Olympiads in Informatics, 2010, Vol. 4, 15–29

Mutual Influence of the National Educational Standard and Olympiad in Informatics Contents

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Abstract. The success of a contestant in the IOI certainly depends too much on the talent of the pupil, the qualification of her/his teachers and additional work with an individual coach. The success of a national team in the IOI however also substantially depends on the level of teaching of informatics at schools in the corresponding country. Strong basic education at regular schools could lead to programming competitions with more participants and allow the selecting of those pupils, who are able to storm the top ranked IOI positions. The goals and the content of the teaching in the Russian schools are defined by the State School Educational Standard (SSES). Taking it into account the teachers and the individual coaches should organize the preparation of students for both the National Olympiad in Informatics and the IOI. In the given article the influence of SSES on the Russian Olympiad in Informatics content is considered.

Key words: olympiads in informatics, IOI, secondary school education, state school educational standard, olympiads in informatics content, competition tasks content.

1. Introduction

Discussing the content of the Russian Olympiad in Informatics (RusOI) for secondary school students it is necessary to stress that it is an official annual event of the Ministry of Education and Science of Russian Federation. RusOI is included in the system of Unified State Examination (USE) of secondary school students. Winners from the final stage of RusOI are accepted in educational programs of universities in the domain of informatics (computer science) without entrance examinations. It means that all secondary school students of the country should have equal opportunity to participate in the olympiad and this opportunity must be guaranteed at the state level.

The goals and the content of the teaching in Russian state schools are defined by the State School Educational Standard (SSES). Organization of the USE also obeys this standard. This fact influences the content of the RusOI in two different ways. On one hand, the olympiad content has to meet all the requirements of the standard concerning the USE of secondary school students in informatics. On the other hand, the olympiad content should be accessible to all students. Each student has to have an opportunity to participate in the olympiad.

In the given article the mutual influence of SSES and RusOI content is considered in depth. In Section 2 the Educational Standard is presented. In Section 3 a comparison

is made between the content of education in informatics and information technologies at schools and the content of the Olympiad in Informatics. In Section 4 some conclusions are formulated. One appendix is included in the paper – a translation of the Russian SSES in Informatics and Information technologies for the high level education in Russian schools.

2. Characteristics of the Russian SSES in Informatics and IT

At the present time, Russian SSES is the basic document which defines the content of school education in informatics and information technologies (the part of the standard concerning the high level of secondary school is given in Appendix). It postulates the main aspects of the modernization of Russian schools, namely:

- introduction of specialized courses in informatics and IT for in-depth training of secondary school students;
- reflection of personal and professional interests of students in the content of secondary education;
- inclusion of creative activities in the learning process;
- formation of key competencies to ensure readiness of students for using the acquired knowledge and skills in real life.

The definition of such goals and tasks had a positive impact on the development of the RusOI. This is because Russian SSES provides, on the first place, the possibility for studying all important subjects during the basic school level (5–9th grades). Until 1998 informatics in Russia was taught only in the high school level (10–11th grades). Students could prepare for participation in informatics olympiads only by means of additional training at specialized educational centers or with individual coaches. Now, lessons in computer science/informatics and information technology are included in the basic level of the school (8–9th grades), and additional lessons in information technologies are also included in the subject "Technology", which starts in 5th grade. The number of classes dedicated for these subjects in each grade is shown in Table 1. So, each student has enough classes in informatics and information technologies in order to meet the requirements of the RusOI and to enter its preparation program.

Thanks to the possibility of all students studying informatics courses in basic school, now the olympiad community looks younger. Children start to express a big interest to information technologies even in the primary school (1–4th grades) where they have a

Table 1

Classes for studying Informatics and Information Technologies in the basic school (5–9th grades)

Subjects	Number of classes (per year)					Total
	5th grade	6th grade	7th grade	8th grade	9th grade	
Informatics and IT	0	0	0	35	70	105
Technology and IT	70	70	70	35	0	245

possibility of receiving initial algorithmic knowledge and get to work with computer programs. This is very important for the children because it eliminates the psychological barriers when they are sitting in front of computer, helps them to understand the actual capabilities of the computers, to develop algorithmic thinking, to initiate informational and instructional activity in educational process, and as a final result to generate an interest in serious informatics. In order to help the teaching of informatics in primary school many free resources were published on the Internet at the site "State Internet-collection of digital educational resources" (SIC-DER, 2007), part "Informatics and ICT", 2–6th grades, named *Set of Virtual Labs on Informatics "Problem Book 2–6"* (in Russian, *Система виртуальных лабораторий по информатике "Задачник 2–6"*).

The second important impact of Russian SSES is that its part (see the Appendix) concerning the high level of the schools (10–11th grades) includes aspects of professional-oriented training of the students. Entering high school each student has to select some professional-oriented courses that will form her/his individual path of development. Thanks to this, each student has the opportunity to implement her/his creative potential in informatics at school, not just at the special centers for training of talented pupils. Obviously, the quantity of such special centers is not enough, and they are only at universities. It is important that the professional-oriented training at schools, including country schools, considerably expands the scope of the students involved in the olympiad movement.

The quantity of classes devoted to professional-oriented courses in informatics is presented in Table 2. It is possible to assert, with a significant confidence, that this quantity of classes satisfies the requirements of talented pupils for deep studying of informatics in many schools in Russia.

The SSES emphasize that the professional-oriented courses in informatics and information technologies for high level of the school aim to achieve the following goals:

- developing and structuring the student's knowledge of mathematical objects in informatics; helping student to understand the means of modeling; teaching them to construct descriptions of the objects and the processes, allowing their computer modeling; helping them to understand information processes in biological, technological and social systems;
- mastering student's skills: to build mathematical objects in informatics, including logical expressions and programs written in formal language, satisfying some description; to create programs in programming language following some specification; to use standard tools and to adjust them for needs of the user;

Table 2

Number of classes for professional-oriented courses in Informatics in the high level (10–11th grade)

Professional-oriented course	Number of classes in Informatics for professional-oriented courses	
	Federal component	Additional component for special courses
Physic/mathematics	4 classes per week	From 1 to 5 classes per week
Information technologies	4 classes per week	From 1 to 7 classes per week

- developing student's algorithmic thinking, including elements of systematic thinking and abilities for formalization;
- forming student's sense of responsibility for the results of their work, positive social activity inside the information society and inadmissibility of actions that break legal and ethical norms when working with information;
- mastering student's skills: to work on projects; to create, edit, format, save, and transfer information objects of various type with the help of modern software; to construct computer models; to implement information projects in a team; to do information work in various spheres claimed from the labor market.

It is important to stress that the above mentioned purposes of the professional-oriented education in informatics are also typical for the RusOI (Kiryukhin, 2008). The experience gained by the olympiad community through the years, substantially promotes creation of new educational technologies for professional-oriented education in Informatics (Kiryukhin, 2009). In particular, the olympiad experience promoted creation of new special elective courses for students, which also include olympiad content.

For these purposes many books (Kiryukhin, 2007; 2008; 2009; Kiryukhin and Okulov, 2007), now very popular in Russia, were published, which help teachers to organize training of talented students and to prepare students for participation in the informatics olympiads. An electronic collection of competition tasks was published on the Internet portal of the RusOI (RusOI, 2009). A system of training contests was created and an Internet-driven contest is organized regularly. Remote on-line practical courses in informatics and information technologies are offered to students of Russian schools (OWPI, 2008). Thus, the professional-oriented component of the preparation of students, including methodical materials and technology of programming resources, are regularly developed and updated.

Anyway, many teachers are still inclined to believe that the content of the Olympiad in Informatics is not linked to the real school curricula. We will provide more detailed analysis in the next section of occurrence of content from the RusOI in the curriculum in informatics for the high level of Russian schools (10–11th grades). It is important to demonstrate that there is a real possibility for students to receive olympiad preparation directly at schools.

3. Relation between SSES and Olympiad in Informatics Contents in Russia

If we consider the SSES in informatics and information technologies for professional-oriented level of the Russian school we will see that the general skills in informatics, necessary for talented students to implement their ideas when solving problems with a computer, are completely covered by the professional-oriented courses. It is especially necessary to stress the wide representation in professional-oriented courses of material necessary for the creation of scientific and algorithmic thinking in students (see Table 3 and the Appendix).

Comparing the content of the RusOI with the topics from the Russian SSES in informatics for professional-oriented level, presented in Table 3, it is possible to conclude

Table 3

Topics of professional-oriented courses in Informatics and Olympiad in Informatics content

Topics from Olympiad in Informatics content	Topics from professional-oriented course in Informatics
Programming language (6 classes)	Rules for construction and estimation of the performance of algorithms. Splitting a task into subtasks. Examples of graphical and numerical algorithms written in programming language.
Computable functions (2 classes)	Functions computable by algorithms. Completeness of the formalization of the computability concept. Universal computable function. Diagonal proofs of non-existence. Inductive definitions of objects. Computable functions defined by systems of functional equations.
Deterministic games with perfect information (4 classes)	Trees. Winning strategy in a game. Game interpretation of logical formulas.
Correctness proofs (4 classes)	Correspondence between an algorithm and the task specification, invariants, inductive proofs.
Practice in construction of algorithms (4 classes)	Numeral system, arithmetic and logical operations; generation of pseudo-random sequences. Algorithms for solving Calculus problems (computation of approximate surface and the value of a function, represented by series, simulation of processes described by differential equations). Brute-force algorithms. Breadth-first and depth-first search.
Data types (4 classes)	Basic data types. Matrices (arrays). Operations with numbers, matrices, strings, lists, usage of pseudo-random numbers. User-defined (abstract) data types.
Complexity of the description of an object (2 classes)	Optimality of the formalization. Algorithmic definition of randomness.
Complexity of calculation (5 classes)	Examples of effective algorithms. Exhaustive search problem.
Events. Parallel processes (3 classes)	Interaction of parallel processes, interaction with the user.

that the curriculum for professional training in informatics in the high level of the Russian school (10–11th grades) to a large degree covers the content of the RusOI. But, as experience shows, for successful performance at the RusOI, especially at the final stages, mastering of material included in the curriculum is not enough. In addition some forms of individual work with talented students is also necessary, as well as actively to develop and introduce various professional-oriented special courses at school.

Topics of professional-oriented courses in Informatics and Olympiad in Informatics content

The Russian SSES for professional-oriented level admits studying of additional special (elective) courses. It is possible to say that the philosophy of professional-training allows each student to receive an education of high quality, following an individual path of development and a profession choice.

It happens that the creation by members of the olympiad community of some professional-oriented special courses, which are accessible to all schools, is possible. In such a way the skills of the teachers preparing contestants, the set of methodical materials

which they use in work with the pupils attracted to informatics, the possibility of cooperation with other students and coaches – direct or through the global network, internet resources, training competitions, and the regular school stages of the RusOI are available for all students. And these are the important necessary conditions, which will allow each school to realize the right of each secondary school student to take part in the olympiad movement in informatics in Russia.

In creating the RusOI curriculum it is necessary to consider also the requirements of the USE defined in Russian SSES. Requirements to participants in the RusOI should correspond to the requirements of the USE. As at the olympiad the same tasks are offered to all participants, irrespective of their grade, we will consider this correspondence both for the basic and the high level of the school.

Preparation in informatics at *the basic level of school* aims to give to students general computing competences (freely to work with the computer and its software) and the ability to put this competence into practice for solving various information tasks (see Table 4).

The analysis of Table 4 shows that the requirements of Russian SSES in informatics for the basic level of schools allows even the students from 8–9th grades to partic-

Table 4
Requirements to preparation of students in the basic level
(Topics from the Standard in Informatics for 8–9th grades)

Topic from the Standard in Informatics for the basic level (8–9th grades)	Requirements to preparation of students in the basic level
Presentation of the information. Information, information objects of various types. Language as a way of presentation of the information: natural and formal languages. Formalization of the description of real objects and processes, examples of modeling of objects and processes, particularly with computer. Information processes: storage, transmission and processing of information. Presentation of the information in a digital form. Units for measuring of information. Control and feedback. The main stages of development of resources of information technologies.	**To use the acquired knowledge and abilities in practical activities and a daily life for:** creation of elementary models of objects and processes in the form of images and drawings, dynamic (electronic) tables, programs (particularly in the form of flowcharts).
Information processing. Algorithm, properties of an algorithm. Ways for description of algorithms; flowcharts. Algorithmic constructions. Logical values, operations, expressions. Partitioning of the task into subtasks, auxiliary algorithm. Processed objects: strings of characters, numbers, lists, trees, graphs.	**To understand, to know**: the main properties of algorithms and kids of algorithmic constructions: following, branching, cycling; concept of auxiliary algorithm. **To know how**: to execute the basic operations with objects – strings of characters, numbers, lists, trees; to check properties of these objects; to build simple algorithms. **To use the acquired knowledge and abilities in practical activities for:** carrying out of computer experiments with usage of ready models of objects and processes.

ipate successfully in the RusOI. As a result, the number of pupils of the 8–9th grades, as a proportion of the participants of the RusOI, permanently increases. Besides a deep knowledge of the mathematical foundations of informatics the technological aspects of education of students at the basic level of school are important, namely, the use of operating systems, network tools for information processing, debugging tools in a programming environment, high-speed typing on the keyboard, etc. The technological skills of the students influence the speed of implementing solutions of competitive tasks and have an effect on the results of participants from the 8–9th grades.

Preparation for the RusOI continues with the professional training at high school. Comparing the content of last the ten years competitive tasks and the curriculum of professional-oriented course in informatics allows the emphasis of those topics of professional-oriented course and the competences of the students, which are valuable for the olympiad. It is necessary to remark, that all topics of the professional-oriented course in informatics are included in competitive tasks. In Tables 5–8 topics from the professional-oriented course in informatics are presented in parallel with the corresponding requirements toward the level of preparation of pupils. The comparative analysis of topics and requirements shows that achievement of each requirement could be evaluated with any competitive tasks. Moreover, each competitive task reveals the competence of the student not fragmentarily but within a set.

Table 5
Correspondence between topics of the standard and requirements at the level of preparation of pupils for the area "Information and informational processes" of the professional-oriented level of the school

Topics of the Standard from the area "Information and information processes" for professional-oriented level of the school	Requirements to the level of preparation of pupils
Kinds of information processes	To recognize the information aspects in the activity of a person and informational interaction in the elementary social, biological and technical systems.
Models of activity of the person	To recognize the information aspects in the activity of a person and informational interaction in the elementary social, biological and technical systems.
Logic and algorithms mathematical models	To know kinds and properties of information models of real objects and processes, as well as the methods and the resources for computer implementation of information models.
	To interpret the results received during simulation of real processes.
Logic and algorithms	To know the general structure of the activities for creation of computer models. To execute virtual experiments and independently to create the elementary models with the use of educational virtual laboratories and the modeling environments.
Basics of the algorithms theory	Properties of algorithms and the main algorithmic constructions; the thesis about completeness of the formalization of notion algorithm.
Programming language	The main constructions of the programming language.

Table 6
Correspondence between topics of the standard and requirements at the level of preparation of pupils for the area "Informational work of the person" of the professional-oriented level of the school

Topics of the Standard from the area "Informational work of the person" for professional-oriented level of the school	Requirements to the level of preparation of pupils
Informational ethics and rights, information security	To know norms of informational ethics and rights, information security, principles of assurance of information security.
Forms of a professional information work of the person	To know assignments and areas of usage of the information and communication technologies and the information resources. To estimate the numerical parameters of information objects and processes: required memory capacity for information storage; a transfer rate and information processing.

Table 7
Correspondence between topics of the standard and requirements at the level of preparation of pupils for the area "ICT Resources" of the professional-oriented level of the school

Topics of the Standard from the area "ICT Resources" for professional-oriented level of the school	Requirements to the level of preparation of pupils
Computer architecture and computer networks	Means and support of reliable functioning of ICT resources. Basic principles of the organization and functioning of computer networks. To fulfill requirements of safety techniques, hygiene, ergonomics and resource-saving by operation with information resources. Support of reliable functioning of ICT resources. To eliminate the elementary faults, to instruct users in basic principles of ICT usage.

Long-term experience in carrying out the RusOI shows that the participants are forming, in addition to all other, the following qualities:

- deep knowledge of the mathematical bases of informatics and the theory of algorithms;
- steady knowledge of information processes, information forms, ways of presentation and transfer of information;
- clear understanding of the principles of operation of computers and the role of software;
- steady practical skills of independent solving of practical tasks with computer programs;
- fluent possession of keyboard input in both Russian and English language;
- clear understanding the structure of computer, skills in operation with peripherals and various media;
- free skills in using: operating system, graphic interface, files system, systems for retrieval, archiving and converting resources, and other applications;
- steady skills in operating with shared and personal resources in a local computer network;

Table 8

Correspondence between topics of the standard and requirements at the level of preparation of pupils for the areas "Technologies of creation and processing of the text information", "Technology of creation and processing of the graphics and multimedia information", and "Processing of the numerical information" of the professional-oriented level of the school

Topics of the Standard from the areas "Technologies of creation and information processing" of the professional-oriented level of the school	Requirements to level of preparation of pupils
Usage of special software tools and digital equipment.	Presentation of information in the form of multimedia objects with a reference system (for example, for allocation in a network). Creations of own databases, digital archives, media libraries. Operating with informational objects, using available knowledge for the possibilities of information and communication technologies. Performing statistical data processing with computer.
Search technologies and information storage Telecommunication technologies Technology of control, planning and the activity organization	Operating with informational objects, using available knowledge for the possibilities of information and communication technologies including creation of data storage structures; to use help systems and other sources of supplemental information; to obey intellectual property rights on information.

- steady skills in operating with specialized software (programming environments, compilers, debuggers);
- free skills in operating with tools of a global computer network (registration, data transfer, information security);
- clear understanding of the norms for operating with information;
- developed sense of self-control and responsibility;
- skills in independent planning of goals;
- general cultural skills of the organization of a jobsite;
- general cultural skills of etiquette;
- strong will for achieving results.

From the above analysis it follows that these competences undoubtedly define a steady professional interest of a student in informatics and a desire for a progress in the professional sphere. Clearly, such a student is potentially active during teaching and will become a successful university student, irrespective of the educational institution selected by her/him. These competences will help to develop her/him and to be successful in any professional field of activity, which she/he will chose in the life.

4. Conclusion

The problems considered in this article play a very important role in the further development of the informatics olympiads in many countries, including the development of the IOI. A large difference between the requirements of the State School Education Standard in Informatics and the content of the informatics olympiads will make these olympiads

accessible only for small number of "professional in informatics" secondary school students. In such case the role of the informatics olympiads will only be to allocate medals among the participants. But this is not the goal. The informatics olympiads should be an example for further development of the State School Education Standards in Informatics and a stimulation for improvement of teachers' activity in their difficult work to find and educate the intelligent elite in each country.

The author hopes that this article will not be the last in the series of articles on the subject and that other members of the IOI community will also share their experience in solving above mentioned problems.

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Appendix. The Russian SSES in Informatics and ICT for High Level of the School

A1. Introduction

Studying of Informatics and Information and communication technologies at a professional-oriented level of the general secondary (full) school is directed to achievement of the following goals:

- developing and structuring the student's knowledge of mathematical objects in Informatics; helping student to understand the means of modeling; teaching them to construct descriptions of the objects and the processes, allowing their computer modeling; helping them to understand information processes in biological, technological and social systems;

- mastering student's skills: to build mathematical objects in Informatics, including logical expressions and programs written in formal language, satisfying some description; to create programs in programming language following some specification; to use standard tools and to adjust them for needs of the user;
- developing student's algorithmic thinking, including elements of systematic thinking and abilities for formalization;
- forming student's sense of responsibility for the results of their work, positive social activity inside the information society and inadmissibility of actions that break legal and ethical norms when working with information;
- mastering student's skills: to work on projects; to create, edit, format, save, and transfer information objects of various type with the help of modern software; to construct computer models; to implement information projects in a team; to do information work in various spheres claimed from the labor market.

A2. The Full Level of School Education Curriculum for Profile Course in Informatics and ICT. Basis Concepts of Informatics and Information Technologies

A2.1. Information and Information Processes

Kinds of information processes. Transfer of information. Signals, coding, decoding and distortion of information. Discrete (digital) representation of text, graphic, sound and video information. Speed of transfer of information. *Perception, storing and processing of information by human, limits of sensitivity and resolution of sense organs.* (N.B. Italics mark the material taught in class but not included in the Requirements to the level of preparation.)

Systems, components, state and interaction of components. Information interaction in a system, control and feedback.

Models in human activity. Descriptions (information models) of real objects and processes, conformity of a description to the object and the purposes. Descriptions by schemes, tables, graphs, formulas. Usage of descriptions (information models) in human interaction, practical activities, research.

Mathematical models: examples of logic and algorithmic languages, use of them for the description of objects and processes of the nature (alive and lifeless) and technology, including physical, biological, economic processes, and information processes in technical, biological and social systems. Use of simulation environments (virtual laboratories) for carrying out of computer experiments in educational activity.

Numeral systems. Logic and algorithms. Statements, logic operations, quantifiers, validity of a statement. Strings (finite sequences), trees, lists, graphs, matrixes (arrays), pseudo-random sequences. Inductive definition of objects. Computable functions, completeness of conception for computability, universal computable function, *diagonal proofs of non existence*. *Winning strategies. Complexity of computation. Exhaustive search. Expressing computable function by system of equations. Complexity of description.* Error-correcting codes. Sorting.

Elements of the algorithms theory. Formalization of the concept of algorithm, equivalence of formalizations. Computability. Construction of algorithms and practical computations.

Programming language. Data types. Basic constructions of a programming language. Programming environment. Basic stages in development of programs. Partitioning of a task into subtasks.

A2.2. Information Activity of a Human

Kinds of professional information work of a human and used tools (hardware and information resources). The professions connected to construction of mathematical and computer models, programming, support of information activities of individuals and organizations. Role of information in the modern society and its structures: economic, social, cultural, educational. Information resources and channels of the state, society, and organization; structure. Educational information resources.

Economy of information sphere. Cost of information activities.

Information ethics and legislation, information security. Laws concerning information, offences in information sphere, measures of their prevention.

A2.3. ICT Means

Architecture of computers and computer networks. Software and hardware of computers and computer systems. Kinds of software. Operational systems. Concept of system administration.

Safety, hygiene, ergonomics, technology requirements of a computer workplace. Typical malfunctions and difficulties in the use of ICT. Equipment of a computer workplace according to the purposes of its use.

Estimation of numerical parameters of information objects and processes, characteristic for the chosen sphere of activity.

Preventive maintenance of the equipment.

A2.4. Technologies of Creation and Processing of the Text Information

Concept of desktop publishing system. Creation of computer publications.

Use of ready and creation of own templates. Use of system for spelling and grammar. Thesauruses. Use of systems of bilingual translation and electronic dictionaries. Collective work with a text, including in a local computer network. Use of the digital equipment.

Use of the specialized tools for editing of mathematical texts and graphic representation of mathematical objects.

Use of systems for recognition of texts.

A2.5. Technology of Creation and Processing of Graphic and Multimedia Information

Concept of a system for computer aided design, environments for computer design and multimedia environments. Formats of graphic and sound objects. Input and processing of graphic objects. Input and processing of sound objects.

Use of the special software and digital equipment.

Creation of complex graphic objects for various domains: transformations, effects, design. Creation and transformation of sound and audio-visual objects. Creation of presentations, performance of educational creative and design works.

Skilled works in the field of cartography; use of geographic information systems in research of ecological and climatic processes, in city management and in agriculture.

A2.6. Processing of Numerical Information

Mathematical processing of statistical data, results of experiments, including the use of peripheral sensors. Use of dynamic (electronic) tables for performance of educational tasks from various domains: processing results of natural-science and mathematical experiments, economic and ecological observations, sociological investigations, individual parameters of educational activity. Examples of elementary problems of book keeping, planning and the account of resources.

Use of tools for solving statistical and settlement-graphic problems. Processing of numerical information by sample problems of accounting and planning.

A2.7. Technologies of Search and Storage of the Information

Concept of database management systems, retrieval systems in computer networks, library information systems. Computer archives of information: electronic catalogues, databases. Organization of databases. Examples of databases: in legislation, in libraries, in public health services, in taxes administration, in social activities, in human resources management. Use of DBMS for creation of school information system.

Use of tools of retrieval systems (formation of requests) for search in educational portals and electronic catalogues of libraries, museums, book publishing, mass-media within the framework of educational tasks from various subject domains. Rules for referring the used sources.

A2.8. Telecommunication Technologies

Concept of tools for telecommunication: e-mail, chat, teleconferences, forums, space bridges, an Internet-telephony. Special software tools for telecommunication technologies. Use of telecommunication in collective activity. Technologies and tools in the global and local computer networks for protection of information from destructions and non-authorized access. Rules for use of anti-virus programs and their adjustment for automatic check of the traffic.

Tools for creation of information objects in Internet. Methods and tools for creation and support of an Internet site.

A2.9. Technologies of Management, Planning and Organization of Activity

Technologies of automated management in the educational environment. Technologies of management, planning and organization of activity of a person. Creation of organizational diagrams and schedules; automation of the control of their performance.

Systems of automatic testing and control of knowledge. Use of testing systems in educational activities. Tools for creation of simple tests and accounting the results of testing.

A3. Requirements to the Level Preparations of Graduates

As a result of studying Informatics and ICT at a profile level the pupil should:

know/understand

- symbolic mathematics;
- the basic constructions of programming language;
- properties of algorithms and the basic algorithmic constructions; the thesis about completeness of formalization of concept of algorithm;
- kinds and properties of information models of real objects and processes, methods and tools of computer implementation of information models;
- the general structure of activity on creation of computer models;
- purpose and areas of use of the basic tools of information and communication technologies and information resources;
- kinds and properties of sources and receivers of the information, ways of coding and decoding, the reason of distortion of the information during the transfer; relation between bandwidth of the channel and the speed of the transfer;
- basic principles of the organization and functioning of computer networks;
- norms of information ethics and legislation, information security, principles of maintenance of information security;
- ways and tools for maintenance of reliable functioning of ICT environment.

be able

- to differentiate: information aspects in human activity; information interaction in the elementary social, biological and technical systems;
- to build information models of objects, systems and processes, using typical tools (programming languages, tables, graphs, diagrams, formulas, etc.);
- to calculate value of complex statement from values of elementary statements;
- to carry out statistical data processing with the help of a computer;
- to interpret the results received during modeling of real processes;
- to eliminate elementary malfunctions; to instruct users on principles of ICT use;
- to estimate numerical parameters of information objects and processes: a memory size necessary for storage of the information; speed of transfer and processing of the information;
- to operate with information objects, using available knowledge of opportunities of information and communication technologies including to create structures of data storage; to use help systems and other sources of help information; to obey rules for intellectual property of information;
- to carry out virtual experiments and independently to create elementary models in educational virtual laboratories and modeling environments;
- to obey requirements for safety, hygienic, ergonomic and recourse saving work with tools of information technologies; to maintain reliable functioning of ICT environment.

be able to use the knowledge and skills in practical activities and a daily life for:

- searching and selection of information, in particular, connected to personal cognitive interests, self-education and vocational counseling;
- presenting information as multimedia objects with system of references (for example, a network hypertext); creations of own databases, digital archives, media libraries;
- preparation and performing of presentations, participation in collective discussion, fixing its course and results;
- personal and collective dialogue with use of modern software and hardware for communications;
- obeying of requirements of information safety, ethics and the legislation.

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