STRATEGY
FOR EFFECTIVE IMPLEMENTATION
OF INFORMATION AND COMMUNICATION TECHNOLOGIES
IN EDUCATION AND SCIENCE IN THE REPUBLIC OF BULGARIA
(2014-2020)

Working group with the Minister of Education and Science,

Sofia, 31.01.2014

About the strategy

This strategy is in accordance with the management practice in the Republic of Bulgaria and is a middle term document, encompassing a 7-year period (2014-2020). The strategy has been developed in accordance with the Methodology for Strategic Planning, approved by the Council for Administrative Reforms with the Council of Ministers on ground of Orders RD09-1223/23.09.2013 and RD09-1676/15.11.2013 of Minister of Education and Science.

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C O N T E N T S

INTRODUCTION – THE ROLE OF EDUCATION AND SCIENCE ON GLOBAL MARKETS

We live in a dynamic time, in an age of turbulant technological changes, global markets and increasingly opening up of social systems for free movement of people, goods and services. In its millennial history, humankind has often been limited by time and distance to execute one activity or another and go through one transformation or another, but in the age of the information society and on the verge of knowledge economy these are no longer obstacles to development. One can travel the world round in less than twenty-four hours by high-speed airplanes, while digital networks connect one instantly with any part of the planet, whenever one needs to communicate with an acquaintance, partner or relative. Technologies and related social models change at such a rate that within a single generation there are changes, which would have needed hundreds of years before. There is no need to give exotic examples; it is enough to remind how the lives of people changed with the invention of electricity, the nuclear energy, space flights, the Internet, mobile communications, social networks… A quick retrospective analysis will easily convince us, that over the last two centuries the world has seen more significant discoveries, than during the entire history of humankind up to that point and the explanation is simple: knowledge is power that once accumulated has a much stronger overall and magical influence on the development of society and, according to the chain reaction principle, there exists a critical mass that once reached is followed by an explosion.

The logical question if are we ready to live in this age and if this crushing acceleration of innovations and discoveries will continue at the same or even faster rates inevitably leads to every country, world organization or social system focising on knowledge and skills. Like Darwin's theory of the survival of the fittest, only the most knowledgeable and skillful individuals, groups and nations can survive and develop in the modern global world. This understanding gains more strength in public and the pursuit of pushing the economy and society forward on the road of knowledge quickly enters the agenda of every single government in the world.

In today's world education is the main driving force of social and economic growth and science is the basis of the change in all important to social development activities. Without these two mainstays of modern civilization man wouldn't exist and the dynamics accompanying them sets serious challenges to every one of us.

This strategy should answer three non-complicated questions: how far our country is ready to participate actively in the establishment and development of knowledge economy; what are the obstacles and how we can efficiently overcome them by means of the new information and communication technologies, which are the main driving force in the development of modern society.

SECTION 1. ANALYSIS OF THE CURRENT STATE, PROBLEMS AND TRENDS

The Strategy for *Efficient Implementation of ICT in Education and Science* up to 2020 (later referred to as "the Strategy") sets the basic goals, tasks, directions in the informatization of the education and science system in the Republic of Bulgaria up to the year 2020, as well as defines the basic principles, approaches and terms for successful realization of the informatization process.

The increasing volumes of the information produced, its active usage in different areas of human activity, the establishment of modern information-communication infrastructure have become the main factors for the occurrence and development of information society. The large-scale implementation of ICT in different spheres of human activity helps the occurrence and development of the global process for informatization of society. In its tuen, this process gives impetus to the **rise of informatization of education and science**.

According to MES data, national education currently is comprised of more than 2 600 educational institutions at different levels (schools, colleges, universities and others) in which more than one million students get their education. Education is backed up by more than 85 000 school and university teachers with many of the university teachers being active in science research. In the science sphere another few thousands of scientists are involved in science researches and developments in around 80 institutes and science units of the Bulgarian Academy of Science and the Agricultural Academy. All these institutions use ICT of various types and kinds at all levels of their activities, including administration, in education and science activity. Overall these institutions currently have around 100 000 computer and terminal devices, serving key processes, with ICT systems bear significant influence on the quality of the corresponding activities, which are often even impossible without adequate technological equipment. Key to the efficient implementation of technologies turns out to be not only ICT infrastructure, but also the skills to work with it, as well as relevant administrative and legislative procedures and adequate modern educational and scientific content and information.

The ICT implementation process meets a series of serious problems that require quantity and quality change as to approaches and means involved:

1. **Lack of systematic and complex approach** to overcoming ICT implementation in education and science problems with separate tasks being taken by national and industry branch programs of specific and inconsistent goals, terms of realization, warrantors and executors;

2. **No unitary information and communication environment,** while wear and tear of computer and terminal equipment and lack of national ICT infrastructure for storing and processing education and science information is a serious obstacle to the development of efficient education and research. For instance, according to a relatively recent research of the European school network, funded by the European Commission, Bulgaria ranks among the last places as to availability of computer equipment in class and opportunities for its use in class. In Bulgarian general schools out of 11 last grade students only 1 has computer or terminal place, whereas in the EU it is 4.

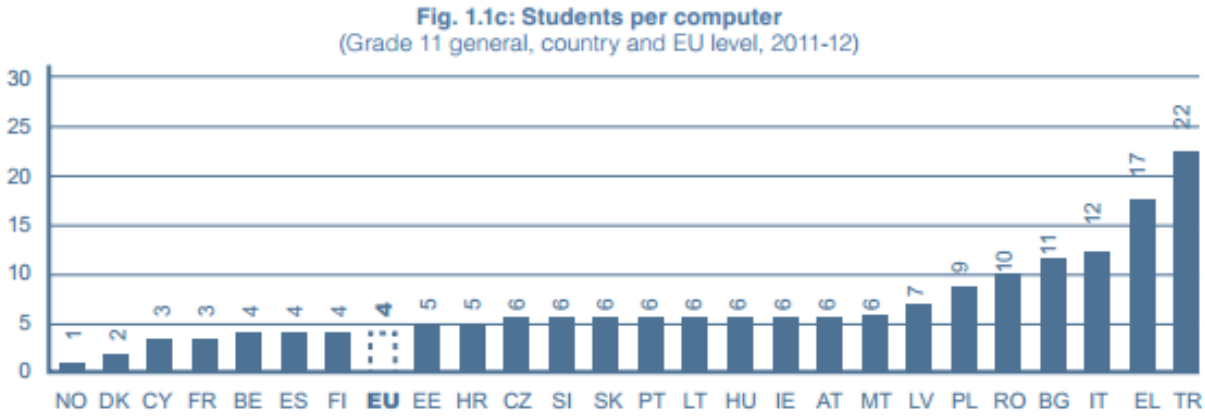

Fig. 1 Number of students (11-12 grades) per computer in different European countries [1]

At the same time Bulgarian teachers (of the same target group of students) are curious and their participation in ICT pedagogical use courses is above the average for the EU, which is a clear indication that with up-to-date facilities and modern communication environment, our country could easily measure with the best European practices.

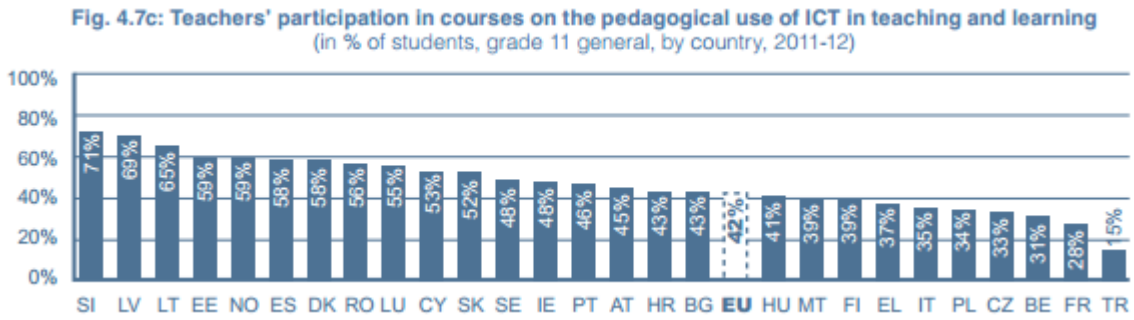

Fig. 2 Participation of teachers in courses for ICT good practice sharing[2]

3. **Lack of process management integrated systems** in education and science; there is no real automation of the resource-consuming administrative work of the teacher and scientist, there are no adequate policies for ICT development at local, regional and national level;

4. **Essential deficit of qualified ICT experts,** which is dramatic in all sectors of education and science at the same time that it is a must for the adequate functioning of the constantly developing ICT infrastructure and services;

5. Lack of continual **qualification of education experts system** for efficient use of up-to-date ICT in teaching and studies;

6. **Increasing amount of paper documents** in education and science contrary to global trends for its reduction;

[1] Source EC (https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KK-31-13-401-EN-N.pdf)

[2] Source EC (https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KK-31-13-401-EN-N.pdf)

7. **Lack of sufficient in quantity, quality and compatibility online digital content** for adequate education and science research in accordance with the upcoming trends to dual, continuous and lifelong learning;

8. Most users **do not have the sufficient skills** for efficient work with ICT.

Even more important turn out to be specific social and economic problems bearing direct impact on quality education and science, like:

- **Bulgarian infavorable demographic situation,** which makes the country one with the fastest aging population in Europe resulting in high average age of school and university teachers and scientists (which hinders the implementation of innovations and reforms) as well as constant decrease of the flow of young people to education and science;
- **Migration on national and European scale** leads to a highly inconsistent distribution of education and science potential as well as lack of equal opportunities in the country and reflux of some of the most perspective talents abroad;
- **Global economic crisis** of significant impact on our country hindering adequate funding of education and science;
- **The generation gap** (including lack of adequate emotional relationship between parents and children) and change of behavioral stereotype, priorities and values as a consequese of some dynamic social processes of regional and global nature;
- **Lack of traditions in the sphere of critical and analytical thinking,** which basically leads to learning by heart and reproduction of knowledge and skills, but not to developing new ones, needed for initiating educational and scientific transformation;
- **Break of the connection between school education and opportunities for self preparation of the student** at home, leading to parents' inability to intervene and offer efficient help and control;
- **Lack of motivation among school and university teachers,** who don't manage to adapt quickly to the new realities and among students, who do not perceive education as a value.

All these negative trends lead to a serious lagging behind of Bulgarian students, resulting in their rating in the last international PISA survey (2012) 39,4% of the sampled 15-year-olds fall below the critical second level in reading, 43,8% have results below the critical second level in mathematics and 36,9% in natural sciences. In comparison with the previous survey PISA (2009), the results show that the share of students with results below the critical threshold is gradually falling by 1,6% in reading, 3,3% in mathematics and by 2% in natural sciences. [3] Still the worrying fact that our country fall among the last ones in the EU, far from the expected average 15% for the EU in 2020 remains. Obviously emergency measures must be taken to find a quick and flexible solution to these issues.

[3] Source: Ministry of Education and Science

The analysis of ICT implementation in education and science allows the identification of some **basic trends:**

1. **Gradually bringing ICT closer to users**: beginning with interactive terminals, followed by personal computers in class, later by one at home, and finally by a mobile portable device (portable computer, tablet, smartphone);

2. **Increase of functionality** from digital information processing, followed by text and graphics processing, and finally by multimedia opportunities (photo, sound, video), and the latest trends (3D and virtual reality);

3. **Convergence of technical means** – by functionality and productivity portable computers no longer fall behind stationary computers. Tablets and smartphones also have more powerful processors and greater memory, which makes them closer to personal and stationary computers and there is also a trend to more smart devices – TVsets, home robots etc.;

4. **Development of cloud ICT infrastructures, technologies and services** – it is enough to mention Google, Facebook, YouTube, Wikipedia and Skype, which have become common names, with a steadily growing trend in offering accessible, efficient, flexible and scalable cloud services turning into a standard for corporative work, training and relax.

An adequate and modern management vision suggests massive use of all these trends in improving ICT implementation and technological renewal, as well as development of legislative basis in accordance with the innovation and technological changes in the development of society. Reasonable implementation of modern information technologies can change the quality of education and science development. Here are some supporting **examples**:

- a digital textbook with interactive stories from real life can help to understand more easily a given natural phenomenon than a mere illustration of academic formulae and diagrams;

- an education discussion online would help break the stereotypes and students and teacher could discuss and analyze problems much more freely;

- developing a modern digital training platform would help parents know what their children study and be actively involved; a similar technology would allow scientists to do research activity more easily and successfully from home etc.

All these prerequisites and trends clearly outline the need of initiating a **special Strategy for Efficient Implementation of ICT in Education and Science in the Republic of Bulgaria,** as one of the strategies with most complex impact on the key problems and aspects of Bulgarian education and science – lifelong learning, digital literacy, qualification of the pedagogical staff, better opportunities for young scientists to do complicated research, not being forced to leave the country etc.

This Strategy is a logical sequel to the National Strategy for Implementation of ICT in Bulgarian Schools (2005-2007) [4] and the National Program "ICT in School" (2008-2013) [5] , by building up on their results and focusing public attention on the potential of information and communication technologies referring to the development of the nation and society.

[4] Source: MES - http://www.mon.bg/opencms/export/sites/mon/left_menu/documents/strategies/strategia_ikt.pdf
[5] Source: MES - http://internet.mon.bg/ikt/

SECTION 2. VISION, MISSION AND GOALS OF THE STRATEGY

The vision for ICT implementation in Bulgarian education and science is connected with:

- Development of unitary modern ICT environment for education, science and innovations;

- Implementation of integrated digital management in all spheres of education and science and automation of the administrative work of university and school teachers and scientists;

- Priority development of generally accessible, universal and compatible (standardized) digital content (including access through mobile devices) as well as significant reduction of paper workflow in education and science;

- Development and adoption of recognized standards and metrics for ICT competency including ICT skills as a component in the career development in education and science;

- Implementation of national external assessment of digital competencies of primary students on graduation and certifying IT skills of students of specialized study course (profiled) and vocational schools;

- Measurable with ICT means actual metrics for education and science development, as well as synchronization with European and world dimensions and classificators, referent frameworks, programs etc., including constant monitoring and active intervention targeting an improvement of Bulgarian positions in science and education exchange;

- Achievement of coordinated planning and realization of ICT projects of the educational and scientific institutions at European, national and regional level – from separate initiatives to realizing long-term and prioritized goals involving maximum stakeholders and achieving economy of scale;

- Development through ICT of new education and science services, registers and generally accessible public information aimed at involving all potential stakeholders to support the strategy - parents, institutions, companies, civil organizations and others.

Mission of the strategy: overall modernization and transformation of education and science through ICT means and achievement of measurable and convincible values of indicators for improving the quality of education and scientific activities in the country, as a result of the Strategy.

Main goals of the Strategy:

– creating **equal opportunities** for all for quality educational services at the level of modern criteria and trends, independently from residence and training through the use of up-to-date ICT;

– forming out **personalities, adapted to life in information society** with all its opportunities, threats, challenges and risks;

– realization of smoother, more efficient and manageable transition of the society towards **knowledge economy**.

To achieve the above specified goals the following **main issues** should be solved:

- provision of **guaranteed, constant and universal access** to quality education and scientific resources and services;
- changes in legislation, **regulating all kinds of training through ICT, legitimazing and encouraging digital content** and active ICT implementation in education and science;
- efficient **incolvement in education of the whole variety of opportunities and means for information access** both within educational institutions and everywhere – from home, on the road etc.;
- understanding and **promotion of the benefits of ICT implementation** among the broader social groups and strata and **encouraging public-private partnerships in** developing education and science;
- acceleration of the **integration of Bulgaria in European and world education and science research space** through up-to-date technologies and activation of the innovative capacity of the nation to the benefit of public development;
- development of learners' **motivation for knowledge gain, constant self-education and critical thinking**, through the use of up-to-date ICT.

Modern society, which we already define as information society, is steadily becoming a mobile society. This means that access to information and services should be provided constantly, independent of time or location of the user. To ensure mobility, new classes of computer devices (notebooks, smartphones, tablets and other) and new technologies for work with information resources and services (a.k.a. "cloud" technologies) have emerged.

Modern learners – school students, university students or PhDs – must have constant access to digital education resources and services. This also refers to the stakeholders in education and R&D at all levels – parents, teachers and scientists. The mobility of every participant in education will be the basis of mobile education in the new information society.

An initial prerequisite for the organization of mobile, and subsequently a ubiquitous education (u-learning), is the creation of legislative basis, methodological and technological provision. In further development of the ubiquitous education information space it's necessary to ensure priority of educational resources and services. Technical means under the conditions of mobile and mass education are only a tool for access to the education resources and services.

SECTION 3. BASIC TENDENCIES IN ICT IMPLEMENTATION IN EDUCATION AND SCIENCE

3.1. Triangle of education and science development

Unitary ICT infrastructure, digital content and ICT training of teachers and scientists are the three tendencies and basic elements of this strategy for efficient implementation of ICT in education and science. Each one of them is crutial to the success of the process of modernizing education and science and its absence will interfere with the closure of the so-called "triangle of education and science development" (Fig. 1). Coincidentally the abbreviation of these three components matches with the abbreviation of information and communication technologies (ICT), as if to show that precisely they are the beneficial outcome of the crisis in education and science. It is important to realize that these tendencies should be developed simultaneoulsy and coordinatedly as long as they mutually complement one another and, for the successful modernization, none of them should be ignored.

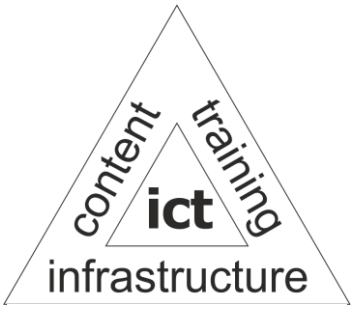

Fig.3 Basic tendencies of modern ICT based education and science

Each of these tendencies includes dozens of measures, which should reflect in specific activities schedules, some of them in need to be prioritized (e.g. backbone education and science network, ICT cloud infrastructure, development of national education portal with digital repository of education resources etc.) in order to execute fully the activities and their interdependence.

3.2. Trends supporting the basic components of the Strategy

Alongside with the three basic trends of the Strategy, we need to mention two other key trends, without which the accomplishment of the Strategy would be extremely hard – the need of creating appropriate legislative basis, supporting the activities and the effective implementation of management systems of processes in the course of their execution.

Examples for legislative ammendments to regulate the priority execution of the Strategy:

- flexible legislation, updated according to headway technologies in ICT education and training through ICT;
- regulations for free sharing and exchange of digital education content;
- State standards and directions for digital textbooks, handbooks and others.

Similar examples could also be given regarding management systems:

- implementation of management-administrative systems in educational and scientific institutions;
- platforms for digital training and control of lessons and content management;
- unified informational system and specialized registers in education and science etc.

3.3. Horizontal impact of ICT measures

School education, science and university education have their specifics, but each of these spheres can be reshaped through ICT. Here are some examples.

Change in the status quo – transition to interactive training (school education)

The change in the education status quo is a complicated process. Bearing in mind that education is inert while modern social processes are extremely dynamic, we come up with lagging behind and catching up could be done only through a comprehensive modernization of education. For example, one or several generations of students study by the same paper textbooks and even if one fact in them changes, it is extremely inconvenient, difficult and financially inefficient to correct the textbooks. At the same time in the age of digital content an online handbook could be changed in just a few seconds and the change would cost hundreds and thousands times less than on paper. However, entirely digital textbooks require a different type of infrastructure, teaching methods, teacher skills and study content. All this needs to be developed simultaneously and in a synchronized way with clear time-tables, funding and responsibilities, otherwise the effect would be lost and the investment would be meaningless.

Quality assessment and development opportunities (higher education)

How exactly the quality of higher education is measured is dubious, however, one can confidently claim that by creating interactive, skill developing and mind provocative ICT environment the quality of education will improve and university students will be more competitive. There is no option for them to be treated differently and to switch to personalized method of trsining in the traditional education. It is new ICT that makes this not only possible, but also absolutely feasible as well as in line with the trends in modern education.

Higher education is not an aim in itself, but a means for acquiring new knowledge and skills, better social realization and, finally, higher life quality. Along such lines, one innovative and modernized, ICT based system of university education would have a healing effect on the economy as a whole, because it will provide students with more informed choice, more flexible forms of training and bigger satisfaction to their expectations for quality education and personal realization.

Teamwork and participation in international science projects (science)

The development of modern science nowadays is impossible without technologies. Even humanities broadly apply ICT as work tools (for example a lot of sociological research is conducted online), while as to technical and natural sciences it is a must if there is to be any scientific activities at all. The participation of Bulgarian scientists in international projects is the modern way of doing science as far as it is difficult to develop serious scientific activity without cooperation at international level. Almost every scientific invention is based on the accumulation of a critical mass of knowledge in different parts of the world and their gathering together leads to the quality leap and the invention itself. That makes reliable communication and accelerated development and ICT implementation a key factor for efficient science.

SECTION 4. PRIORITIES, STAGES , EXPECTED RESULTS AND BENEFITS

4.1. Priority fields of ICT implementation in science and education

The above outlined five main directions include dozens (if not hundreds) of possible measures to influence ICT development in education and science, which could be grouped, each of the groups of different weight and significance to development. As far as it is important to prioritize, the more significant for the general accomplishment of the Strategy are:

Cloud technologies based education and science development environment

One of the persistent world trends in developing ICT is the migration to the so-called "cloud" technologies. They are based on centralized storage and processing of information, flexible mechanisms for resource management and distance from the end user. Some of the main advantages of cloud technologies are efficient use of technical means and information resources, decrease of development and system exploitation means, opportunities to ensure high security level etc.

The implementation of cloud technologies in education and science will allow the provision of mobility, accessibility and topicality of educational and scientific resources. The cloud environment will allow, with no additional means, the use of constantly updated computer infrastructure, programming means and services. Ir will significantly reduce the resources for structuring and maintenance of local infrastructures, as well as will make it possible for scientists, pedagogues, learners and their parents to get involved in education with their personal computer devices.

Universal cloud technologies migration changes the priorities in ICT implementation processes. Computer devices become secondary and each of them ensures access to digital education and scientific resources and services independently of type, brand, producer and location. Educational resources and services become of primary impotance for the development of which the main efforts should be directed in order to create a comfortable environment for access to resources with various devices, including mobiles.

Unified information environment and modernization of education and science infrastructure

The material and technological basis for ICT development is **information-communication infrastructure** providing environment for the implementation of cloud services and data sharing (including through mobile devices). It is an aggregate of territorially distributed state and corporative computing systems, communication networks (channels for data transfer, commutation means and information management flows), information resources, which have been stored, processed and digtally transmitted as well as organization structures and legislative mechanisms providing for its efficient functioning.

It is necessary to foresee the timely replacement of morally and physically outdated technical information devices in education and science institutions, bearing in mind that on the average moral outdating of computer devices is no longer than 5 to 6 years. One of the modern ways to extend the life of computer equipment is the implementation of terminal solutions and virtualization technologies, which actually export the calculations in the cloud while preserving relatively modest parameters of end users' devices.

The principle of development of cloud technologies in education requires the provision of high-speed access of all educational institutions to Internet and connectivity. It is necessary to build and maintain a high-speed backbone optical network for the needs of education and science, ensuring transport environment for access to Bulgarian and international digital resources.

In view of maximazing the participation in educational process through mobile devices for personal and collective use, it is appropriate to develop in education institutions wireless networks (type Wi-Fi and next), too.

The complex use of various computer devices is possible with an effective and safe authentication system for users and identification of their activity in computer networks. Such a system can be developed through personal digital certificates, electronic cards with contactless devices or other protected forms of authorized access.

Development/implementation of digital publically accessible and universal education resources

The basis of digital education resources should be digital handbooks and course tools, providing the following model opportunities:

- adaptation of content components and user interface according to the individual needs of the trainee and his/her current knowledge level (personalised learning);
- use of additional means for impact on the trainee (multimedia components of digital textbooks with animation, video fragments, interactivity);
- powerful and convenient mechanism for navigation and semantic search, including in external education resources and portals aiming at providing a broad range of resources on a given topic;
- interactive and adaptable tests to check covered issues, which can have intelligent add-on to spot knowledge gaps and a follow-up focus on checking identified gaps;
- elements of artificial intelligence, including mechanisms for vocalizing the studied texts and comments on the graphic and multimedia objects;
- future development towards 3D graphics and virtual reality etc.

Digital education resources can be created at budget expense (presumably textbooks for the main subjects), at the expense of education institutions funds, as well as on business and initiative basis. The de-

ployment of digital education resources will be based on decisions of authorized expert bodies (expert council, science-methodological council etc.). It is necessary that education institutions and authors' teams, developing digital education resources, act in close cooperation, in order to save financial resources, seeking broad public support from publishers, developers, students, teachers etc.

Active network interaction among the participants in education and science process

Within the framework of concept of digital and mobile training, the education is provided not only through communication of the type teacher-trainee, typical of the traditional form of training, but also through active network interaction (including via social networks) among trainees through exchange of knowledge, skills and good practices in non-formal education.

Communication among pedagogical staff who gets an opportunity to actively discuss, use, and improve developed methodologies, technologies, education means, to share pedagogical experience is crucial. Network communication among trainees and graduates, potential employers, pedagogical staff, parents etc. is important, too. The modern information-education environment should maintain all popular technological forms of communication within developed education portals, e-learning platforms, personalized social networks etc.

Broadenening up digital distance education forms

Digital education should be considered as one of distance education forms, which offers opportunities to study irrelevant to one's job and residence location, as well as flexibility (opportunity for trainees to study whenever and wherever it suits them) and economy (significant reduction of costs for travelling to educational location). Among the promising dimensions of distance learning we should also consider the adult education (improvement of qualification and re-qualification, training courses, preparation for enrollment examination etc.), as well as additional children and youth training (including additional studies in sciences and mathematics, ecology and biology, humanities), specialised training.

Implementating the digital form of acquiring education should significantly change the nature of pedagogical work, whose main functions should become the creation of digital study materials and consultating trainees.

The integration of informatization means in education should be considered as an implementation of a complex toolset and new ICT skills and with corresponding methodological, organizational and staff provision.

The realization of the Strategy principles, on its own, brings about a new type of education – the so called **mobile (and in the future ubiquitous) training.** For the realization of mobile education we need:

– flexible curricula in accordance with the specifics of the corresponding task, as well as the inclinations and capabilities of the particular trainee;

– inclusion on the list of allowable forms of distance (online) group and individual classes and consultations and other events in a specific format;

– in certain cases legislative adoption of full or partial replacement of paper-based documents or activities by their digital analogues (digital diary; digital homework etc.).

It is necessary to **develop methodologies for efficient and justified use of ICT in education** leading to significant improvement of educational outcomes. Efficient use of ICT suggests:

– reduction of students' time and other expenses for different tasks (e.g. teachers' lesson preparation, test checking etc.);

– improved visibility, emotional consistency of education, students' motivation (for instance demonstrations of quality study materials with the help of a multimedia projector);

– solving educational tasks, which are impossible or absurd to solve without the use of ICT (e.g. detailed diagnostics of knowledge gaps among trainees, display of complex virtual models, experiments etc.).

ICT implementation will contribute to the creation of a new atmosphere in educational institutions, where cult of knowledge and critical thinking are crucial. Such atmosphere could be a result of a holistic system of activities, close to and comprehensible for all education stakeholders.

Production and use of information and knowledge. Human potential development.

Modernization of education requires the introduction of the following rules in education and staff qualification in view of the information technology development of the country:

- to provide the needed financial resource for the development of education;
- to create conditions for lifelong learning for the greater part of the economically active population, to improve the system for staff qualification and re-qualification of redundencies because of structural changes in the §economy;
- to develop a large-scale system to enhance the information and computer literacy of the population, to update or adopt standards for training and conditions for certification, to introduce courses for people with special educational needs;
- to change the forms and methodologies of education at all levels based on extensive use of ICT, which requires finalization of ICT implementation in education, implementation of programs on developing educational study and scientific content and providing methodological qualification of teachers for ICT use in education and research.

Pedagogues should have the necessary qualification in the sphere of ICT use in education. The development of the various types and forms of mobile education should be accompanied by a new organization of the network of science and methodology services, ensuring personal professional development and information and methodology support of the pedagogical staff.

Constant additional qualification of pedagogical experts, in various forms, should be provided for their functional computer literacy at the level of modern requirements, as well as opportunities to choose and use methods and means to reach the educational goals in a flexible and mobile information environment. An important part in the mass transition of pedagogical staff to work in a mobile information environment should play the system for additional adult education, qualification through distance training and network interaction among pedagogical staff.

Informational environment as a basis to improve education management

Massive use of ICT and the network information-communication infrastructure in the field of management will allow significant improvement of educational and science institutions. The use of ICT and the Internet leads to a new quality level of tackling the following interrelated tasks:

- improvement of the management of organizations and institutions at the expense of transition to digital document workflow; formation, development and integration in a unified network of education and science institutions; development of a system of distributed, regularly updated databases of management information;
- integration of state information resources and creation of conditions to provide citizens and organizations with publically accessible, scientific and administrative information;
- organization of live interaction among the management bodies at all levels of education and science organizations, as well as with citizens, business and other social subjects.

A distinctive feature of future software and information systems in the field of education should be the wide implementation of the so-called **green information technologies.** Examples: a) automated document generation – through composition of their elements, processed by different systems; b) provision of opportunities for independent (parallel) work of users with the maintained objects; c) replacement of unnecessary document printing as the access to each document is granted to authorized users through the very systems; d) digital confirmation/signing of documents with electronic means etc.

Some of the most important tasks are development and implementation of **national information-analytic systems and implementation of compatible digital document workflow systems**. Their main purpose is to provide the management bodies at all levels with timely, reliable and complete information to help managerial decision-making. Such development is impossible before settling the problem with the digital signature (it suggests development of legislation regulating the implementation of green technologies, because in everyday practice managerial decisions are taken after processing and analysing printed statistics documents, formally stamped and hand-written signed).

The implementation of cloud systems in education management should be done through a complex of activities to provide information security. As a whole, with the right organization of such systems, information protection should increase as a consequence of the concentration of safety functions in a secure center for data processing.

Developing a system for horizontal and vertical education and science portals

The development and adoption of a common approach and principles in developing education and science portals and their digital archives and disaster recovery systems is a specific task, connected with sharing and provision of services of different categories depending on their status, area of interests etc.

(Self-) assessment automation of the quality of education and science activities

The assessment of the state of separate professional trends and specialties in university education in the country is hindered by the fact that procedures and the greater part of the indicators are connected with time dynamic data and results. The latter is the reason for doubling and discrepancy in the data and information, collected, shared and analyzed by national and international agencies and institutions. In this connection, it is important within the framwork of the Strategy to accomplish automated support of the procedures for quality assessment under relatively complex rating systems (some of them with more than 100 indicators). This could be accomplished through:

- implementation of integrated national information system for education and science management, working in real-time, unifying data and time-schedules and eliminating the greater part of exchange of information through paper documents;

- adoption of relevant legislation and optimization of management and (self-) assessment quality procedures aiming at improving their efficiency;

- eliminating subjectivity in taking decisions and evaluation and providing their publicity and transparency.

A backbone to such an integrated national system is a corresponding database and a cloud of services, the design and development of which should be another important task of the Strategy. In this direction it is necessary to settle the problem of developing an integrated information base of data and services with special attention to data migration from already developed information systems (for material facilities, trainees, diplomas, teachers etc.).

Development in the above mentioned directions wouldn't reach their goals, unless several tasks in the field of standardization and regulation of education are solved. Such tasks are, for example, the creation of standards for digital study content, national standards, concerning management procedures and quality assessment etc.

4.2. Stages of realization of the Strategy and expected results

The Strategy could be relatively divided into three stages with the corresponding important results:

I stage. Key investments – short-term (2014-15)

- unified backbone network, connecting REI, universities and science centers;
- national ICT cloud infrastructure for the needs of education and science;
- a backup center for storage, data processing and provision of services
- wireless (Wi-Fi) infrastructure in educational and scientific institutions;
- national digital education and study content management platform;
- legislation on digital study content and ICT competences;
- pilot implementation of integrated management system at school and university level;
- education portal and digital handbooks for all sciences and mathematics subjects.

II stage. Mobility and security – middle-term (2016-17)

- permanent optical or high-speed connection with educational institutions;
- opening up of education and science environment to mobile devices (m-learning);
- integrated national education information and management system;
- digital platform for video-training, teleconferences and R&D;
- regional resource centers for data and content;
- digital handbooks with interactive content for all general subjects.

III stage. Universality and sustainability – long-term (2018-20)

- unified education environment for ubiquitous learning (u-learning);
- transition to digital textbooks for all subjects;
- virtual classrooms and laboratories;
- national system for online exams and external assessment;
- automation of quality assessment;
- open and universal access to education and science resources.

4.3. Analysis of the benefits of the Strategy implementation

The implementation of the Strategy is expected to have a favorable effect in the following areas:

- More efficient public expenditure and encouraging of private investments in the sphere of education and science. The basic savings will derive from economy of scale, as well as from more efficient otganization of different activities thanks to their automation and transformation through more up-to-date and flexible management and control methods, while private investments will be encouraged by legislation;
- Sustainable and beneficial environment for provision of quality education and efficient science, based on the most up-to-date trends in ICT development. The implementation of the suggested measures will create adequate conditions, material facilities, exitatory legislation and motivation for personal development of Bulgarian students, PhDs, teachers and scientists;
- Raise of the competitiveness of Bulgarian education and science, being subject to clearly measurable indicators (e.g. how the results of our students have changed in PISA survey, how many universi-

ty students have started a job connected to their major and with what average income, how has the number of scientific discoveries and patents increased by periods etc.);

- Solution to a number of important social and demographical problems. For instance, the opportunity of every student to have online access to the best lecturers and digital lessons would settle the inequality between small villages and the big city, while on the other hand access to quality education at spot would slow down the rates of migration and demographic depopulation of whole areas in the country;
- Creation of efficient bond between school and parents, which is particularly important in the context of lifelong learning, dual and continuous learning and the need of parents to cooperate actively with their students' self-preparation at home, because modern education has long ago come out of the classroom. The availability of flexible digital education and training platforms will unite the pursuits of teachers, parents and students, will contribute for a daily, informal communication and swill ignificantly increase the efficiency of education;
- Strengthening teamwork and international cooperation, as ICT are especially appropriate for creating partnerships, virtual communities and distributed in time and space creative teams. Many achievements of the international science are due to the increased opportunities for teamwork and many of the best education practices are already spread digtally. Last, but not least, the increased opportunities for information exchange will bear direct economic effect, because they will allow participation of many more Bulgarian professionals and teams in European and international projects;
- More prepared school and university students in view of life realities, because education with the help of new ICT would be much more flexible and sensitive to modern trends, to the expectations of business and to the need of fast adaptation to the dynamic life and constant changes in the surrounding world;

- Permanent ecological effect, because ICT in its many dimensions will lead to significant decrease of paper documents, tests, handbooks, textbooks, reports and research results (i.e. the need of cutting out forests will decrease), while digital networks significantly decrease the need of travel, which will reduce harmful emissions of burnt gases in the atmosphere;
- Favorable impact on all sectors of national economy, because it will create examples of information exchange, training practices, implementation of information systems with no-paper management etc., which may be implemented successfully in most working processes and social activities;
- Raise of school and university teachers' and scientists' prestige, because they will become leaders of education and science transformation, mastering new technologies and optimizing their administrative duties, which will give them more time for their students and PhDs, as well as for innovations and science activities;
- Better legislation for creativity and innovations promotion and free exchange of quality education and science content, which will help education, as well as economy as a whole;

- Strengthening the role of Bulgaria in the Pan European and global education and science space, which will make Bulgarian schools, universities and science institutes role models and desired partners in future projects, will attract international students and will help out better integration in the EU;
- More spare time and personal privacy for teachers and scientists, because it will increase the effectiveness of their work and will make their personal life more sustainable and manageable, giving them more time for rest, creativity and personal development;
- Quicker and more efficient implementation of the lifelong learning concept in Bulgarian society, by force of established habits and sharing good educational practices, which is undoubtedly among the leading trends in the development of modern society in order to make citizens competitive;
- Establishing new social models and certain change of the whole functioning of the society and the interactions within it, because efficient digital exchange and the turbulent penetration of online work and service styles (including international experience) will naturally contribute to all economy sectors and social life and will contribute to faster large-scale implementation of digital management, e-democracy and other positive trends of the 21st century,

SECTION 5. LEGISLATION FOR THE STRATEGY REALIZATION AND RELATIONS WITH OTHER STRATEGIES AND PROGRAMS

The Strategy is developed in accordance with the legislation in force of the Republic of Bulgaria. The execution of the Strategy foresees improvement of legislation or initiation of new laws. If needed, as a result of new laws or ammending existing ones, the Strategy will be updated in the process.

Adopted acts and legislative bills, in accordance with which the Strategy has been developed:

- Project of Human Resource Development Operative Programme (2014-2020);
- Project of Science and Education for Intelligent Growth Operative Programme (2014-2020);
- Project of Regions in Development Operative Programme (2014-2020);
- Project of Innovations and Competitiveness Operative Programme (2014-2020);
- Project of National Strategy for Development of Pedagogical Staff (2014-2020);
- Project of National Strategy for Literacy Encouragement and Promotion (2014-2020);
- Project of Strategy for E-Government of the Republic of Bulgaria for the period 2014-2020;
- Project of Innovation Strategy for Intelligent Specialization in the Republic of Bulgaria 2014-2020;
- Vocational Education and Training Act;
- Higher Education Act;
- Science Research Promotion Act;
- National Road Map for Science Infrastructure;
- National Programme for Development of School and Pre-school Education and Preparation 2006-2015;
- National Reform Programme 2012-2020;
- National Programme “Digital Bulgaria 2015”;
- National Development Programme “Bulgaria 2020”;
- Human Resource Development Operative Programme (2007-2013)
- Strategy for Reduction Early School Leavers in Education (2013-2020);
- Strategy for Educational Integration of Children and Students from Ethnic Minorities up to 2015;
- National Strategy for Development of Broadband Access in the Republic of Bulgaria (2012-2015);
- National Strategy for Development of Science Research 2020;
- National Strategy for Lifelong Learning (2014-2020);
- Europe 2020 (EC strategy);
- Horizon 2020 (EC strategy);

SECTION 6. BASIC PRINCIPLES AND MECHANISM FOR THE STRATEGY IMPLEMENTATION

For the purposes of the Strategy realization a series of conditions should be met, including qualification of education experts in view of timely development of educational resources and services needed, as well as models and methodologies for their efficient use and also for their implementation under conditions of mobile education. The following principles and approaches for the realization of the basics of the Strategy are envisaged:

Project approach for ICT implementation based on complex solutions

Today many activities in the field of ICT implementation in education are accomplished not as projects, but as processes. It is suggested to pass onto project principle in all aspects of ICT implementation: from equipping education and science institutions with computer devices to development and implementation of education and science resources and cloud services. This will provide the basis for the achievement of expected results and will increase the responsibility of contractors. When choosing projects it is necessary to prioritize complex solutions, which will ensure the coherent effective functioning of all components of the information and education environment.

The project approach will also allow bearing personal responsibility in executing pacticular tasks and processes in ICT implementation in education and science. It is necessary to foresee joint liability of the representatives of all parties, participating in the projects – not only of ICT developers, but also of users.

Flexibility of ICT implementation process planning

The project approach in informatization of education and science somehow changes the requirements for long-term planning. In this regard the basic directions of ICT implementation should be planned in strategic perspective (5-7 years). The specific projects within these strategic directions should be initiated, realized and, if necessary, corrected annually, and in particular cases more often.

Practical results orientation

The indicators for informatization of education are often considered in the context of the number of trainees per computer, equipment of education institutions with high-speed internet etc. It is suggested to pass gradually to other indicators, arising from the main goal of informatization of education. Because of this all projects should finish not merely with specific products and services, but also with specific practice as to their usage, and also with analysis of usage results. Practical results orientation and creation of conditions for continuity suggest that the information needs of end users of education services – students and their parents should come first.

Maximum use of personal computer devices

ICT society is impossible to develop, if the use of information products and digital services does not include personal computer devices. These are home desktop computers, which most families nowadays have, personal portable computers, mobile devices (tablets, smartphones, e-readers etc.). The inclusion in education of all these devices that belong to teachers and parents, pedagogical staff and managers, will make permanent and systematic use of ICT possible. The positive result of such an approach will be significant reduction of state expenses for equipping education and science institutions with computer devices.

State and business partnership

Public-private partnership in the field of informatization of society and economy has proven its effectiveness in many countries. A properly organized partnership between the state and business allows significant reduction of budget expenses and increases the return rate of investments. In setting such a partnership the leading part should have the state order for settling one or another education and scientific task or problem. The main thing, that a state and business partnership should guarantee for education and science is quality and permanent maintenance of informatization processes, necessary and timely modernization and development of information and education environment.

Development of long-term, sustainable models and strategic thinking

Information and communication technologies are not everlasting and have relatively short lifetime in comparison with any other type of infrastructure and traditional public objects, goods and services. Within the Strategy long-term thinking and sustainable habits and moods in support to ICT development should be activated broadly among broad social strata. The target groups should gradually recognize and support the effectiveness of ICT investments and initiate sustainable models for further support of the benefits after the planned period planned has expired.

Constant change as part of the status quo of the economy of knowledge

One of the key effects of ICT implementation is the cognitive transformation, connected with the quality change in education, science and all related social dimensions (economy, working environment, relax etc.). Any new knowledge, skill, innovation or technological change brings along new competences and develops the capacity and competitiveness of the individual. A basic aspect of ICT development is the constant change and the need for it to be perceived as an opportunity for improving the working and home environment, increasing the opportunities for expression and realization of the individual and boosting one's own happiness. At the end readiness and willingness to change are the basis for social development and progress.

SECTION 7. CRITICAL AND RISK FACTORS AND PROACTIVE MEASURES FOR THEIR OVERCOMING

The Strategy is of complex nature and envisages the need of coordinated activities in all directions for informatizatio of the education system.

Technically the most complicated for realization and critical in terms of consequences are timely formation and development of a sustainable, reliable and secure telecommunication infrastructure, development of cloud technologies and data backup centers and implementation of management systems at all development stages of the Strategy.

Organizationally challenges are connected mostly with synchronization of separate activities in time and the complex understanding of the need of ICT implementation as a holistic ecosystem, rather than as a toolset of non-connected measures.

Financially the main concerns are connected with the provision of budget funding for the whole period of the Strategy execution, and politically – with the need of clearly shared vision with all responsible factors, that ICT implementation besides inevitable expenditure means key investment, ensuring many times higher additional value than any other budget item.

In the table below identified risk factors and possible responsive and proactive measures are listed:

Critical and risk factors	Responsive and proactive measures
1. Lack of sufficient political will for the realization of the Strategy	• Need of detailed and exhaustive communication with the responsible people and institutions at all levels on every step of the realization • Provision of support by end users and broad publicity of the most significant results
2. Lack of clearly stated public support for the realization of the Strategy	• Media campaign and involvement of a broader range of partners – academic institutions, public organizations, companies and others to support the Strategy • Publishing business analyses and expert opinions on the benefits and social dimensions of the projects
3. Lack of specific projects and clear responsible bodies for the realization of the Strategy	• Clear identification of responsible factors for the realization of key measures (MES, RIE, EA ECNIS and others), broad promotional campaign and contest principle in choosing contractors • Provision of media interest and high level public control on the execution of the Strategy
4. Lack of synchronization between linked activities, which could hinder their effective realization	• Support of complex projects with clear action plans and schedules and effective monitoring of the execution from the relevant audit and responsible institutions • Publishing a road map of the activities and constant public control on the execution of the separate measures in time

5. Dynamic change of technologies and need to adapt measures	• Definition of key technological experts to every concrete project for identification of such risks • Drawing consultants with the necessary expertise and capacity in all institutions/bodies controlling and managing the execution of the Strategy • Providing opportunities for broad public control (including through online forum) on the overall execution of the Strategy and on needed updates of measures
6. Political or economic crisis	• Prioritized and permanent support of key measures to provide relative security of the whole execution • Drawing a broad range of public-private partnerships for the execution of the Strategy in order to reduce its dependence on a single financial source
7. Lack of adequate level of managing continuity (the Strategy is for 7 years)	• Connecting key activities and processes in education and science with the execution of the Strategy and its successful completion • Popularization of the good practices and successful projects in order to promote continuity
8. Lack of sufficient motivation and/or skills among the institutions that execute the Strategy	• Periodic updating knowledge and skills and finding adequate legislative, financial and moral incentives to motivate responsible employees • Drawing external experts with the necessary capacity and competences by flexible forms of engagement and payment
9. Lack of sufficient motivation and/or skills among the end users	• Identification of adequate measures for training and popularization of activities among end users and emphasis on social dimensions and benefits
10. Technological problems and incorrect sizing of measures	• Consultations in the process of operation with a broad range of experts at all levels of education, science and business, using international experience for innovative tasks

CONCLUSION

The realization of the Strategy will be carried in coherence with its Action plan and will allow:

1. **Equal opportunities for quality education services** for the population meeting the modern requirements of national and international standards, independent of place of residence and training and on this basis – forming a personality, adapted to life in an informational society, taking account of all opportunities, threats, challenges and risks;

2. All educational and scientific institutions and management bodies of the education and science at different levels to be provided with **high-speed Internet access and broadband connectivity with national and international information resources**;

3. Taking the so called "cloud" technologies, to create a **unified information education and scientific environment** in the Republic of Bulgaria, to realize the m-learning principle and develop widely the systems for distance training and scientific cooperation;

4. To increase significantly **the quality and quantity of the existing education and scientific digital content** in Bulgarian, which will help the effective transition of Bulgarian society towards an economy of knowledge;

5. **Paper documents in education and science to be reduced many times** (in some estimates - more than 3 times).

There are enough good examples in the world for the improvement of the effectiveness of education and science and one of the leading trends is the implementation of information and communication technologies as the main part of the modernization of education and science. Of course ICT are not panacea, but they help greatly in overcoming a lot of problems in education and science in a natural, informal and friendly manner, at the same time engaging the mind of the student, giving greater opportunities to teachers, helping relations with parents and allowing more adequate teaching of complex matters through interactive multimedia examples.

The State, the municipalities, the education institutions, the companies and public organizations can build a clear and winning model of interaction as to student education and the necessary changes nedded for a quality education, while the implementation of information and communication technologies is the easiest, the most pragmatic and cheapest way for this to happen or at least to set the foundations for this transformation.

Annex 1. Dictionary of terms and abbreviations in the Strategy

- **3D** – three-dimensional, using technology, realizing or simulating volume;
- **Call center** – center that receives calls, usually combined with some kind of service provision;
- **Disaster Recovery** – recovery after a disaster, describes a process, policies and procedures, connected with the recovery of technological workflow of an infrastructure or business service after a breakdown;
- **European e-Competence Framework** – European framework used to measure e-competence;
- **Facebook** – the largest world online social network and same name company, founded in 2004 by Mark Zuckerberg and his co-students in Stanford, spreading today to over billion of active users;
- **Gb** – Gigabit (=10^9 bits), measurement unit for digital information, most often used for measuring transmission speed of computer networks, nearly equal to 125 megabytes/second, which corresponds to the transfer of a relatively big movie in high (HD) resolution in about half a minute;
- **Google** – the world biggest search tool and same name company for online services;
- **Helpdesk** – center for operational help and service;
- **Mb** – Megabit (=10^6 bits), measurement unit for digital information, most often used for measuring transmission speed of computer networks;
- **PISA** – Programme for International Student Assessment, popular world survey lead by the Organization for Economic Co-operation and Development among students from different countries with the purpose of surveying their mathematical, scientific and linguistic skills and improvement of education;
- **Skype** – the world's most popular online service for voice and chat communication, currently owned by Microsoft;
- **WiFi** – trade name of a wireless technology for Internet connectivity, popular for its high speed and relatively limited coverage;
- **Wikipedia** – the most popular free online encyclopedia in the world, developed by volunteers;
- **YouTube** – the most popular world service for video sharing, owned by Google;
- **Authentication** – confirmation of identity;
- **Virtualization** – a term with a wide use, mostly related to the use of computer resources for simulation of real hardware, operational systems, platforms and machines. Virtualization makes possible the starting of multiple processes on a single hardware machine, with efficient use of existing resources;

- **Virtual reality** – a term that means unreal world, stimulated by computer systems and audio-video equipment and used for technical simulations, games, training etc.;

- **Ubiquitous learning**, **u-learning** - a way of accessing learning environment in almost any context or situation (including different devices, mobile technology etc.);

- **SACP** – State Agency for Child Protection;

- **SANS** – State Agency for National Security;

- **Digitalization** – transforming given information into digit type. In the context of the Strategy it is used basically to illustrate the electronization of the study content and the transformation of paper textbooks and handbooks into digital ones;

- **Distance education** – a sphere in education that aims to give training to participants, who are not physically present at a certain place. They communicate at a convenient for them time through paper or electronic carriers, or through technology, which allows them to communicate in real time. In the context of the Strategy the electronic education is seen as one of the forms of distance education;

- **CEFR (Common European Framework of Reference)** – standard European frame, allowing the classification of one's comprehension and knowledge level of a foreign language;

- **EC** – European Commission;

- **Electronic/digital textbook** – paperless textbook, realized entirely by ICT, with digital content, most often including interactivity and multimedia;

- **Electronic education (e-education)** – education entirely based on ICT, as in the context of the Strategy it is basically seen as the most modern variation of distance education;

- **Electronic/digital content** – every content, existing in the form of digital information;

- **Electronic/digital learning handbook** – paperless handbook, realized entirely by ICT, with digital content, most often including interactivity and multimedia;

- **EU** – European Union;

- **EA ECNIS** – Executive Agency "Electronic Communication Networks and Information Systems"

- **ICT** – Information and Communication Technologies;

- **Informatization** – a process of massive introduction and implementation of ICT in various social activities;

- **IT** – Information Technologies;

- **MI** – Ministry of Interior;

- **MC** – Ministry of Culture;

- **Mobile education** – education, realized remotely and flexibly, most often by means of mobile technologies;

- **Mobile learning (m-learning)** – learning, based of portable devices (tablets, smartphones);

- **MES** – Ministry of Education and Science;

- **Cloud ICT infrastructure, cloud technologies** – ICT infrastructure, allowing remote access to computer resources (hardware, software, databases) and services. Practically all popular Internet resources use cloud services and this is a model, followed by business, governments, educational and scientific institutions;

- **Online training** – training by means of the internet, in the context of the Strategy it could be a synonym to mobile and digital education;

- **Optic (fiber) network, optic connectivity** – computer network of internet connectivity, based of optical fibers, which in most cases allow very high speeds depending on the terminating devices, which realize the connection;

- **Public-private partnership** – a way to realize an activity of a public interest with the participation of government and non-government subjects. It is common for the market economy related to more complex projects, which require long-term and huge financial resource;

- **REI** – Regional Education Inspectorate;

- **Terminal computer solution** – computer solution based on architecture, that consists of server and terminal workstations, where the basic processes are run on the server and the terminal stations are often distinguished by a simple construction, high reliability and low electricity consumption;

- **Broadband** – in the context of the Strategy it is used as a synonym to high-speed and in most cases it means allowing speeds of 10 and more megabits. The term “broadband” evolves with time, simultaneously with the increase of Internet access speeds.

Annex 2. SWOT Analysis of the Strategy

	STRENGTHS		
	Building on successful existing government projects (e.g. optical network for the government administration) Structural funds of EU in the application field of the Strategy Projects in process of execution, whose results could be used (e.g. the currently building data center in MES) Serious motivation of stakeholders for the realization of the Strategy, because of the multiple problems, that it solves Business interest in the Strategy realization, the existence of economy of scale	Lack of long-term complex and systematic approach to the solution of the problem Lack of unified ICT environment and of integrated process management systems in education and science Lack of ICT staff and insufficient ICT qualification of stakeholders Global economic crisis, unfavorable demographic situation, migration processes Inequality among different participants of the execution (e.g. little village school and large metropolitan school)	WEAKNESSES
OPPORTUNITIES	Turbulent development of ICT in the foreseen period of the Strategy realization Starting of public-private partnerships Opportunities to use own mobile devices to participate in the processes of Strategy execution Implementation of project approach, flexibility of planning and orientation towards practical results Development of “green technologies” in education and science	Political or economic crisis in the period of Strategy execution Problems of technological nature and inaccurate sizing of measures Lack of adequate level of managing continuity and empathy because of the relatively long period for the Strategy realization (7 years) Lack of specific projects and clear responsible bodies for the realization of the Strategy Lack of synchronization among linked activities, which could hinder effective realization	
		THREATS	

Annex 3. Basic measurable indicators for the effective realization of the Strategy

Indicators	Measure-ment unit	Basic * value	Goal value Stage 1	Goal value Stage 2	Goal value Stage 3
Regional Education Inspectorates included in a backbone high-speed network	%	0	100	100	100
Public universities connected with optical network to the backbone educational network	%	0	100	100	100
Science units connected with optical network to the backbone educational network	%	0	70	100	100
Schools connected with optical network to the backbone educational network	%	0	10	45	60
Average speed of internet access of public schools	Mb	30	45	80	100
Speed of the Bulgarian connectivity to the Pan European research network GÉANT	Gb	1	10	100	1 000
Public schools completely equipped with Wi-Fi connectivity	%	15	60	95	100
Schools covered by electronic platform for e-learning	%	0	100	100	100
Schools that have implemented technology for setting a virtual classroom	%	2	5	50	100
Schools that have implemented paperless documenflow	%	0	2	85	100
Universities that have implemented paperless documenflow	%	0	4	100	100
Science units that have implemented paperless documentflow	%	0	3	95	100
Schools that have implemented a comprehensive information-management system	%	0	0	100	100
Universities that have implemented holistic information-management system	%	0	2	90	100
Teachers and scientists who use authentication services	%	20	45	90	100
Teachers with certificates for basic and advanced computer literacy	%	20	40	85	95
Teachers who took courses for sharing good pedagogical practices using ICT	%	5	15	90	95
Trained teachers for creation and use of digital content	%	15	45	80	100
Education content in school secured with digital handbooks	%	30	70	90	100
Video collections and educational movies, uploaded to educational portals of MES	number	50	300	2 000	4 000
Developed virtual panoramas for education needs	number	800	1 500	3 500	5 000
Multimedia education materials	number	2 500	5 000	20 000	50 000
* Source: Ministry of Education and Science					

Annex 4. Action plan and organizational provision of the Strategy

Annex 4.1. Implementation methodology – seeking synergy among the separate elements

The Strategy is accompanied by a schedule for realization, where special attention is given to the priority of tasks solved. The tasks by direction are arranged in such a way as to achieve the "domino effect" aiming at making the settling of the next tasks faster. By developing the model action plan, some basic aspects are taken in consideration:

- In the different vertical spheres of the Strategy implementation (school education, university education, science) there are lots of common and similar horizontal ICT measures, that can and should be considered and implemented once and not separately for every direction with the purpose of optimizing the financial and administrative resource and economy of scale;
- When suggesting specific measures with schedule for execution, under consideration are taken the current state of all measurable indicators, the executed national programs, projects and existing strategies in this or similar areas, as well as all accepted or in the process of execution strategies and programs, including the ones that are funded by European programs;
- Budget forecast for the execution of the suggested measures is based on the existing information in the current ICT situation in the different organizations, an expert evaluation of the size of needed investments, as well as analysis of the possible funding sources by observing the principles of admissible expenses and control against double funding of any specific measure and every separate budget year;
- The suggested measures are grouped in 5 directions (ICT infrastructure, ICT training, educational digital content, regulation, management systems) and are consolidated in 50 specific activities, where the detailed description of every measure in the context of execution is subject to specific projects within the action plan;
- Because of consolidated activities, the duration of most of them covers the whole period for strategy realization (2014-2020), as financing is uneven or is kept relatively stable according to the specifics of the separate activities – for example, the equipment should be replaced, fixed etc., which is the reason in the frames of one relatively short period (7 years) to have recurrence of identical costs;
- The Strategy should gain maximum publicity and draw the sympathy of a big part of Bulgarian citizens, as far as it concerns them directly and their active cooperation is needed (e.g. communication between teachers and parents, attracting school boards, civil organization and businesses for support of specific measures etc.);
- When executing the Strategy there will be close cooperation with the target groups, while the Ministry of Education and Science, besides being the main funding body, will also be direct executor and coordinator of the majority of activities. The trends in the Strategy execution will be phased delegation of budget and responsibilities to end beneficiaries (decentralization principle) and development of acting mechanisms for coordination of results and exchange of good practices, including use of international expertise.

Annex 4.2. Schedule, possible financial sources and responsible implementation bodies

The following tables show the target groups, the possible funding sources and the responsible institutions and organizations for the Strategy realization, whereas the same legend is used for all other groups of activities.

Category user (target group)

A – kindergartens/service units/schools and related institutions/organizations/people
B – university/higher school and related institutions/organizations/people
C – science institute or unit and related institutions/organizations/people

Type (possible source) of funding

D – Government budget
E – European programs
F – need of own funding, without it being calculated in the forecast budget

		Year	20xx							
Target group	**Funding source**	**Activity/measure**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Responsible institution**
		ICT infrastructure								
ABC	DF	Development, expansion and integration of unified backbone network for the needs of education and science	X	X	X	X	X	X	X	MOH, EA ECNIS, REI, target groups
ABC	DF	Development, renovation and maintenance of zones with wireless access and communication infrastructure in schools/universities/institutes/ student hostels	X	X	X	X	X	X	X	MES, target groups
ABC	DF	Creation, renovation and maintenance of national and regional cloud ICT infrastructures for the needs of education and science	X	X	X	X	X	X	X	MES, REI, target groups
ABC	DF	Ensuring access to national, European and world education infrastructures – GÉANT etc.	X	X	X	X	X	X	X	MES, target groups
ABC	D	Ensuring a team and center for monitoring and communication in education and science	X	X	X	X	X	X	X	MES
BC	DF	Implementation of specialized video-streaming infrastructure, video-conference systems and IP telephony	X	X	X	X	X	X	X	MES, target groups
ABC	DF	Subsidizing internet access or development of permannent optical (fiber) connectivity to educational and scientific organizations	X	X	X	X	X	X	X	MES, EA ECNIS, target groups
ABC	DF	Passing on to virtualization solutions and platforms	X	X	X	X	X	X	X	MES, target groups
ABC	DF	Providng licensed software – operational systems, office packages, programming environments, antivirus and grpahics software, specialized software for vocational and profiled high schools, people with special educational needs etc.	X	X	X	X	X	X	X	MES, target groups
ABC	DF	Co-funding of organizations in education and science for the implementation of new ICT products	X	X	X	X	X	X	X	MES, target groups
ABC	DF	Purchase of portable computers and/or tablets for teachers/scientists	X	X	X	X	X	X	X	MES, target groups
ABC	DF	Ensuring subsidized Internet (including mobile) access to innovative science practicioners, pedagogical staff and trainees		X	X	X	X	X	X	MES, target groups
A	D	Identification, R&D and implementation of free educational programs and applications		X	X	X	X	X	X	MES

Infrastructure is a key element of ICT development and should be present in the Strategy from the first to the last moment. A lot of the suggested measures are crucial to the Strategy execution as far as not only the lack, but also the temporary fallout of an important infrastructural component could have irreversible consequences on the end result.

No less important is the digital educational and scientific content. To a high degree it gives the added value to the whole Strategy, as far as no other group of activities will make sense, if it is not considered in the context of content, which should be distributed and develop the competences of Bulgarian educational and scientific institutions. It should be license clean, accessible for all, interrelated and reusable, whereas an important condition is the creation of national repositories with all publications and science results of developments, funded by public means.

		Year	20xx							
Target group	**Funding source**	**Activity/measure**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Responsible institution**
		Educational content								
BC	DE	Ensuring access to specialized information databases (science information and others)	X	X	X	X	X	X	X	MES, target groups
ABC	DE	Initiatives for digitalization of current educational and scientific content		X	X	X	X	X	X	MES, target groups
ABC	DE	Support of exsting information catalogue resources with educational content and centralized access to electronic periodic editions	X	X	X	X	X	X	X	MES
AB	DE	Licensing and localazation of valuable international education resources and programs, available online	X	X	X	X	X	X	X	MES
AB	DE	Support and expansion of national education portal with digital semantic repository for educational resources	X	X	X	X	X	X	X	MES
ABC	DE	Creating education web sites, programs and self-training systems			X	X	X	X	X	MES, target groups
ABC	DE	National campaigns for stimulating the creation of digital content by students, teachers, PhDs and scientists	X	X	X	X	X	X	X	MES, target groups
ABC	DE	Development of video-lctures and educational movies, including such made by students, teachers, PhDs and scientists		X	X	X	X	X	X	MES, target groups
AB	DE	Development of national system for passportization, licensing, maintenance and monitoring of the existing digital educational content		X	X	X	X	X	X	MES, target groups
A	DE	Development or urchase of e-handbooks for the needs of general and vocational education		X	X	X	X	X	X	MES
A	DE	Development of specialized education programs for children with SEN		X	X	X	X	X	X	MES
A	DE	Creation and support of national online bank for tests and tasks		X	X	X	X	X	X	MES
A	DE	Funding educational online games and competitions, virtual panoramas, 3D modelling etc.	X	X	X	X	X	X	X	MES, target groups

ICT training is another leading element in the Strategy. Undoubtedly no success could be expected without ICT competent and qualified staff, and also the training in this area is too dynamic and it is necessary to be constantly overbuilt.

		Year	20xx							
Target group	**Funding source**	**Activity/measure**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Responsible institution**
		IT training								
ABC	E	Training for creating and using of digital content, creating information portals, web-based and mobile applications		X	X	X	X	X	X	MES, target groups
ABC	E	Promotion of foreign language training and teamwork (including international) through ICT		X	X	X	X	X	X	MES, target groups
ABC	E	Training and additional qualification of ICT skills, including ICT courses for advanced (system administrators and others), as well as preparation of talented students in ICT		X	X	X	X	X	X	MES, target groups
A	E	Creation and sharing good pedagogical practices with ICT means (implementation of ICT in the classroom as part of the process)		X	X	X	X	X	X	MES, target groups
AB	E	Organization of virtual classrooms, laboratories and teleconference sessions for school and university students and PhDs			X	X	X	X	X	MES, target groups
A	DE	Setting a demonstration and training center for new ICT based educational technologies		X	X	X	X	X	X	MES
AB	DE	Organization of electronic school and of electronic university		X	X	X	X	X	X	MES
A	E	Creating and funding the activity of a national center for qualification, certification and testing of ICT skills, including online		X	X	X	X	X	X	MES
A	E	Training in ICT use for children with SEN and other specific needs		X	X	X	X	X	X	MES
A	DE	Implementing measures against internet addiction in adolescents		X	X	X	X	X	X	MES, target groups

Bearing in mind the long-term goals, perspectives and sustainability of the Strategy, it envisages also promotion of foreign language training and teamwork (including international) through ICT. One of the goals of the Strategy is to accomplish closer integration in the structures of the EU and encouraging of the educational and scientific exchange. This can't happen without actively breaking language barriers and free communication of Bulgarian scientists and students with their colleagues in Europe and around the world, including through participation in initiatives for achieving relevant European benchmarks, frameworks (CEFR) and language and ICT competences (European e-Competence Framework).

The next section is entitled “Management systems”, as far as the management is an inseparable part of the application of technologies and in many aspects ICT are taken as a synonym to management technologies.

The measures suggested in the table below in one form or another are connected with the general management of the Strategy, ensuring important elements of its functioning.

		Year	20xx							
Target group	**Funding source**	**Activity/measure**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Responsible institution**
		Management systems								
ABC	DE	Use of authenticating services – support of electronic signatures of management and administrative staff in educational and scientific organizations	X	X	X	X	X	X	X	MES, target groups
ABC	E	Support for implementation of complete management-informational system in educational and scientific organizations including paperless document workflow	X	X	X	X	X	X	X	MES, target groups
ABC	D	Funding a unified information system and specialized registries in education and science (of diplomas, of scientific degrees etc.)	X	X	X	X	X	X	X	MES
ABC	D	Providing dedicated funding from MES for ICT support in the relevant organizations – educational institutions, science units		X	X	X	X	X	X	MES, target groups
A	D	Consultations and centralized helpdesk and call center on ICT related subjects	X	X	X	X	X	X	X	MES
AB	DE	Development of a flexible system of indicators for evaluation of the impact of ICT on the quality of education		X	X	X	X	X	X	MES
A	D	Development of a national system for online exams and external assessment	X	X	X	X	X	X	X	MES
AB	DE	Provision of platforms for digital training and control of classes, content management and communication with parents and students	X	X	X	X	X	X	X	MES, target groups

A lot of the suggested measures (e.g. unified information system and specialized registries in education and science) might have an effect that is far beyond the needs of the described target groups. If such systems were open to the general public, they would have a serious impact on the whole society and would draw its attention to the process of planning of education and policy making. Thus the system of education and science would become more transparent, more predictable and friendlier and finally the Strategy would give serious levers for the participation of civil society in decision making as to important social issues, connected with education and science, in line with the principles of effiective planning, real democracy and market economy.

Last, but not least comes legislative regulation of different aspects of the Strategy functioning. The Strategy emphasizes mostly on the legal measures that promote the use of certified education content, where a reasonable balance is sought with protecting copyrights, which until this moment is ineffectively solved, mostly because of the turbulent penetration of ICT in all spheres of social life.

Another important aspect is the development of state standards for developing digital text- and handbooks, as far as this is a still not well studied issue and an adequate legal interpretation is needed in the nearest future, since the world could not stop its development because of existing legislative gaps.

		Year	20xx							
Target group	**Funding source**	**Activity/measure**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Responsible institution**
		Regulations								
ABC	D	Legislation for effective balance between protection of copyrights and free sharing of certified educational content		X	X	X	X	X	X	MES
ABC	D	Support of legislation for prevention of cybercrimes and the distribution of harmful content			X	X	X		X	MES, SACP, MK, MI, SANS
ABC	D	Provision of financial and administrative stimuli for companies, investing in ICT for education		X	X	X	X	X	X	MES, MF
A	E	Development of national standards for creation of digital text- and handbooks and regulation, encouraging the use of digital content in school		X	X	X	X	X	X	MES
A	DE	Creating appropriate regulations for ICT training and training through ICT	X			X			X	MES
ABC	E	Legislation connecting the ICT competencies with the qualification requirements and career development of pedagogical and science staff		X						MES

A measure to provide financial and administrative relieves for companies investing in ICT for education and science is included, because it is clear that the existing funding will never be really enough. Similarly to some of the better developed in this aspect countries like the USA, opportunities for private subjects to participate in the process of informatization are explored, but with clearly regulated conditions and engagements of the participants in the process.

It is supposed that the regulations that link ICT competencies with the qualification requirements and career development of teachers/scientists would also have favorable effect on the process of Strategy implementation. Technologies are not a purpose, but tools and the people, who have mastered them, are usually more knowledgable, more capable and more useful than the rest and it is in line with the normal marketing mechanisms this to be encouraged.

Annex 4.3. Budget forecast by year and type of activities – *by year, in thousands BGN.*

Activity/measure	2014	2015	2016	2017	2018	2019	2020	Total in thousands BGN
ICT infrastructure	19 520	37 690	38 560	36 960	40 460	35 460	35 460	244 110
Development, expansion and integration of unified backbone network for the needs of education and science	3 000	2 000	800	500	1 000	2 000	2 000	11 300
Development, renovation and maintenance of zones with wireless access and communication infrastructure in schools/universities/institutes/students' hostels	3 000	6 000	1 000	1 000	2 000	1 000	1 000	15 000
Creating, renovating and maintaining national and regional cloud ICT infrastructures for the needs of education and science	2 200	5 000	3 000	2 000	2 000	2 000	2 000	18 200
Ensuring access to national, European and world educational infrastructures – GÉANT etc.	500	1 500	1 500	1 500	1 500	1 500	1 500	9 500
Ensuring a team and a monitoring center for communications in the system of education and science	120	240	360	360	360	360	360	2 160
Implementation of a specialized video-streaming infrastructure, video-conferent systems and IP telephony	80	250	500	1 000	1 000	1 000	1 000	4 830
Subsidizing internet access or development of permanent optical (fiber) connectivity to educational and scientific organizations	1 500	5 000	5 000	3 000	1 000	1 000	1 000	17 500
Passing to virtualization solutions and platforms	60	1 000	2 000	3 000	2 000	2 000	2 000	12 060
Providing licensed software – operational systems, office packages, graphics and antivirus software, CAD, GIS etc., as well as software for vocational and profiled high schools, people with special educational needs etc.	4 000	6 000	8 000	8 000	8 000	8 000	8 000	50 000
Co-funding of organizations in education and science for implementation of new ICT products	5 000	10 000	15 000	15 000	20 000	15 000	15 000	95 000
Purchase of portable computers and/or tablets for teachers/scientists	60	500	1 000	1 000	1 000	1 000	1 000	5 560
Provision of a subsidized internet (including mobile) access to innovative science practioners, pedagogical staff and trainees	0	100	300	500	500	500	500	2 400
Identification, R&D and implementation of free educational programs and applications	0	100	100	100	100	100	100	600
Educational content	8 280	19 580	25 150	29 500	25 500	24 000	24 000	156 010
Ensuring access to specialized information databases (science information and others)	5 000	10 000	10 000	10 000	9 350	9 000	9 000	62 350
Initiatives for digitalization of existing educational and scientific content	0	1 000	2 000	3 000	3 000	3 000	3 000	15 000
Support of existing information catalogue resources with educational content and centralized access to electronic periodic editions	1 000	1 000	1 000	1 000	1 000	1 000	1 000	7 000
License and localization of valuable international educational resources and programs, available online	2 000	2 000	2 000	2 000	2 000	2 000	2 000	14 000
Support and expansion of national educational portal with digital repository for educational resources	60	250	500	1 000	1 000	1 000	1 000	4 810
Creating educational web sites, programs and self-training systems	0	0	1 000	2 000	1 000	1 000	1 000	6 000
National campaigns for stimulation of creation of digital content by students, teachers, PhDs and scientists	70	500	1 000	1 000	1 000	1 000	1 000	5 570
Development of video-lectures and educational movies, including such made by by students, teachers, PhDs and scientists	0	750	1 000	1 200	900	750	750	5 350
Development of national system for passportization, licensing, maintenance and monitoring of exiting digital educational content	0	1 000	2 000	1 000	1 000	1 000	1 000	7 000
Development or purchase of e-handbooks for the needs of general and vocational education	0	2 000	3 000	4 500	3 000	2 500	2 500	17 500
Development of specialized educational programs for children with SEN	0	80	150	300	500	500	500	2 030
Creating and support a national online bank for tests and tasks	0	500	500	500	250	250	250	2 250
Funding educational online games and competitions, virtual panoramas, 3D modeling etc.	150	500	1 000	2 000	1 500	1 000	1 000	7 150
IT training	0	8 750	12 220	16 420	14 620	13 240	11 680	76 930
Training for creation and use of digital content, creation of information portals, web-based and mobile applications	0	2 000	2 000	2 000	2 000	1 500	1 000	10 500
Promotion of foreign language training and teamwork (including international) through ICT	0	150	300	500	500	500	500	2 450
Training and additional qualification of ICT skills, including ICT courses for advanced (system administrators etc.), as well as training of talented students in the sphere of ICT	0	300	500	1 000	1 500	2 500	2 500	8 300
Creating and sharing good pedagogical practices with ICT means (implementation of ICT in the classroom as part of the process)	0	500	2 000	4 000	3 000	2 000	2 000	13 500
Setting virtual classrooms, laboratories and teleconference sessions for school and university students and PhDs	0	0	1 000	2 000	2 000	2 000	2 000	9 000
Setting a demonstration and training center for new ICT based educational technologies	0	2 000	3 000	1 000	1 000	1 000	1 000	9 000
Organization of electronic school and of electronic university	0	2 000	1 000	4 000	3 000	2 000	1 000	13 000
Creation and funding the activity of national center for qualification, certification and testing of ICT skills, including online	0	1 500	2 000	1 500	1 000	1 000	1 000	8 000
Training for ICT use with children with SEN and other specific needs	0	240	300	240	120	240	180	1 320
Implementing measures against internet addiction in adolescents	0	60	120	180	500	500	500	1 860
Management systems	12 190	9 000	10 650	10 650	9 650	9 900	10 400	72 440
Use of authenticating services – support of digital signatures of management and administrative staff in educational and scientific organizations	150	500	500	500	500	500	500	3 150
Support to implement a complete management-information system in educational and scientific organizations including paperless document workflow	4 000	3 000	3 000	3 000	2 000	2 000	2 000	19 000
Funding a unified information system and specialized registries in education and science (of diplomas, of scientific degrees etc.)	900	1 000	1 000	1 000	1 000	1 000	1 000	6 900
Providing dedicated funding from MES for ICT support in relevant organization – educational institututions, science units	0	500	1 500	2 000	2 000	2 000	2 000	10 000
Consultations and centralized helpdesk and call center on ICT related subjects	60	150	150	150	150	150	150	960
Development of a flexible system of indicators for evaluation of the impact of ICT on the quality of education	0	1 000	2 000	1 000	500	250	250	5 000
Development of a national system for online exams and external assessment	80	350	500	1 000	1 500	2 000	2 500	7 930
Provision of platforms for digital training and control of classes, content management and communication with parents and students	7 000	2 500	2 000	2 000	2 000	2 000	2 000	19 500
Regulations	160	1 330	1 760	2 780	1 560	1 500	1 420	10 510
Legislation for effective balance between protection of copyrights and free sharing of certified educational content	0	250	500	1 000	500	500	250	3 000
Support of legislation for prevention of cyber-crimes and the distribution of harmful content	0	0	60	120	60	0	10	250
Provision of financial and administrative relieves for companies, investing in ICT for education	80	0	0	80	0	0	80	240
Development of national standards for creation of digital text- and handbooks and regulation, encouraging the use of digital content in school	0	1 000	1 200	1 500	1 000	1 000	1 000	6 700
Creation of appropriate regulations about ICT training and training through ICT	80	0	0	80	0	0	80	240
Legislation connecting ICT competencies with the qualification requirements and career development of pedagogical and science staff	0	80	0	0	0	0	0	80
Total for the activities in thousands of BGN	40 150	76 350	88 340	96 310	91 790	84 100	82 960	**560 000**

Note: All activities are funded after preparation of concrete projects and approval by the corresponding funding program