimate a level of knowledge of pupils, there is an experience of such estimation on other areas (were developed together with the international organizations the appropriate tests and techniques). However still nobody was engaged in such estimations in scope of ICT. And still in short-term and long-term plans these problems stand, as without the decision of these questions introduction of ICT becomes senseless (if not the result is seen).
Research (3 - column 1.1, 5 - column 2.1). Researches in the field of use of ICT in education only start to be carried out. In Institute of Pedagogical Researches the subjects of such researches is determined and it is expected, that results of these researches will help to approach to questions of introductions of ICT not only intuitively.

TAJIKISTAN

Notes for summarizing

Main aspects	Core ~~problems~~ principles	Main problems and "bottle necks"	Ways of overcoming, success practice	Recommendations	Other comments
Political, economic and social conditions for integrating ICTs into education	Disaster!				
Technological conditions for integrating ICTs into education	No hope of realistic progress in the visible future.				
Pedagogical aspects					
Ethical aspects	Paramount!				
Teacher aspects					
Funding and fundraising					
International and cross-national co-operation					
Other aspects	Euphemistic				

plans with no justification in reality

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: Republic Tajikistan Tadjikistan

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims				
Objectives				
Methods of implementation			√	
Funding plan				
Quality Assurance and Evaluation, Indicators	√			
Focus on primary phase				
Focus on secondary phase	√			
Focus on tertiary phase	√			
Focus on adult education				
Special needs				
Curriculum & pedagogical development				
ICT as a subject				
ICT across the curriculum	√			
Vocational ICT training				
Software	√			
Generic software tools			√	
Subject specific software and digital materials	√			
Localising, versioning, licensing				

Production, delivery, updating and use				
Capacity building				
- Pre-service teacher education	✓			
- Staff development		✓	✓	
Support				
- Technical		✓		
- Pedagogical		✓		
- Media design		✓		
Technical infrastructure			✓	
Hardware		✓		
Local-area networks		✓		
Wide-area networks (Internet)			✓	
Management				
- national level	✓		✓	
- local level				
- institutional level	✓		✓	
Quality Assurance, Inspection				
Research		✓	✓	
Student assessment				
Other, please, specify		ICT in control energetic	✓	

MA

TAJIKISTAN

Notes for summarizing

Main aspects	Core ~~problems~~ principles	Main problems and "bottle necks"	Ways of overcoming, success practice	Recommendations	Other comments
Political, economic and social conditions for integrating ICTs into education					
Technological conditions for integrating ICTs into education					
Pedagogical aspects	No thought given to curriculum				
Ethical aspects					
Teacher aspects					
Funding and fundraising					
International and cross-national co-operation					
Other aspects					

Republic of Tajikistan.

The integration of informational and communication technologies in education.

1. INTRODUCTION

Despite of a heavy position of today, usage of computers in the field of education in Tajikistan has the traditions. In 70-th simultaneously with appearance of such specialities, as an Automated System of Control, Computer facilities etc. the computers began to be used at training and check of students' knowledge in the Tajik Polytechnic Institute and at the Tajik State National University.

In 1986 the computer science became mandatory course in High Schools, and state program of introduction of computers in the educational system of Tadjikistan began to be embodied in life. As well as in other countries, at the end of 80-th the activity directed on creation and usage of information technologies (IT) in the field of education, in many Higher Educational Establishments and some bther schools of Tajikistan, was carried on mainly by enthusiasts. The spectrum of their activity was wide enough. It included practically all educational levels, various educational disciplines. However because of civil war and followed ruin the enthusiasts' operation were not fixed by practice of wide implantation, as in other countries of former USSR.

What is done in Tajikistan at the present time from the point of view of education, computer science and ICT in education? For the answer to this question we shall give a brief evaluation of a current situation in the country.

2. TAJIKISTAN

General information. Population: 5,7 millions (1989г), among them 1464,8 thousand are High School students and 79,2 thousand are University students. Territory: 143100 square kilometers. Adjacent states: Uzbekistan, Kirgizstan, Afghanistan, National Republic of Chine. Radical nationality: the Tajiks (62 %). National minorities: the Uzbeks (23 %), Kirghiz, Turkmen, Tatar etc. (8 %), Russian (7 %). Capital: Dushanbe. Declaration on Independence: September 9, 1991г.

Geographical situation. Tajikistan is located in a South-East of Central Asia. 93 % of territory occupied with mountains concerning to the system Tyan-Shan, Hissar-Alai and Pamir (up to 7495 meters of height,), divided by valleys (Fergana, Zeravshan, Vakhsh, Hissar etc).

Climate. A climate sharply continental and dry. In valleys and on flatnesses (up to 500 m of height)
average temperatures of January from -1 C in North, up to +3C in the south, average temperatures of July
accordingly 27 and 30 C. Settlings 150 - 300 mm per one year. At heights of 500 - 1500 m average temperatures of January up to -20C, average temperatures of July 10 – 12 C. Deposits up to 1200 - 2000 mm
per one year. In a South-West the dry and hot wind - Afghan frequently blows.

Water resources. Large glaciers: Fedchenko, Zeravshan etc. Main rivers: Amudarya, Sirdarya, Vakhsh, Zeravshan. Large lake - Karakkul. There are also artificial lakes - reservoir and irrigation canals.

The natural complex. Soil: gray-terrestrial, brown, mountain-meadow. Grassy and semibush vegetation of deserts prevails; in mountains (at height of 1200 m) - archa, nut wood; above 2400 m-
steppe, meadow steppe and high-mountainous meadows. Reserves: Tigrovaya Balka, Ramit and Dashtidjumsky.

Economic situation. After disintegration of USSR Tajikistan has appeared in a deep economic crisis. Followed for it reduction of production accelerated by the break of integration connections with republics, loss of the allied grants, civil war and the natural catastrophes have resulted in curtailment of production to 1995г. on 50 % concerning a level of 1988. The capital

investment

and acquisitions of the equipment considerably have decreased, having conceded a place to import of consumer goods, mainly grain.

Resources and industry. 60 % of an industrial output concerns to the branch of light (in main textile) and food-processing industries.

Heavy industry. Main branches of a heavy industry - electric power industry, mining, non-ferrous metallurgy, mechanical engineering and metal working, industry building materials.

Resources. Extraction and enrichment of ores of colour and rare metals (zinc, antimony, mercury), gold. Non-ferrous metallurgy (aluminum factory in city Tursun-Zade, hydrometallurgical in Isfara etc.). Tadjikistan has deposits of rare units, such as uranium etc.

Mechanical engineering. The enterprises of mechanical engineering make agricultural machines, equipment for trading enterprises and public catering, textile, light technical equipment, transformers, home refrigerators, cable etc. (main centre - Dushanbe).

Chemical industry. The chemical industry develops (factories: nitric - in Kurgan - Tube, electrochemical - in Yavan, plastic - in Dushanbe).

Light industry. Main branches of light industry: cotton cleaning, cotton, silk, carpet-weaver (Dushanbe, Khujand, Kairakkum etc).

Food-processing industry. Fruit-canning, oil-fatty branches are selected in a food-processing industry.

Fuel and power engineering. There are no reconnoitered large deposits of petroleum, gas or coal in territory of Tadjikistan. The coal import provides some part of need in the electric power, though the hydroelectric power stations play more important role in power engineering. Tajikistan, where is worked out only 17-18 billion kilowatt–hours by hydroelectric power stations, can produce 100 - 150 billion kilowatt-hours and become the largest manufacturer of the electric power in Central Asia. The basis of electric power industry makes Hydroelectric Power Station: Nurekskaya, Golovnaya, Baipazinskaya (on Vakhsh river), Kairakkumskaya (on Sirdarya river), etc; Rogun and Sangtudin Hydroelectric Power Station on Vakhsh river are being created. Large ТЭЦ - in Dushanbe, Yavan. The brown coal (Shurab), petroleum (in North and South of republic), natural gas (Vakhsh, Hissar valleys) is extracted.

Transport. The transport communications are limited with a hilly terrain and pass in valleys and through saddle-points. The road nets are leaky, in bad condition. The main highways and railway connect Tajikistan with other areas of Central Asia. A main type of transport - automobile. Length of motorways of common use is 13,2 thousand kilometers, including with a hard coating - 11,6 thousand kilometers.

Agriculture. The agriculture of republic is grounded on watering agriculture. Tajikistan is the main supplier of a cotton and fruit. An output level of food products is low.

Structure of the bank system. In February 1991 Tajikistan began the process of introduction of two circle bank system, having accepted the legislation, governing the activity of central bank - National Bank of Tajikistan, and also activity of commercial banks.

Perspectives. Despite of today's state of economy, the Republic of Tajikistan has a large economic potential. Tajikistan is a gold, colour metals, chemistry, waterpower engineering, mechanical engineering, light and food-processing industry. Tajikistan is significant and quickly growing spares of labour spares, capacious enough and stable market of selling of the foodstuffs and consumer goods. And, at last, it is a wide sphere of investment of the foreign investments and modem technologies both in key economic branches of a national economy, and its infrastructure, including tourism.

Factors of interest. Among the factors and conditions promoting growth of interest of the foreign businessmen to Tajikistan, it is possible to allocate:

- Significant stores of mineral-raw and vegetative resources;
- Unique ground-climatic conditions favorable for development of an agriculture as a raw base of a process industry;
- Usual infrastructure of the national economic complex;

- Scientific and production potential; high and steady rates of reproduction of the population and manpower, that enables to develop of labour-consuming production.

3. EVALUATION OF A CURRENT SITUATION IN THE SECTOR OF EDUCATION

Tajikistan has inherited from the past the developed network of educational establishments and appropriate potential of pedagogical stuff, high coefficient of a spanning of children by an education system and gender equal rights in obtaining mandatory base education. In 2000 1464,8 thousand of High School students and 79,2 thousand of University students, that is every third inhabitant, studied in Tajikistan.

In 1999 in Tajikistan 4484 educational establishments functioned including: 562 preschool establishments, 3522 comprehensive schools, among them 38 schools, boarding schools and children's houses for the children - orphans, 50 technical schools, 24 higher educational establishments.

Since 1992 the real expenditures on education from the state budget have decreased (from 11,1 % of GIT in 1992 to 2,1 % in 1999). Soul expenditure for this period have decreased from 5,8$ up to,3,6 $. Insufficient budget financing at republican and local levels do not represent the possibilities to support the historically usual high level of education sector.

A problem of "the lost generation" is created in a transition period in conditions of financing reduction of an education system, increase of number of poor families, leaving of the best part of the teachers from the system because of low wages, the deterioration of material and technical base, growth of number of children abandoning schools. Acutely there is a problem of education saving and its development.

The poverty in Tajikistan was aggravated by civil war 1991-1993 , the general damage from which is estimated in 7 billions of US dollars. According to data of statistics, as a result of civil war 55000 children became orphan, 26 000 women became widows, having lost the supporter and began to head family, 195 000 men have gone away to the countries of CIS.

According to МВФ and ВБ about 20 % of schools in Republic were destroyed and plundered, many school buildings and constructions require the realization of repair-restoration works and complete equipping by the educational equipment, visual aids, technical means of study. On precomputations and with account of inflation on reconstruction and the restoring of school buildings 66,3 billion somoni is required. The number of schools requiring urgent major overhauls increases. For today this number makes 1845 schools all over the Republic, 282 of which are in cities and 1563 in a countryside.

As the conversation in focal groups has shown, practically in all inspected areas the schools require urgent realization of major overhaul, the windows have no glasses, no doors, no desktops, no chairs. The buildings of schools are not heated, it is cold and damp there, no restrooms inside. Since September till October many students do not attend schools because of harvest. In northern areas of the Republic cold disease are increased in winter because of absence of heat in classes, 85 % of inspected schools were closed for quarantine.

The natural growth of the population in the Republic anticipates growth of number of student's places at schools. The number of places in High Schools in 1999 has decreased in comparison with 1990, and the number of the students has increased on 112 %.

The existing status of buildings and constructions of educational establishments strongly reduces attendance of occupations, negatively influences quality of the educational process.

Till now curriculums and programs of the Soviet times are used in educational institutions. Despite of some attempts to reconsider the curriculums and programs significant changes in them is not observed. Curriculum and the programs are not enough reflect real changes in Tajikistan.

For improvement of the educational process according to the requirements of time it is necessary to reconsider a contents of the curriculums and programs not overlooking new information technologies in education. In a number of cases the new approaches become more competitive and economically favourable.

Distinctive feature of crisis in education sector became a sharp collapse of budget financing volume. If the densities of current expenditures on education in general volume of expenditures of the budget in 1990 made 22,1 %, in 1999 this indicator has decreased almost twice and has made 12,2 %. For this period the expenditures of a state budget on education have decreased from 9,5 up to 2, 1 %.

The deficiency of budget financing is partially compensated by other various sources of financing. The multichannel principle of education financing ensuring 9-years mandatory education is accepted. Education is included in the program of the World Bank on a mitigation of poverty, finance is allocated on not disputed budget and educational programs cooperate with Aga-Khan Fund. Investments of Islamic Bank of Development work on recommendation of material base of schools. The education program of peaceful dispositions UNISEF, emergency help UNESCO, CARET ITERNATIONAL, MISSIONS of SAVING of children and many others are successful. But nevertheless they poorly work on a perspective of integration of ICT in education as they carry isolated character. Concept of integration of ICT in education of Republic of Tajikistan is absent for today.

In conditions of limitation of the state budget education is not any more free-of-charge in customary sense of this word. The expenditures on education of children in each family grow from year to year. For the majority these expenditures are incommensurable with their income, that is why the base education for many children became unavailable. So a reason of not attending of school because of absence of clothes have marked: in Dushanbe - 22,7 %, Sogd area - 38,7 %, Khatlon area - 30,6 %. The expenditure of a state budget on wages of the teachers has decreased from 75,8 % in 1990 to 48,8 % in 1999. The average monthly wage of the workers of an education system in the Republic makes 6 somoni, the low spanning of children in preschool establishments can result in loss of an initial link of an education system. The number of children, who are not visiting school in the age from 7 till 15 years, makes 4898 all over the Republic.

Gender balance in education is reduced. As a rule, the girls make 25-30 % of a total number of the students. Because of absence of resources 30 % of the girls and 20 % of the boys from poor families can not visit preschool establishments. Frequently eldest children look after small children and can not attend school because of it.

Another important problem of not employment of the young girls is their early marriage, as in first, family will get rid of necessity to feed one more child, in second, places of study are far from places of residing and parents are afraid for children safety.

The low family incomes, insufficient address help to poor families, gender problems do not provide equal access to education.

Till 1991 the systematic system of improvement of professional skills and retraining of the staff operated for branch of education in Republic. Since 1992, because of deficiency of money resources in an education system the retraining of staff practically has not been made.

The analysis shows, that 10 % of the teachers working in schools, have no appropriate qualification, the best staff went on highly paid job, the experts with knowledge of the new educational technology do not wish to work in educational institutions.

The researches which have been carried out in pilot schools, show that the wages of the teachers provide only 20 % of vital expenditures. The remaining 80 % of these expenditures teacher should find in additional earnings in free time.

Existing crisis situation in the system of preparation of pedagogical staff, improvement of professional skill and retraining, the complicated conditions of job reduce prestige of education and motivation of the teachers work.

Termination of the centralized deliveries of the equipment for educational establishments, absence of the adequate industry in Tajikistan have reduced in shortage of the tutorials and educational equipment (chairs, desktops, board etc.), which require complete replacement or restoration.

The shortage of the textbooks directly has an effect on poor people, as earlier support by the textbooks was free-of-charge. The textbooks do not suffice practically for all students: in initial classes it makes one textbook per 6-10 students. The literature available in the school library does not correspond to the school program, and in the market the cost of one textbook makes 1.5-5.3 somoni. There are no notebooks, pens, and other school accessories. Students go to school without briefcases, and carry notebooks in hands. As was found out there are not enough teachers at schools, the reason of that is low wage. There are problems on preparation of the textbooks on Uzbek, Russian, Kirghiz languages with the purpose of support of equal access of all ethnic groups to education.

Since 1992 the textbooks for High Schools and methodical manuals for teachers have not been issued. Their contents deserve attention. For last 8-10 years the publishing industry has lost competitiveness, its resources are exhausted. The printing houses require serious reconstruction.

Such visual aids and equipment, as satiny maps of the world, board, the copy machines, colour are fine, modern technical means of education (projectors, photocopy machines, computer equipment with Internet connection), as a rule, are absent.

Low equipment of material and technical base of educational establishments by the textbooks, equipment and other resources make priority search of new methods and forms of support of an education system. The break on the ways of mass usage of new information technologies in education in Tajikistan is expected.

4. MAIN DIRECTIONS OF THE STRATEGY OF ICT IN TAJIKISTAN

Despite of efforts of a society and executive authority, the educational system in Tajikistan is in deep crisis. The number of the teachers and experts is reduced in the field of education. The number of the students going to receive fundamental education decreases; the requirements to a level of a professional education and cultural level are reduced. There are no textbooks, manuals. The break in a position of leading and peripheral educational institutions is increased, and amount of computers installed in high schools are not enough. Today only some of high schools in Tajikistan have computer classes, and only some hundreds of computers are for 1464,8 thousand of students.

Despite of a bad general level of development of telecommunications and computer infrastructures, the leading educational establishments partially have solved problem of computerization of education (Presidential Liceum, Turkish Liceum etc.) that is typical for developed countries.

Basing on the carried out analysis, we can assert, that concerning usage of information technologies in the field of education, Tajikistan is neither advanced, nor developed country. This country is of a transition period, which requires: development of infrastructures of information and communication technologies; support and development of available intellectual resources and entrance in global information and educational structures.

Tajikistan requires fast increase of a level of average and professional education up to a level of international standards from the point of view of contents, methods and resources. The Ministry of Education of Republic of Tajikistan puts a problem of implantation of information technologies in the educational system being a part of the National program on informatization of Tajikistan. Let's reduce substantive position of this concept:

Position 1: *Education and computer science are not yet considered as major components of the common process of informatization in Tajikistan. Majlisi Oli has approved main directions of the National program of informatization of Tajikistan directed on creation of computer support and an appropriate level of development of telecommunication infrastructures.*

Position 2: The chain of informatization of education of Tajikistan consists in rise of efficiency of the educational process by increase of information volume, offered for training, and improvement of methods of performance of this information for usage at schools, home life and on workstations.

Position 3: *The process of informatization requires training of the teachers and students by methods of an effective utilization of modern information technologies and knowledge of appropriate international standards. For solving of this problem the system of individual training based on intellectual tutors and methods of distance education will be created.*

Position 4: *The saturation of educational institutions by modern computers, computer communications and IC-resources is a main result in the field of education. It should cause radical changes and intensification of training in appropriate areas. Internal and international networks of database and knowledge base will be created, the access to the information of most universities of the world will appear. In many educational institutions there will be organized laboratories equipped by computers and laboratories of virtual modeling called to prepare a new generation of the teachers.*

The amount of higher educational institutions having access to Internet steadily grows, though it is poorly used in the educational process.

Ministry of Education of Republic of Tajikistan formulated the basic perspective problems of the telecommunication educational network:

- Implantation of telecommunication technologies in the educational system and training of the teachers and students to work in Internet;
- Distribution of the software and other teaching materials;
- Support of distance education;
- Professional education in the field of telecommunications.

The experience shows, that the telecommunication networks give remarkable possibilities for the new various forms of education. The computer networks expand possibilities of the traditional educational process, increasing number of students, overcoming distances or offering more floppy and open methods of training. These technologies allow to use various resources (graphics, sound, hypertext) or their combination on any distances. Creation of open educational space - some kind of call for the traditional computer forms of training. The distance educational systems are open for any participants, irrespective of time and location.

Fast development and introduction of information technologies have created a paradoxical situation, when the computers, audio and video resource can widely be applied in the educational process, however do not find due application because of failing the teachers to use potential possibilities of information technologies. This situation is typical for many countries, and Tajikistan is not exception.

For introduction of computers and IT in schools and high schools it is needed to have the system approach of organization of the large number of measures on delivery of technics and for training of the teachers. Usage of the ready electronic tutorials and manuals it is not enough: any teacher as a representative of a creative profession will prefer own electronic teaching materials standard on their periods. The good compromise would be to give teachers a possibility of adapting of ready electronic manuals according to their needs.

As a whole on Tajikistan there is a problem of development, wide discussion, governmental acceptance and ensuring of realization of the program "National program of informatization of education of Republic of Tajikistan". Ministry of Education of Republic of Tajikistan works over there problems with participation of group Focal Point IITE in Tajikistan.

Professor Chekalin V.G.

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ESTONIA

Notes for summarizing

Main aspects	Core ~~problems~~ principles.	Main problems and "bottle necks"	Ways of overcoming, success practice	Recommendations	Other comments
Political, economic and social conditions for integrating ICTs into education					
Technological conditions for integrating ICTs into education		NO VIREMENT			
Pedagogical aspects Inf.	optional as a subject but compulsory as a X-curricular ~~topic integrated~~	ON FUNDING			
Ethical aspects					
Teacher aspects					
Funding and fundraising					
International and cross-national co-operation					
Other aspects					

can this be articulated
eg. in Maths, Science etc

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: Estonia

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims	+	+	+	+
Objectives	+	+	+	+
Methods of implementation	+		+	
Funding plan	+		+	
Quality Assurance and Evaluation, Indicators			+	
Focus on primary phase				
Focus on secondary phase		+	+	+
Focus on tertiary phase	+		+	
Focus on adult education				
Special needs	+	+		
Curriculum & pedagogical development				
ICT as a subject				
ICT across the curriculum			+	
Vocational ICT training				+
Software		+		+
Generic software tools				
Subject specific software and digital materials		+		+
Localising, versioning, licensing	+	+		
Production, delivery, updating and use			+	

Capacity building				
- Pre-service teacher education		+		
- Staff development		+		
Support				
- Technical				
- Pedagogical				
- Media design				
Technical infrastructure				
Hardware		+		
Local-area networks		+		
Wide-area networks (Internet)		+		
Management				
- national level		+		
- local level		+		
- institutional level				
Quality Assurance, Inspection				
Research				
Student assessment	+	+		
Other, please, specify:				
High level political promotion	+	+	+	+
Multilingual ICT culture				
Vocational schools				

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: Estonia

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims	+	+	+	+
Objectives	+	+	+	+
Methods of implementation	+		+	
Funding plan	+		+	
Quality Assurance and Evaluation, Indicators			+	
Focus on primary phase				
Focus on secondary phase		+	+	+
Focus on tertiary phase	+		+	
Focus on adult education				
Special needs	+	+		
Curriculum & pedagogical development				
ICT as a subject				
ICT across the curriculum			+	
Vocational ICT training				+
Software		+		+
Generic software tools				
Subject specific software and digital materials		+		+
Localising, versioning, licensing	+	+		
Production, delivery, updating and use			+	

Capacity building				
- Pre-service teacher education		+		
- Staff development		+		
Support				
- Technical				
- Pedagogical				
- Media design				
Technical infrastructure				
Hardware		+		
Local-area networks		+		
Wide-area networks (Internet)		+		
Management				
- national level		+		
- local level		+		
- institutional level				
Quality Assurance, Inspection				
Research				
Student assessment	+	+		
Other, please, specify:				
High level political promotion	+	+	+	+
Multilingual ICT culture				
Vocational schools				

ESTONIA

Analysis of the Grid, main bottlenecks, the future plans and parameters for evaluation

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In this document we start with the legal basis and current stand of ICT-related activities in Estonian educational system. Relevant web-addresses are also given, if possible (most of them contain materials written in Estonian only).

Basic regulations

In this section we list and describe shortly the basic documents and programs determining the state policy on ICT use in general and in education in particular. The list is ordered by the date of their acceptance by respective bodies and starts from 1997 (there were a number of activities before 1997 as well but these will not be described here).

1. **"Information Systems in Education"** (ISE, 1997-2000, 2 MEUR), a European PHARE program (www.ise.ee). There were four sub-programs:
   1) Policy, strategy and dissemination (development of a national policy on ICT for the Estonian school system; establishment of EU links for schools and administrators; production of information materials for schools etc),
   2) Education information system (development and implementation of a client-server information system covering schools, counties and the Ministry of Education; provision of necessary hardware and software to the Ministry and counties; training Information Systems managers for counties),
   3) School management project (development and piloting of school administration software; provision of hardware and software to schools; planning of implementation and training),
   4) ICT support and development (establishment of computer training and curriculum centers in 15 pilot schools; design and delivery of training and teacher development program; development of strategies and resources for ICT use in the classroom; training the teachers and school administrators; telematics conferences for teachers and school administrators). During the first implementation phase, Phare ISE began in 2001 to implement the software developed – GP-Untis and Extens – into 125 Estonian schools (there are in total about 230 secondary schools in Estonia).
2. **"Tiger Leap",** a national program for computerization of schools, managed by the *Tiger Leap Foundation* (Tiigrihüpe SA, 1997-2000, www.tiigrihype.ee, includes 10,5 MEUR from the state budget and 5,6 MEUR from local communities). The program had a number of activities (sub-programs):
   1) Tender system of buying computer hard- and software for schools has been implemented (including development of 39 packages of original educational software),
   2) 10 900 teachers got initial ICT training and 2 600 teachers specialized ICT courses (there are about 17 000 school teachers in Estonia),
   3) a portal for teachers "Õpetaja võrguvärav" has been developed (www.opetaja.ee). This portal contains learning materials, news, articles and documents for teachers, information about ICT courses for teachers, subject sections, chat rooms, software recourses

divided by subjects, Frequently Asked Questions, links to other educational recourses etc.

4) Sociological studies, PR towards ICT usage etc, for example *Tiger Tour*, a tour around Estonia taking place every summer with tens of (networked) computers installed for public use with accompanying presentations.

3. **"Basics of Estonian Information Policy"** ("Eesti Infopoliitika Põhialused") accepted in 1998 by the Parliament of Estonia (www.eik.ee/ein/infopol.htm). This document determines the main principles and activities necessary for leading Estonian citizens into *Information Society*. Special attention has been paid to legal issues, private sector support, interaction between citizens and the state etc. One of the aims of the document is to create equal access to information recourses for all citizens avoiding division the people into "information rich" and "information pure". For this purpose, necessary information infrastructure should be created. Two priority areas for supporting from the state budget were defined: education and public administration.

4. **Public Internet Points** (PIP) established by Open Estonia Foundation (www.oef.org.ee) in rural areas, villages and cities. In PIP's the citizens have free access to Internet connected computers, for a symbolic fee.

5. **"E-State"** ("e-riik", 1998, www.riik.ee), a standard model for any public institution (2000, www.riik.ee/moodulid.html).

6. **"Tiger Leap Plus"**, a follow-up of "Tiger Leap" program ("Tiigrihüpe Pluss", 2001-2005, 25 MEUR, www.tiigrihype.ee/tiiger_pluss/strateegia.html) accepted by the Government of Estonia. The goal of the program is to apply ICT for creating conditions of learning society in regular schools where computers will be used as a natural component of learning process. There are four priority areas:

   1) Development of ICT competences of graduates, teachers and administrators,
   2) Virtual learning (development of learning software, virtual cooperation of teachers, legalization of virtual learning, development of a virtual gymnasium etc),
   3) Development of ICT infrastructure (modernization of soft- and hardware, Internet connection, technical support for schools),
   4) Cooperation of all involved parties – the state, local communities, schools, parents and organizations).

   The foundation will cover 33-50% of costs (the rest will mainly be covered by local communities). The majority in the Foundation council members are people from schools and universities.

7. **"Look into the World"** ("Vaata Maailma", 2001-2003, 16 MEUR), an initiative of leading Estonian companies to support massive use of Internet services. The aim: at least 70% of citizens will use Internet in 2003. Concerning teachers: all teachers should have computers at home, with free on-line connection to Internet.

8. **"Requirements for school teacher competencies in educational technology"** (2001), a decree of the Minister of Education. The document defines necessary competencies in educational technology for all teachers, similar to internationally accepted principles (http://cnets.iste.org). Namely, every teacher:

   1) Understands the role and functioning principles of hard- and software systems of ICT,
   2) Is able to use ICT hard- and software, as well Help system and reference materials,
   3) Knows ICT based active learning and project learning principles and methods,

4) Prepares with computers guidance materials for supporting pupils independent work,
5) Is able to find from Internet and from other electronic media additional information necessary for teaching,
6) Can critically analyze different materials, compare alternatives, refer and cite correctly,
7) Gathers and systematizes data by using ICT,
8) Uses different ICT tools for composition and presentation his/her materials,
9) Describes the role of ICT in society, understands the role of ICT in trade market and in his/her professional development,
10) Knows and follows legal procedures and "good practice" related to the usage and spreading electronic information,
11) Recognizes threats to health, social and intellectual development of pupils related to the usage of ICT,
12) Uses e-mail for interaction with pupils, parents and colleagues.

All pre-service teacher-training programs in universities and colleges should guarantee to the graduates the competences listed above.

Additionally, there are some declarations which - although not official documents - are accepted on a very high level:

1. **"Scenarios for Education in Estonia until 2015"** ("Eesti Haridusstsenaariumid 2015", http://web.ibs.ee/hring/stsenaariumid.html), 1998. The main aim of the document is to describe different possible strategies for education in Estonia and to propagate the idea of *Learning Estonia*.
2. **"Learning Estonia"** ("Õppiv Eesti", http://www.zone.ee/tkoolitus/teemad/oppiveesti.htm), a report of Academic Council of the President of Estonia to Estonian Parliament (Riigikogu) in 1998.

The current stand

Informatics Subject Commission at the Ministry of Education coordinates the implementation of ICT in schools.

Basic statistical data about ICT in schools:

- 25 pupils in average to one computer (mainly *Pentium*),
- 75% of schools have on-line Internet connection,
- 42% of persons teaching Informatics in schools have teacher's qualification in Informatics (57% in average for other subjects),
- 85% of teachers are female,
- *Informatics* is optional as a subject, but is compulsory as a cross-curricular topic which must be integrated into other subjects,
- The teachers' average salary is lower than average salary in the country,
- Average number of pupils in schools is 289 (therefore the usage of commercial educational software is relatively expensive).
- 35% of citizens belong to Russian speaking minority (about 20% schools are based on Russian language and about 5% are mixed). This fact (existing of two communities in society) causes certain difficulties in developing a well-organized information society.

In-service teacher's abilities to use ICT in teaching process can be characterized by results of a sociological study made in 2000 and supported by Tiger Leap Foundation. For example, the pupils' answers distribution to the question *Does your teacher have needed skills in using computers?* was following:

- Most of them have 13,4%
- Some of them have 14,2%
- Most of them are beginners 41,3%
- They do not have any skills 1,0%
- I don't know 30,2%

To the question *Where did you study computers?,* the answers distribution was following:

- At school lessons 41,6%
- By myself 31,5%
- From parents 17,9%
- I did not study at all 4,8%
- At special courses 4,1%

ICT in pre-service teacher training. Pre-service teacher training will mainly take place in Tallinn Pedagogical University (TPU), in Tartu University (TU) and in Tallinn Pedagogical Seminar. As TPU is the main producer of teachers we will shortly describe ICT role in teacher training there.

1) At the moment there are two compulsory ICT courses for *all teacher students*: a) ***Basic course*** after which students should be able to use ICT tools for their own needs (composition of documents, use of Internet tools etc) and b) ***Information Technology in School*** after which students should be able to use ICT in general teaching process. A third compulsory course ***ICT in Subject Teaching*** will be introduced from September 2001 (this course was optional until now). The courses will be delivered by the *Department of Informatics*, *Department of Educational Sciences* together with the *Center of Educational Technology* and by specialty departments, respectively.
2) *Informatics Teacher* qualification can be obtained as a minor only (www.cs.tpu.ee/koolitus), ICT courses take nominally one year. As a rule, mathematics is as major. This program (Teacher of Mathematics and Informatics) got international accreditation in 1996. According to this report, "The Department provides excellent facilities and experienced teachers for the training of school teachers in computer science", "Computer classes are of up to the best standards in Europe".
3) There is a 3-year bachelor program for preparing *School ICT managers* (www.cs.tpu.ee/IF). This program does not contain teachers training program (i.e. the graduates do not get teachers qualification). ICT manager is a person who is developing and maintaining ICT infrastructure and school information system, supporting teachers in developing learning materials, and possibly learning programs, applying and leading ICT projects etc.
4) There is a 2-year master program "*Multimedia and Learning Systems*" (www.cs.tpu.ee/MM) after which the graduates should be able to develop multimedia based educational software. The applicants to this master course can have university degree in whatever specialty (not necessarily in ICT).

ICT in in-service teacher training. Additionally to the *Tiger Leap Foundation* supported courses (given mainly by TPU and TU lecturers as well by leading school teachers in ICT) there are some other initiatives. For example, a 40-hour course "*Teach to the Future – Key Trainer program*" for implementing MS Office 2000 in school subjects is currently running. This course is a joint development of Intel Company and Oxford University.

Analysis of the Grid

In the following we will give short explanations and comments of marks (+) in the Grid.

1. *Rationale&Aims* and Objectives are fixed in all of the main documents listed above.
2. "Tiger Leap Plus" has detailed *implementation* and *funding* plan.
3. *Quality Assurance* will be mainly achieved by ICT competences, both for teachers and pupils.
4. "Tiger Leap" and "Tiger Leap Plus" are both supporting mainly secondary education.
5. The number of state financed students in ICT has been considerably increased in last two years (both in universities and in vocational schools).
6. Special needs were supported by *Tiger Leap* program and will be supported by *Tiger Leap Plus* program as well.
7. *ICT across the curriculum* will be strongly promoted in the following years. This was the main reason why ICT competencies for teachers were fixed.
8. Vocational ICT training will most probably be profoundly revised in the future. Estonian Information Technology Society initiated activities which should harmonize ICT curricula in vocational schools with *European Professional Informatics Certificate* curriculum (www.cepis.org).
9. Purchasing and development of educational *software* is one of the priorities of *Tiger Leap Plus* program.
10. Schools are strongly encouraged to use only legal software.
11. All teachers training institutions should revise their curricula introducing new ICT courses.
12. Hardware, local-area networks and Internet connections are supported by *Tiger Leap Plus* program.
13. *In management*, there are ICT coordinators in counties who are playing important role in innovation activities.
14. Concerning *student assessment*, the necessary ICT competencies for school graduates have been developed.
15. Without *high level political promotion* it would not be possible to achieve good results. Implementation of ICT tools in education is very expensive and can be done by the state only. This should be a national task, all significant parties (government, communities, companies, parents, foundations etc) should be involved.
16. At the end we list a couple of items which we consider as important and where there is some room for improvements in Estonia: *multilingual ICT culture* and *vocational schools*.

Main bottlenecks

Here we list some problems (bottlenecks) related to the implementation of ICT in schools. Although the following text reflects the views of the authors of this document, these are more or less accepted as problems by most of the subject specialists and educational institutions. We group the bottlenecks by the level of institutions responsible for solving them.

State level

1. ***Financial support*** to develop ICT activities in education ***is extremely unbalanced***: while comprehensive schools and in-service teacher training are generously supported, vocational schools and universities (including pre-service teacher training) lack any special additional support.
2. There is ***no state order for educating ICT-teachers*** from the universities. The teachers for ICT have been studied informatics as a minor only and therefore their qualification is not sufficient for acting as ICT managers (called "Infojuht" in Estonian) in schools (which role the ICT-teachers in majority of cases are also playing). This concerns both comprehensive and vocational schools.
3. The ***state order for educating ICT managers is not big enough***, and even then decreased from 35 in 1999 to 20 in 2001.
4. ***Tax regulations do not promote to invest into education***. For example, financing courses will be considered as a special advantage and will be fully taxed.
5. ***Salary conditions*** for ICT-managers in schools are ***far below those in private sector***. Therefore it is nearly impossible for schools to hire and keep highly qualified specialists. For university graduates there is no obligation to work after graduation some period of time in schools.

University level

1. There is ***not enough research*** at the universities devoted to problems of using new technologies in education. It is accepted by academicians that educational theories should be considerably revised and a new theory – *digi-didactics* – should be developed.
2. ***Teacher trainers are not sufficiently qualified*** in using ICT tools adequately in learning process and in preparing teacher students to use them in school context.
3. ***ICT infrastructure*** for teacher training at the teacher training institutions ***does not correspond to the needs***.

School level

1. There is a ***lack of both qualified ICT-teachers and ICT managers*** who could act as promoters for applying ICT tools in education, developmental work and trainers of their colleague teachers. Although the situation is not good in Estonian speaking schools, it is even worse in Russian speaking schools. This is also why the teacher's portal *Õpetajate võrguvärav* is operating in Estonian language only and almost does not contain materials written in Russian. Presence of highly qualified specialists in schools is of vital importance because production of educational software is not profitable for software producing companies (the target group – Estonia with its 1,4 million citizens – is too small). Development of original educational software and adaptation of existing software should mainly be done by ICT-teachers and by ICT managers.

2. ***Not enough educational software*** based on Estonian language. There is only one company in Estonia – *Miksike* – who is specialized on development of educational software (www.miksike.ee).
3. The ***subject teachers do not have enough skills*** for preparing high quality learning materials nor for using ICT tools in teaching process.
4. ***Relatively low financing level of Eenet*** who is the main Internet provider for schools. A number of schools are using radio links what will soon be abandoned in Estonia and new solutions need new investments.

The future plans

The future plans are in great extent determined by already cited programs "Tiger Leap Plus" and "Look into the World" as well by the policy of Ministry of Education (state order for ICT teachers and ICT managers, targeted investments into ICT infrastructure in teacher training, qualification requirements for school teachers and university teachers etc). On top of that we list some more vitally important aspects directly not mentioned in above cited programs.

The universities should:

1) significantly expand research in educational technology. Among other activities it should be planned:
   - To join with SITES program (www.pedanet.jyu.fi/cato/sitesmain.html) and with the follow-up world wide research programs,
   - To start national targeted research programs in educational technology,
   - To join with European Union 5th Framework program applications,
   - To broaden PhD studies in the area.
2) Significantly modernize teacher training by expanding implementation of ICT tools and modern educational technology methods into teaching/learning process (i.e. to start "Tiger Leap for Universities" or at least "Tiger Leap for Pre-service Teacher Training").

Additionally, all teachers training institutions are developing and will develop distant education courses.

Comprehensive and vocational schools should:

Guarantee that ICT competence of teachers and other personnel will correspond to requirements according to the following three level scale:

- The persons with elementary skills in ICT (given under ***Basic Regulations***, "Requirements for school teacher competencies in educational technology" for teachers; similarly for school administrators),
- Person(s) who is(are) coordinating usage of ICT tools along the curriculum,
- The ICT manager.

Probably the best possible solution in many cases would be to join the second and third competencies by preparing ICT managers who also have teacher's qualification.

The state (possibly via *Tiger Leap Foundation*) should:

1) Guarantee that the Phare ISE program will successfully be completed (for example, at the moment only part of the schools were supplied with the Extens program),
2) Order from the teacher training institutions enough ICT teachers and ICT managers.

Indicators

The following indicators were accepted by *Tiger Leap Plus* program:

1) An average number of pupils for one computer,
2) Percentage of schools having on-line Internet connection,
3) The condition of hardware (parameters, age etc),
4) The number of teachers and administrators who have needed ICT competences,
5) The net of educational institutions providing continuing education courses,
6) Percentage of schools where ICT will be used in subject teaching,
7) The amount of learning materials accessible by Internet, and the number of usage,
8) Knowledge about global developments in ICT, their usage in everyday work.

Armenia

Nowadays one of the priorities in the national policy of Armenia in the sphere of informatics and information technologies is the issue of the social rehabilitation and integration into the modern society of the people with special needs. This category includes not only desabled persons but mainly unemployed, whose status is due to the fact that their professional skills are not requested by the society.

Unfortunately the share of the persons with special needs stays very high in Armenia. The first reason for that is the economic crisis in the country under development, the second one is the earthquake consecuenses that the country is still faced.

In the condition of poor natural resources provision and the geographic situation of the country that isn't advantageous it's information science and information that becomes the priority trend in the national development. It comes along with the policy of the Armenian government as well as with the European Union approaches which strives to make Armenia the regional center of information technologies has been accentuating recently. Obviously, international organization like UNESCO are also involved in the process.

Armenia is a traditional center of development of informational science in the former USSR and nowadays there is high amount of highly skilled professionals in armenia who due to the social and conomic problems lost their jobs and qualification. Their rehabilitation as the participants of the process of economic development now is a key trend in the work of the system of postgraduate education in Armenia and particularly of the only specialized educational institution of that kind in the Republic, The State Institute of Staff Development and Upgrading in Informational Science.

"The bottle neck" in the problem solution may be called the absence of the common approach to the development of the multistage system of life-long education widely using information technologies resources. The same importance acquires the creation and improvement of the methodic, technical means and educational software for persons with special needs using modern technologies.

As the way of passing by the bottle necks the creation of the infrastructure of special stationary and mobile centers of informatics for the persons with special needs is supposed. The first results of this work show that the goal may be achieved in a short-term period.

The creation and improvement of the methodology of informatization of education is required. Step by step the focus on the postgraduate and higher education must be carried over to the secondary, primary and pre-school education. The issues of the education for people with special needs must be paid special attention.

Creation of the correlated curricula at all levels of education using information tecnologies not anly as a subject but also as a means of training will allow restructuring of the system of lifelong education. The special attention must be paid to the localization and adaptation of the existing methods, software and tools.

Achieving these goal will be impossible withou focusing on the issues of staff development for the teachers of diferent levels. It's also very important to improve the technical infrastructure of the education system, provide education centers with new hardware, create local and regional educational networks with the possibility of integration into global networks.

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: armenia

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims	√			√
Objectives		√		√
Methods of implementation	√			√
Funding plan	√		√	
Quality Assurance and Evaluation, Indicators	√			√
Focus on primary phase			√	
Focus on secondary phase	√			√
Focus on tertiary phase		√		√
Focus on adult education		√		√
Special needs	√			√
Curriculum & pedagogical development				
ICT as a subject		√		√
ICT across the curriculum		√		√
Vocational ICT training		√		√
Software	√			√
Generic software tools		√		√
Subject specific software and digital materials	√		√	
Localising, versioning, licensing		√		√

Production, delivery, updating and use		✓		✓
Capacity building				
- Pre-service teacher education	✓	✓	✓	✓
- Staff development	✓	✓	✓	✓
Support				
- Technical		✓		✓
- Pedagogical		✓		✓
- Media design	✓			✓
Technical infrastructure	✓			✓
Hardware		✓		✓
Local-area networks	✓			✓
Wide-area networks (Internet)		✓		✓
Management				
- national level	✓		✓	
- local level	✓			✓
- institutional level		✓		✓
Quality Assurance, Inspection	✓			✓
Research	✓		✓	
Student assessment	✓		✓	
Other, please, specify				

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: Moscow

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims		√		
Objectives		√		√
Methods of implementation	√			√
Funding plan	√			√
Quality Assurance and Evaluation, Indicators	√			√
Focus on primary phase	√			√
Focus on secondary phase		√		
Focus on tertiary phase		√		
Focus on adult education	√			√
Special needs	√			
Curriculum & pedagogical development				
ICT as a subject		√		
ICT across the curriculum	√			√
Vocational ICT training		√		
Software	√			√
Generic software tools	√			
Subject specific software and digital materials		√		
Localising, versioning, licensing		√		

Production, delivery, updating and use		✓		
Capacity building				
- Pre-service teacher education		✓		
- Staff development		✓		
Support				
- Technical		✓		✓
- Pedagogical		✓		✓
- Media design	✓			
Technical infrastructure	✓			
Hardware		✓		
Local-area networks	✓	✓		
Wide-area networks (Internet)	✓	✓		
Management				
- national level				
- local level	✓			✓
- institutional level	✓			✓
Quality Assurance, Inspection	✓			✓
Research	✓	✓		✓
Student assessment	✓			✓
Other, please, specify				

Список заданий для «домашней работы»

Пожалуйста, ставьте галочки (√) в соответствующие клетки, отмечая Ваши национальные/региональные приоритеты.

Страна/регион: Россия, Москва

	Краткосрочные (1-2 года) планы		Долгосрочные (3-5 лет) планы	
	Разработка	Совершенствование / Пересмотр	Разработка	Совершенствование / Пересмотр
Основания и цели		√		
Задачи		√		√
Способы осуществления	√			√
План финансирования	√			√
Оценка и контроль качества, показатели	√			√
Акцент на начальном образовании	√			√
Акцент на среднем образовании		√		
Акцент на высшем образовании		√		
Акцент на образовании для взрослых	√			√
Образование людей с особыми потребностями	√			
Разработка учебных планов и педагогика				
ИКТ в качестве предмета		√		
ИКТ в учебном плане	√			√
Профессиональное обучение ИКТ		√		
Программное обеспечение	√			√
Неспециализированные программы для ПК	√			

Предметно специализированные компьютерные программы и материалы в цифровом формате		√		
Локализация, создание версий, лицензирование		√		
Производство, доставка, обновление и использование		√		
Укрепление потенциала				
- Подготовка преподавателей		√		√
- Повышение квалификации персонала		√		√
Поддержка				
- Техническая		√		
- Педагогическая		√		
- Средства связи	√			
Техническая инфраструктура	√			
Компьютерное оборудование		√		
Локальные сети	√	√		
Глобальные сети (Интернет)	√	√		
Управление				
- национальный уровень				
- региональный уровень	√			√
- уровень учреждения	√			√
Контроль качества, инспекция	√			√
Исследования	√	√		√
Оценка учащихся	√			√

Другое (уточните, пожалуйста)				

MA

BELARUS

Notes for summarizing

Main aspects	Core ~~problems~~ principles	Main problems and "bottle necks"	Ways of overcoming, success practice	Recommendations	Other comments
Political, economic and social conditions for integrating ICTs into education					
Technological conditions for integrating ICTs into education					
Pedagogical aspects	CS for selected students in some schools				
Ethical aspects					
Teacher aspects					
Funding and fundraising					
International and cross-national co-operation					
Other aspects					

No plan ?

The task sheet for the homework

Please indicate by ticking (√) the cells your national/regional priorities.

Country/region: **Belarus**

	Short-term (1-2 years) plans		Long-term (3-5 years) plans	
	Producing	Updating / Revising	Producing	Updating/ Revising
Rationale & Aims		Y	Y	
Objectives		Y	Y	
Methods of implementation		Y	Y	
Funding plan		Y	Y	
Quality Assurance and Evaluation, Indicators	Y		Y	
Focus on primary phase		Y		Y
Focus on secondary phase		Y		Y
Focus on tertiary phase		Y	Y	
Focus on adult education	Y		Y	
Special needs	Y		Y	
Curriculum & pedagogical development				
ICT as a subject	Y		Y	
ICT across the curriculum	Y		Y	
Vocational ICT training		Y	Y	
Software		Y		Y
Generic software tools		Y		Y
Subject specific software and digital materials	Y		Y	
Localising, versioning, licensing		Y		Y

Production, delivery, updating and use		Y		Y
Capacity building				
- Pre-service teacher education		Y		Y
- Staff development		Y		Y
Support				
- Technical		Y		Y
- Pedagogical	Y		Y	
- Media design	Y		Y	
Technical infrastructure		Y		Y
Hardware		Y		Y
Local-area networks		Y		Y
Wide-area networks (Internet)	Y		Y	
Management				
- national level	Y		Y	
- local level	Y		Y	
- institutional level		Y		Y
Quality Assurance, Inspection	Y		Y	
Research	Y		Y	
Student assessment	Y		Y	
Other, please, specify				

INFORMATION and TELECOMMUTICATION TECHNOLOGIES in BELARUS

Nikolai Listopad
Computer Analytical Center of the Ministry of Education of Belarus

Since its declaration of independence in 1991 Belarus has embarked on a path of transition to a democratic civil society and market economy. This process has been accompanied by gradual integration into the world community, accession to numerous international conventions and membership in international organizations Historically, Belarus used to rely upon the intellectual resources of its citizens. While still a part of the USSR, Belarus was a high technology and science center for the whole country. The collapse of the USSR and the following economic crisis made it impossible for Belarus to preserve its leading position in science-intensive product manufacture. Notwithstanding these changes, Belarus was able to preserve a considerable part of its potential. As a result of the economic crisis and disintegration, Belarus is almost completely devoid of information and communications infrastructure. The digital resources necessary for developing and supporting reforms, which are available to governmental and non-governmental organizations, are very modest. Internet access is quite limited and most institutions do not have it at all. The existing communicational infrastructure does not fit the growing demands, and thus impedes the development of democratic reforms, the improvement of governmental management, and the transition to a market economy.

Fast access to data and the opportunity for electronic information exchange is vital conditions for the successful functioning of state organizations, NGO's, and educational institutions. Access to world information resources is required for the normal running of state institutions, NGO's, educational and scientific institutions in order to develop democracy and improve state management. As a result, this leads to successful human resource development.

Knowledge of both the Internet and computer comes to be increasingly important for people. Students have to be taught to use Information, Computer, Internet and Communication. The knowledge in this field is growing very fast. There are new technologies born through going this way. They have made great progress in industry and in about all people services. These new working places, "made" with computers, are very attractive to young people getting for jobs.

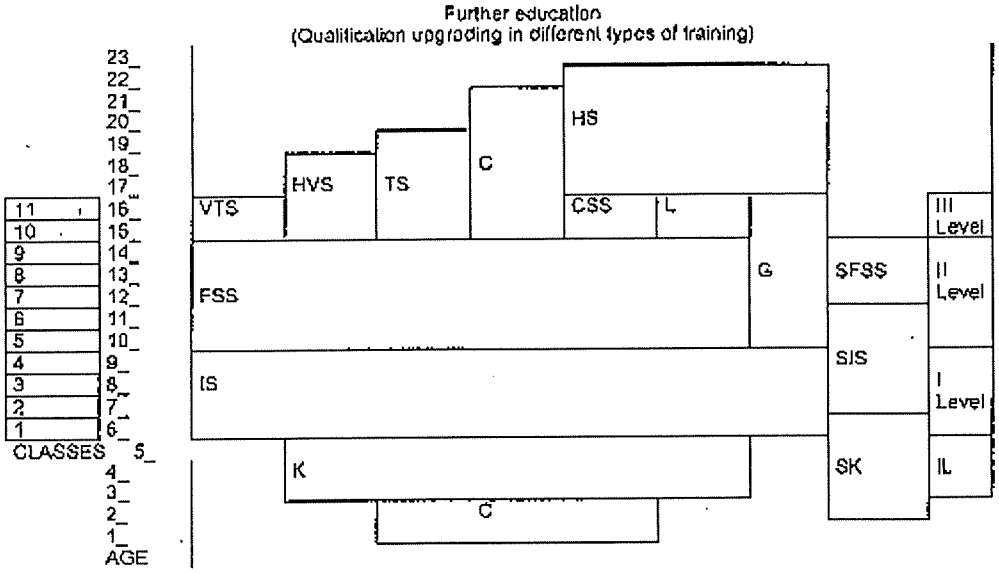
Today information is one of the most important strategic resources of a society. The acquiring of sovereignty by the Republic of Belarus and its economy transition to the market principles challenged the changing of the traditional principles of the society organisation

THE STRUCTURE OF THE NATIONAL EDUCATIONAL SYSTEM

The process of forming and development of the education system in the Belarus Republic is implemented according to the constitutional demands and guaranties in the field of education, providing equal opportunities for its acquiring, the integrity of the educational system and succession of all the educational stages. The structure of the national educational system is based on on the principle of continues education and training.

Scheme 1

Structure of education in the Belarus Republic



- IL-Initial Level;
- C-Creche,
- K- Kindergarten;
- SK - Special Kindergarten;
- IS- Initial School;
- S1S - Special Initial School;
- FSS - Fundamental Secondary School;
- SFSS - Special Fundamental Secondary School;
- G - Gymnasium;
- VTS - Vocational and Technical School,
- HVS - Higher Vocational School,
- TS - Technical School;
- C - College;
- CSS - Complete Secondary School:
- L - Lyceum;
- HS - Higher School (Universities, Academies, Special Higher Educational Institutions)

THE SYSTEM OF HIGHER EDUCATION IN THE BELARUS REPUBLIC.

At the beginning of the 2000/01 school year the System of higher education in the Belarus Republic consisted of 42 state higher educational institutions (HEI), Management Academe under the President of the Belarus Republic and 19 non-governmental HEI:

The number of students

	The number of HEI	The number of their students
State HEI	42	174 189
Non-state HEI	19	23 192
Total	60	197 381

Academical staff:

Staff, total	15 153
Includinq females	6252
Including doctors of science	843
Including females	101
Candidates of science	7104
Includinq females	2312

THE SYSTEM OF SPECIAL SECONDARY EDUCATION IN THE BELARUS REPUBLIC

At the beginning of the 2000/01 school year the system of special secondary education in the Belarus Republic consisted of 146 state special educational institutions (SSEI) including 77 technical schools, 18 colleges and 51 schools . Besides there are 3 non-governmental SSEI:

The number of students

	The number of SSEI	The number of students
Govrnmental SSEI	146	121 560
Non-governmental SSEI	3	812
Total	149	122372

SSE/ staff:

Staff total	10838
Teachers on the staff	8414
Including females	5768

THE SYSTEM OF SECONDARY EDUCATION IN THE BELARUS REPUBLIC.

At the beginning of the 2000/01 school year the system of secondary education in the Belarus Republic consisted of 4808 schools of general education, 98 special schools and boarding schools for the children with mental or physical deficiency, 25 sanatorium boarding schools, 82 evening schools and 242 professional and technical schools subordinate to the Ministry of Education. Besides, there are 15 schools and 10 vocational and technical colleges, subordinate to other Ministries and institutions

	The number of educational institutions	The number of their students	The number of teachers
Day-time schools	4808	1 538 068	126489
Evening schools	82	20911	788
Special schools	98	20095	2666
Vocational and technical schools	252	130083	14064

According to the acting law, the control after the education in the Belarus Republic is realised by the body of state administration (legislation -Supreme Soviet (the Parliament) of the Republic, laws execution - the Cabinet of Ministers) as well as the regional control administration. The Ministry of Education of the Belarus Republic has the control over the submitting higher and secondary special educational institutions, scientific and educational and methodological organisation, institutes of qualification upgrading, republican departments and organisations. It carries out the general organisational and methodological control after the activity of the educational departments and administrations of the regional. Executive Soviets of People s Deputies which are in charge of children s pre-school and out-of-school institutions, schools of general education, vocational and technical and pedagogical schools and colleges At the begging of 2000 there were 4 576 preschool and 3318 different out-of-school institutions in the Belarus Republic.

INFORMATION TECHNOLOGIES IN THE SYSTEM OF SECONDARY EDUCATION.

The creation of the national system of teaching the basis of information technologies application started in 1985, in the framework of the federal programme. First of all it was based on the introduction of the new subject "The bases of informatics and computers" in the existed curriculum. The lack of the school teachers of the new subject caused the involvement of the teachers with the different level of informatics knowledge, various fundamental education and working experience. Within the period of two years (1985 - 1986) on the base of universities and pedagogical institutes there was organised the mass pre- and in-service training. In 1985 pedagogical institutes started to train teachers of informatics. During the first six years the school subject of informatics developed in the republics of the former USSR in common directions and by the common programmes. The school course of informatics pursued the following objectives - the forming of student's notions about computer information technologies and their role in society s development, - providing students with the simplest skills of using computer information technologies.

The achievement of the educational aims in the course. The bases of informatics and computers were stipulated by learning the programming languages and their application in the solution of computing problems. The passed years witnessed the considerable progress made in providing students with the skills of programming, and as the result was the successful participation of the Belarus students in the different Olympiads on informatics. The development of computer hardware and software revealed the necessity of changing the content and the structure of informatics teaching at school. The analysis of the teaching experience of the course based of informatics and computers of computer hardware and software resources, of society s needs revealed in its turn the necessity of the division the process of students digestion the basis of computer literacy at school; 1 VIII -IX forms - the basic course providing the minimum of students general educational skills and knowledge; 2 X-XI forms - the specialised students training in informatics, different in its volume and content depending on students interests and schoolresources. In order to innovate the content of the course in 1995-96 there was developed and introduced the programme of the new basic course called “Informatics”. The objectives of the new course were almost the same but the means of their achievement had radically changed. The content basis of the course consisted not of the programming languages, but of the universal programmes for information processing text processing computer graphics, DBMS, spreadsheets etc. The programme strengthened a general educational aspect of subject. The basic nftions of the course are computer, information, data processing, algorithm,

model. In 1996-1997 there were published new textbooks for the course. Now, the specialists are working out the complete methodological set In 2000 there were developed the programmes of the specialised courses on informatics for the students of the 9th-10th forms with the extended training in informatics, in mathematics, physics and economy. There was started the preparation for the work with these programmes. Nowadays, those who are involved in the process of secondary information technologies introduction in education are solving the following problems - the equipment of the fundamental schools of general education (nine years schools) with computer hardware (today the level of school equipment makes up only 6 % of the demanding level) teachers training for fundamental schools - the equipment of the specialised schools with up to date computer hardware and software. At present, the situation with information technologies application in the educational system is determined by the three following factors - hardware, software and professional level of the specialists in information technologies application in the field of education. Nowadays, computers are used at school to form the basis of informational culture, to form students' skills of the practical work with computer and applied software 84 % of the available computers allow to realise a basic course of informatics in practice. However, we should obviously take into consideration the fact that computers are more and more often applied as an educational tool in the process of learning the general educational and specialised subjects. And in this context, the capacity of the today available computers, installed in a mass school is not sufficient. In this connection, educational institutions and organisations are oriented at the application of the IBM-compatible computers.

To successfully implement ICT technology you should use the computer network. In Belarus there are a lot of Nets, but one of the more powerful from them is Unibel – R&D computer network. Since 1992 UNIBEL network provides a wide set of full services based on TCP/IP protocol and has developed extensive experience in this area. It currently serves more than 250 customers, including a lot of major institutes, Belarussian State University, Belarussian State polytechnical Academy etc. UNIBEL represents Belarus in many international networking organisations such as TERENA, RIPE, CEEnet. Network is supported by Open Society Institute, NATO, UNESCO programs, NICE-Global project on ATM-technology and others.

UNIBEL provides services through Computer Analytical Centre (ACC) communicational node. ACC is a research organization responsible for research and coordination of activities in field of information and computer communication for academic and research community of Belarus. ACC is involved in a number of projects and activities connected with the promotion of "informatization" of the universities of Belarus and with the establishment of computer networks in the

country.

Some communication Projects successfully realised by the ACC are the following:

- Minsk Internet Project
- INTERNET project supported by UNDP
- NICE- project

The main goals of these Projects are to provide full access into information resources of the global computer networks for a lot of organisations of the City of Minsk and to introduce the Internet culture as a part of the civil life of the city and nation.The program's aims for future are to develop the infrastructure and increase the number of Internet users in the Republic of Belarus. We feel that the first priority for future should be to provide international Internet connectivity. The second priority should be to develop infrastructure further in Minsk and the regions. We feel that the third priority should be providing training of specialists for science, education, culture, legislation, etc.).

Currently an Internet backbone network was put in place in Minsk. Fibre optic network is now connecting nine nodes including Belarusian State University, BELTELECOM, Centre of Information Security and UNIBEL Network Operation Centre located at Computer and Analytical Centre of Ministry of Education. Training Centre has been established at Belarusian State University.As a result over 75 organisations from the Belarussian provinces gained Internet access. Among them are Vitebsk State University, Vitebsk University of Technology, Polotsk University, Gomel University, Gomel Polytechnical Institute, Mogiliov Technical Institute, Mogiliov Regional Library, Brest Polytechnic Institute, Grodno State University, Grodno Medical Institute and others.

Advantagies and Disadvantagies ICT

The process of forming and development of the education system in the Belarus Republic is implemented according to the constitutional demands and guaranties in the field of education, providing equal opportunities for its acquiring, the integrity of the educational system and succession of all the educational stages.

Higher school hardware is based on IBM-compatible computers The modern multimedia computers are still rare nowadays However the software meets the level of the latest world developments. In the present conditions the mass character of information technologies introduction in the system of education of the Republic first of all is restrained by the low level of availability, related to the present financial support of the educational system The lack of the technical support stipulated the poverty of the other parameters (effectiveness and convenience) though it is also connected with psychological aspects: teachers are not ready to use information technologies The perspectives of information technologies

application in the Republican system of education are first of all related to the increasing of the financial support of this process, to the propaganda of information technologies through the distribution of the information about the latest developments in this field.

The combination of computer techniques and means of communication emerge the new computer function - they become a means permitting to widen the scope of the information space of a given organisation, to expand the opportunities of the information interaction up to the scope of a city, region, republic and, finally, to provide entering the world information space. In this case a personal computer user finds himself involved into a powerful telecommunication infrastructure, he or she becomes an element of a global computer network

To cross to advantages and disadvantagies of ICT there is a main contradiction between ICT and education. If you take the system of education that you could see there very slow changes. In the same time the changes of the ICT are very rapid. For example, your computer you should upgrate every two years. But the changes in education are happened for ten years. We should remember it if we are talking about development and introduction ICT in education.

So, There are the following advantagies:

1. Open new opportunities (for interation via Internet, more flexibility for traning)
2. Individualized learning and teaching.
3. Distance learning.
4. Group learning and teaching via Intenet.
5. To have the opportunities to get any information.
6. To exchange the information.

Disadvantagies:

1. Teachres are not ready to use the ICT.
2. Students don't want to read the books, they are provided Internet acess.
3. You could solve a lot of problems:

administrative-economical problems - the obligation for educational institutions to allocate hardware and software;

personnel problems – the obligation for educational institution to select from the teaching staff a special group of teachers for supporting of ICT projects;

methodical problems– most of the teachers currently do not have the skills, required for use ICT

technological problems – software applications are not very expensive for educational organizations.

There is a specific circle of problems, connected with the changes of the teacher's role. Some authors say about a potential **danger of dehumanization of education**, elimination of " the linchpin of the process - a personal contact between the teacher and the learner in the classroom ". That means distance learning via Internet, using

communication technologies and so on..

4. Create physical and technological infrastructure
5. Develop required skills: total computer literacy, information handling, critical & creative thinking and other..

In Belarus development and introduction ICT are implemented in frame of several State Programmers and Projects. First of all these is State Programmer "Informatization of the System of Education of Belarus". The Programmer is oriented to the secondary schools. The main goal – to introduce the ICT in learning process.

"Information Computer Network for the System of Education of Belarus" deals with the problems of the creation of information education resources, development distance learning.

The main goal of Programmer "Creation R&D Network" is to provide high speed access to global information resources for R&D community.

More information about current situation with ICT in Belarus you could find in our Matrix.

Today information is one of the most important strategic resources of a society development. It caused the inflow of tidy investments in the creation of information systems and technologies. So it became obvious that the further society s development is widely determined by the level of its informing citizens in the field of their professional activity

Conceptual positions of introduction of ICT in education of **Ukraine**

1. Global tendencies

Social - economic needs of a developing society act as the requirement to an education system and, in the main thing, consist in creation of conditions for maintenance: · harmonious becoming and development of the person as individual and a member of a society, reproduction in rising generation of social, national and world culture, formation of sensual sphere and valuable system which is based on universal and culture values; · vocational training which provides formation at the person of the appropriate properties, skills of social - useful productive activity, provides on this basis his competitiveness on labour markets, an opportunity of his active participation in social - economic activity of a society. It is obvious, that these two requirements and processes are mutually connected and mutually develop one another.

Characteristic and determining feature of modern stage of social and economic and scientific and technical development of a society is change of dominant kinds of activity, displacement of the centre of gravity in public distribution of work to such kinds which are connected to wide use of modern information and communication technologies (ICT).

Continuous and fast development in world of ICT allows to speak that today ICT are one of the most widespread means of activity of the person, influence formation of methods and ways of their activity and thinking, with the help of existing and developing global communicative networks open new opportunities of dialogue and reception of the information. Conducting function which today is provided with means of ICT, consists not in calculations, but in accumulation, ordering, a filtration and display of information objects, their communications in planetary scale. This process is accepted for naming information of a society, and the society gradually gets features of information society.

Information of a society assumes outstripping information of sphere of a science and education where, basically, the personnel and scientific and technical base of the information as process and social - economic phenomena, the future of achievements and development of a society as a whole is pawned. Information of education acts as a component of the general tendency of globalization of world processes of development, as determining information and communication basis of harmonious development of the person and social - economic systems of a society. To prepare the person for active ability to live in an information society - one of the main tasks of the present stage of modernization of a national education system, and creation of scientific and pedagogical maintenance of this process - one of the main tasks of a pedagogical science.

2. The purposes of information of education

Information of education (introduction of information and communication technologies - ICT in education) is the ordered set of the interconnected organizational - legal, social and economic, educational-methodical, scientific and technical, industrial and administrative processes directed on satisfaction of educational, information, computing and telecommunication needs of participants of teaching and educational process.

Information of education is the integral component of information of a society. it essentially influences the contents, organizational forms and methods of training, the doctrine and management of educational-cognitive activity, and also results in changes in activity of pupils, teachers, heads of educational institutions and consequently should capture all directions and spheres of their activity.

Information of educational process, being one of the most important making informations of education, assumes creation, introduction and development is computer focused educational environment on the basis of information systems, networks, resources and the technologies constructed on base of ICT.

An overall objective of information of education is preparation of rising generation, a significant part of the population of the country for high-grade fruitful ability to live in an information society, improvement of quality, availability and efficiency of education.

Realization of an overall objective provides achievement of such small objectives: · formation of information culture of trained people which becomes today the integral making of general culture of each member of a society, characteristic feature and a necessary condition of existence of an information society as a whole; · creation of new and additional (for the account and on the basis of introduction of ICT) conditions of improvement of quality of education in the way:

development and wide introduction in practice of education of new person focused technologies of training, creation of new generation of computer focused means of training; differentiations of teaching and educational process for the most full development of bents and abilities of the person, satisfaction of his inquiries and needs, disclosings of his creative potential; the organizations of effective collective educational activity, including ex-territorial and joint international (education without borders);

expansions of space and increase of efficiency of an easy approach to information (including international)educational resources, databases and knowledge, development of means of formation, storage, search and representation of information educational objects, creation of the automated library systems; development of means of an estimation of results of educational activity (including estimations of educational achievements) and managements of training; · development of new forms of education

and educational technologies which are essentially based on ICT, realization of concepts of open and distance education, increase on this basis of availability and maintenance of exterritoriazation and internationalization of education; · perfection of management by education, creations of the automated control systems at all organizational levels of an education system and at a level of different types of educational institutions; · increase of a level of coordination, efficiency and flexibility, maintenance exterritoriation and internationalizations of scientific researches spent for an education system, wide use of methods, means and technologies of management of projects, formation of modern scientific toolkit and expansion of active space of research experiment.

The degree introduction of ICT in education in many respects displays depth and scales of information of a society, and this process carries universal in relation to an education system character. That is why introduction of ICT in education promotes achievement of the majority of the purposes of all education system. Thus, realization of an overall objective of information of education is provided with achievement of such small objectives which in many respects coincide with overall aims of development of education. Among such small objectives we shall note creation of new and expansion of existing (for the account and on the basis of introduction of ICT) opportunities for: · democratization and internationalization of education, outlook and culture of the person; · increases of a level of fundamentality general and vocational training; · formations at children and youth of a complete scientific picture of the world, need and skills of independent scientific knowledge, self-training and self-realization according to individual opportunities;

· development at children and youth of creative abilities, the organization and an individualization of training of the gifted students and youth, including realization of distance Olympiads; · creations of system of distance testing of a level of knowledge and educational achievements; · development of system of nonscholastic adult education, · more full satisfaction of needs of the population of microdistrict or settlement in culture and educational and socially significant services, use for these purposes of computer and communication means of educational institutions which are located in territory of this microdistrict, settlement or are most approached to him; · development of system of vocational guidance, selection and address employment, creation of special computer focused means for maintenance of this work; · development of special education of persons with features of phisical development, creation of new special methods, means and educational technologies, expansion of scales of scope by such education of the appropriate layers of the population, creation of special means of revealing and diagnostics of features of this development, the correctional and rahabilitation help; · increases of a level of before-professional preparation of learning senior classes of a comprehensive school, vocational training of pupils

professional and students of higher educational institutions, other categories oftrained, expansions of a spectrum and adequacy of application of expert, modelling systems, simulators and other professionally focused means of training and the control of a level of professional competence; · achievements of differentiation, integration and variation of level education, development of further education and education of adults, perfection of system of retraining and improvement of professional skill, including pedagogical and the managerial personnel of education, creation of conditions for education of members of a society during all their life;

· maintenance of the control of dynamics of a state of health of children and learning youth, formation and maintenance in an actual condition of computer information databases of the medical diagnostics appropriate to the medical, preventive and correctional help, spent during term of training, the analysis of influence of character of the organization of the training, used methods, means of training, adverse factors of an environment, other adverse factors on a state of health of pupils both during all term of training, and in the remote prospect.

3. Priority directions and tasks of information of education

To priority directions of information of education on 2001 - 2010 it is necessary to attribute such tasks: 1. Realization in 2001 - 2003 of the project " Pilot schools - 2000 ". 2. Creation of normative base of information of education. 3. Equipment of rural comprehensive schools by means of ICT in all territory of Ukraine. 4. Increase of quantity of educational institutions of all types and the levels of accreditation connected to a network the Internet. 5. Creation of organizational both scientific - methodical conditions and maintenance of introduction of results of the project " Pilot schools - 2000 " in wide educational practice. 6. Creation of a network of the regional service centres for support of activity of educational institutions in a direction of delivery, introduction and service of means of ICT. 7. Creation of textbooks, manuals, other methodical materials for maintenance of teaching and studying of school subjects with wide use of ICT. 8. Development of conceptual bases of creation of an infrastructure of the industry of computer focused means of training, in particular, computer software of training. 9. Creation of system of certification of pedagogical means of ICT. 10. Creation of the state fund of pedagogical software of various purpose.

11. Development of branch unit of the Internet of the first level (computer and network means) and creation of the second level of this unit for providing of access to branch unit the Internet, to its information resource of pupils, educational institutions and scientific institutes of an education system of Ukraine and foreign countries. 12. Creation of national educational Internet portal for maintenance of ex-territorial use of a national educational resource, access to the international sources of the scientific and educational information, realization of the concept of open education. 13. Creation of information-technological and scientific and pedagogical maintenance of national system of

distance education. 14. Creation of system of distance preparation, retraining and improvement of professional skill pedagogical and the managerial personnel of education. 15. Creation of system of formation and support in an actual condition of an information educational resource, a network of the automated library systems. 16. Creation of the specialized, corporate and local networks on national, regional educational levels and at a level of educational institutions of all types and levels of accreditation, development of a computer network URANIUM for scientific and educational establishments.

17. Creation of the state system of coordination and management of information of education,including realization of monitoring of key parameters of information of education. 18. Realization of complex pedagogical researches of actual problems of information of education, including, problems of formation of the contents of level information education, computer focused educational environment, open and distance education, formation of an information resource and other actual problems. 19. Realization of the international projects on problems of information of education.

4. The organization and management of process of information of education

For maintenance of the organization and management of process of information of education the specified tasks of priority directions of information should be integrated in the program of information of the education, designed for the certain period, and each of tasks should be submitted and be carried out as the separate project with the design purposes, resources and results. Thus, the program of information of education will be the ordered set of the projects coordinated within the limits of the program aimed at realization of an overall objective and small objectives (the design purposes). For development of strategy, priority directions, maintenance of interdepartmental coordination of the works stipulated by the program of information of education, the Interdepartmental commission under presidency of Vice-premier of minister of Ukraine is created.

For realization of operative management by the Program, coordination of performance of projects and work of executors the parent Organization will be determined from among the educational / scientific organizations of system of the Ministry of Education and a science Ukraine.

5. " Pilot schools - 2000 " Realization of the project " Pilot schools - 2000 " assumes the basic tasks of the project: 1. Development of the normative base necessary for realization of the pilot project. 2. Development of requirements and of some optimum structures of educational computer complexes for different types of educational institutions, in view of quantity in them pupils, number of educational groups and other essential parameters. 3. Delivery to rural comprehensive schools of educational computer complexes on all territory of Ukraine and their connection to a network the Internet.

4. Development of scientifically-grounded technical and economic approaches and decisions on the organization of effective connection and use of different types of educational institutions to a network the Internet in view of their specificity of place in territory of Ukraine. 5. Creation of the Ukraine allocated experimental network of the city and rural general educational and professional educational institutions equipped with educational computer complexes connected by the Internet. 6. Creation of an experimental network of the regional service centres for support of activity of pilot educational institutions in a direction of delivery, introduction and service of means of ICT. 7. Development of structure general educational and before-professional training to computer science, principles and approaches to training other subjects of the school general educational program focused on wide application of ICT. 8. First-order development of an educational complex of computer software in subjects of the school general educational program. 9. Development and release of experimental textbooks, manuals, other educational-methodical materials for maintenance of teaching and studying of school subjects with wide use of ICT.

10. Creation of experimental system and realization of distance retraining and improvement of professional skill of pedagogical and the managerial personnel of education involved in the pilot project. 11. Development of branch Internet unit for maintenance of realization of tasks of pilot experiment. 12. Creation of experimental system of formation and support in an actual condition of an information educational resource, an experimental network of the automated library systems. 13. Development of organizational - functional and financial principles of introduction and use of ICT in general educational educational institutions, in view of an opportunity of their multiplane use in interests of the various social and industrial structures located in territory of school microdistrict. 14. Realization of complex pedagogical researches of actual problems of information of the education, connected to realization of the pilot project. 15. Creation of system of coordination and management of the pilot project. 16. Development of programs and realization of a complex of pedagogical experiments with a network of pilot educational institutions. 17. Realization of monitoring of key parameters of the pilot project.

18. The analysis and correction of pilot approaches and experimental educational-methodical materials by results of pedagogical experiments, preparation for introduction of positive pilot results in wide educational practice. Performance of the majority of tasks of the project " Pilot schools - 2000 " are stipulated by the Decision of the Cabinet of Ukraine from May, 6, 2001 number 436.