What Should be E-Learning Course for Smart Education

Natalia V. Morze[1] and Olena G. Glazunova[2]

[1] Borys Grinchenko Kyiv State University

n.morze@kmpu.edu.ua

[2] National University of Life and Environmental Sciences of Ukraine

e_glazunova@yahoo.com

Abstract. The article deals with problems of creation and use of e-learning course for smart education. Structural features, the ratio of form and content of the smart course elements and its properties: individual learning paths, content personification, the use of training elements with links to public information resources, interactive training elements, multimedia, communication and cooperation elements are substantiated.

1 Introduction

Modern information society is gradually transformed into Smart Society, as noted by sociologists, philosophers, specialists in IT sector, educational specialists, etc. This concept implies the new quality of society, in which a set of technological means, services and Internet used by trained people, leads to qualitative changes in the interaction of subjects that allow receive new effects – social, economic and other benefits for a better life [1].

During Smart Society formation the paradigm of education and educational technology is naturally changing. The tasks of training of the new format specialist, successful and competent to work in the Smart Society rely on the new universities – Smart Universities where the integration of technological innovations and the Internet can provide a new quality of the educational and scientific processes, the results of training, scientific, innovation, educational, social and other activities.

The conceptual basis of the Smart University is a large number of different scientific sources, and information and educational materials, multimedia resources (audio,

graphics, video) that can be easily and quickly designed, assembled to a certain set, adjusted individually for each student, his/her need and peculiarity of educational activity and the level of educational achievements.

2   Problem

It is obvious that in conditions of development of Smart Society the educational paradigm will also change. Smart Universities will perform new functions. Accordingly, the requirements for e-learning courses that ensure students' needs in educational resources will change. Our mission is to substantiate theoretically the properties of such e-learning course, its structure and components, and to test the effectiveness of its use experimentally as well.

3   The Presentation of the Main Research and Explanation of Scientific Results

3.1   Characteristics of the Smart University

5 key characteristics of the Smart University can be distinguished: social orientation, mobility, accessibility, technological effectiveness and openness [2].

Social orientation consist in the personalization of education, building of the individual education cards (Smart-card), organization of the efficient communication and collaboration in education, cooperation, application of design and game techniques, communication via social networks services, etc.

The second, equally important, feature of the Smart University is *mobility*. Mobility should be understood not only in the narrow interpretation - as an access to the educational content through mobile devices and their use for scientific researches, payment transactions, implementation of feedback with the teacher or the representatives from the dean office or departments, etc [3]. Mobility is important as an access of each student and teacher to the educational services from any place and at any time.

Accessibility as feature of the Smart University is characterized by a single point of entry to e-learning and scientific databases, media library, information kiosks, online resources and access control systems to them, etc.

Technological effectiveness provides a viability of the Smart University IT infrastructure by the means of cloud-technologies, innovative technologies of virtualization, open interfaces, based on the principles of simplicity, modularity, scalability, etc.

Openness in the system of the Smart University foresees availability of the open repositories of educational materials for forming e-learning courses and providing training for students, open access to scientific articles and conducted researches and their results [4].

3.2   Infrastructures of the Smart University

Modern university should have the appropriate infrastructure to support the requirements of the Smart Education. In particular, the activity of e-learning center, multimedia center, scientific laboratories with the relevant open virtual environments and open resources, library, including electronic one with the open access to the resources, multimedia classrooms and computer labs should be based on the use of advanced campus network with Internet access, including one on the basis of wireless technologies, cloud infrastructure, technologies of mobile access to e-learning resources, system of distributed access to the resources. The effective functioning of such a sophisticated infrastructure is impossible without a united center of data processing, from where materials are distributed to the structural units: institutions, faculties and departments, regional branches, dormitories, academic buildings, student centers, etc. (Fig.1).

Effective activity of the Smart University will enable to realize not only the tasks of formal, but nonformal and informal training as well. According to studies [5,6] nonformal and informal learning takes 70% in the total structure of the educational process and only 30% of learning is formal, in other words structured by years and semesters of training, learning plans and programs that is usually provided by the institution.

3.3   Features of the Smart Education

Smart Education sets a number of tasks for teacher on which performance depends the effectiveness of teaching and students motivation to nonformal and informal learning, which is based on the students skill to study independently. To interest the modern student, who has access to a large number of high quality modern electronic materials that can be easily found in the Internet, by conventional text linear (non-multimedia) materials, only presented in electronic format, nowadays is almost impossible, especially in formal training. We should create such resources that will integrate multimedia, text, feedback tools on the basis of specific teacher's individual recommendations and external electronic resources that will meet individual needs and characteristics of the modern student - regular user of the Internet resources and social networks. Therefore the integral components of information and educational environment of the modern university should be: institutional repository of knowledge with full-text electronic educational and scientific resources; educational portal, which provides electronic support of all student's learning activities for each discipline in the form of e-learning courses with individual tasks and distinct and clear evaluation criteria that are implemented with tools and methods of forming assessment; video portal with multimedia resources for teaching and research activities; wiki portal as an environment to provide teamwork and collaboration; online services based on the use of Web 2.0 and Web 3.0 services and technologies, etc.

One of the main tendencies in the development of Smart Education is the openness of learning systems – placing the educational content openly available to students around the world, the development of systems with open code, development of

knowledge-sharing under the scheme "student-student", "teacher-teacher", "students-teacher" and "students-teachers" [7,8]. An important step in the development of the idea of massive open electronic courses was the adoption of the UNESCO declaration on global policy on the issue of open e-courses, which sets the task of developing standards for electronic courses, providing synergy in access to them, conducting educational seminars on the development of courses and their use, collaboration between scientists and teachers, education quality assurance [9].
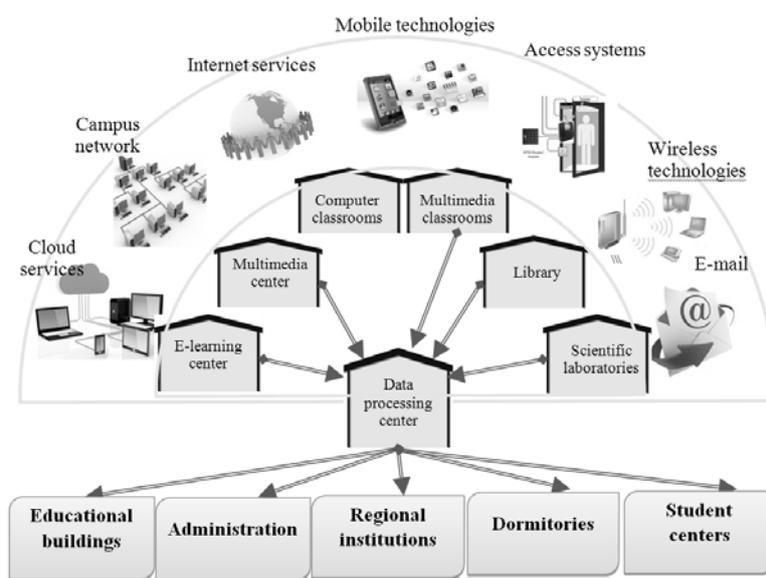

Fig. 1. SMART University infrastructure

3.4   Properties of E-Learning Course for Smart-Education

Some scholars define electronic course as didactic computer environment that contains classified material from the relevant scientific and practical field of knowledge that is combined by a single software shell, in which the following functional components are selected: information and navigation (meaningful connections, annotation and course structure, information, system of references, the searching system), informative (interrelated informative elements of the course – theory, practice, guidelines, additional materials, information resources, including electronic and open), diagnostic (formative assessment tools in the form of clear evaluation criteria for all types of students activity, including self-assessment and mutual assessment, evaluation not only of academic achievements of students, but also evaluation of formation of skills of the 21-st century – to solve problems, work in team, communicate effectively and collaborate, etc., the testing system of current, intermediate and final control) [10]. Electronic course for Smart education should provide flexible learning of the students in an interactive learning environment, which allows him to adapt quickly to the envi-

ronment, to study in any place, at any time on the basis of free access to content all over the world. In our opinion, the electronic course for Smart Education can be represented as a certain scenario or trajectory of educational events how to work with electronic resources in the form of knowledge-map that leads to the achievement of learning effect and has the following properties:

- Flexibility – enabling rapid resources editing and making adjustments in educational trajectory
- Availability of individual learning scenario, in other words, the possibility to draw up an individual educational program for each student from the set of training elements
- Integration of training elements with other open information resources
- Focusing on the learning needs of the student, the personification of content
- Interactivity of learning elements of the course, the maximum use of multimedia technologies (videocasts, animation, video tutorials, screencasts, etc.)
- Feedback between the teacher and the student in the course
- Availability of training elements to ensure effective communication and cooperation of students between themselves and with the teacher, in particular based on the design technology [11]
- Availability of game educational elements
- Providing communication through modern services of social networks [12]

Creation of e-learning courses usually is carried out with the help of Content Learning Management Systems. To create an effective e-learning course for Smart education not only available electronic resources of information and educational environment of the University should be used, but also open external information resources and Web services that will serve as sources of educational and informational materials for electronic course and as means of communication and cooperation (Fig.2).

Information and educational environment of the university should be focused on solving the problem of joint creation and use of academic knowledge for the needs of students and teaching staff of the university. On the one hand, the teacher by himself adds academic resources to the information and educational environment, such as video clips and video tutorials posted on educational video portal and on the other hand, he has the possibility to use available public resources for creating e-learning course. So, to create an electronic course it is sufficient for the teacher to actualize material that is available from other sources, submit it in accordance with the above mentioned properties and criteria of evaluation of its quality, add the necessary training elements of the course according to the adopted structure and develop an individual learning scenario for each student, consider the individual evaluation criteria of educational achievements of students and developed skills of the 21st century.

3.5   Structure of E-Learning Course for Smart-Education

Analysis of papers devoted to the creation and use of e-learning courses [13, 14] led to the conclusion that in the issue of the course structure they should be focused on the modular principle of its construction. When structuring the content of educational

subject by the principle of training modules each module should consist of interconnected theoretical, empirical and practical components of the content, each of which would carry out an independent function. Thus the educational discipline module is an information and didactic unit, in which the approach to structuring the whole into parts is unified. It has a complex structure that includes goal of its integral development, objectives, content and results with the corresponding system of formative assessment.
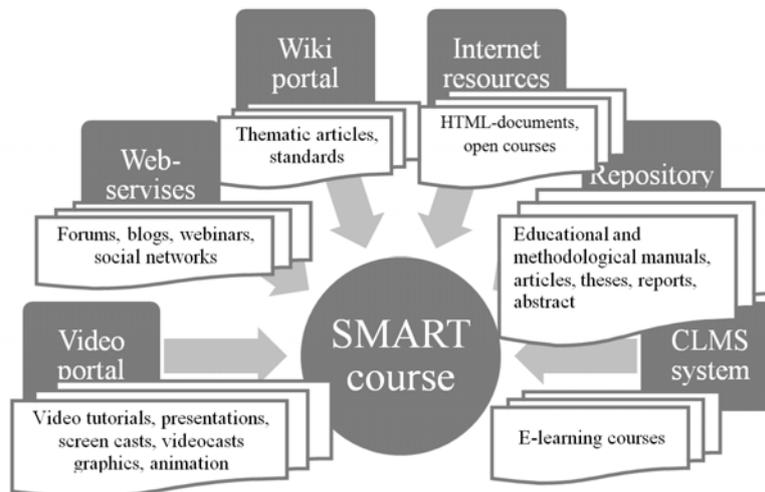

Fig. 2. Sources of electronic course formation for Smart education

Furthermore, the structure of the e-course for Smart education should provide availability of:

- Tools to build individual learning trajectory (prior surveys, questionnaires, tests, formative assessment tools, including check-lists and tables of evaluation criteria, etc.)
- Multimedia presentations of summarizing character, video resources, interactive electronic manuals, external Web resources with multimedia theoretical material
- Links to external public resources including articles, conference proceedings, research materials, etc.
- Discussions on the forums, feedback with teacher, webinars and other Web services
- Intermediate control elements during the lessons and formative evaluation instruments, final control in the form of control tasks and tests, element of reflection

Each element of the training course must meet certain standards and be evaluated using criteria that are accepted at the level of educational institution [15].

Approximate structure of Smart course is shown in the Figure 3.

Example of the course topic, created in the CLMS Moodle environment, presented on training and information portal NUBiP Ukraine (http://it.nubip.edu.ua/course/view.php?id=21).

Further we will focus in more detail on the features of the e-learning course structure for Smart education.
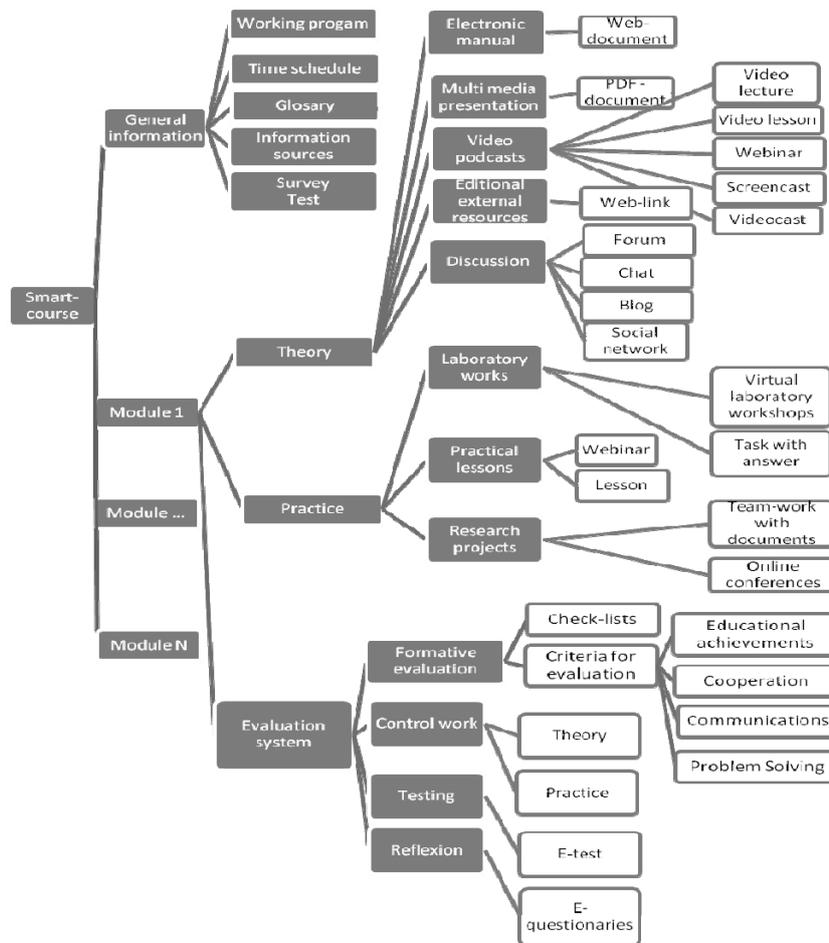

Fig. 3. Structure of the electronic training course for Smart education

3.6 Formation of Individual Learning Trajectory

For the modern student, who has formed basic IT competences, there is a need not only in the access to the resources, but mostly in the navigation knowledge-map, "guidebook" to knowledge, that can be found in information space, as it is important to help student to find quality resources. And this is a complex task for untrained student. Smart education using Smart courses of the new model is the most comfortable and modern teaching model for such cyber-students. To build individual training

trajectory of the student in the electronic course you can use several approaches. One of them lies in the prior survey and testing of the students in terms of competence in the course educational material and the preparation of educational trajectory on the results of such survey and their identified learning needs (Fig. 4). Thus the survey is based on extensive use of formative assessment tools that provides self-assessment and mutual assessment.
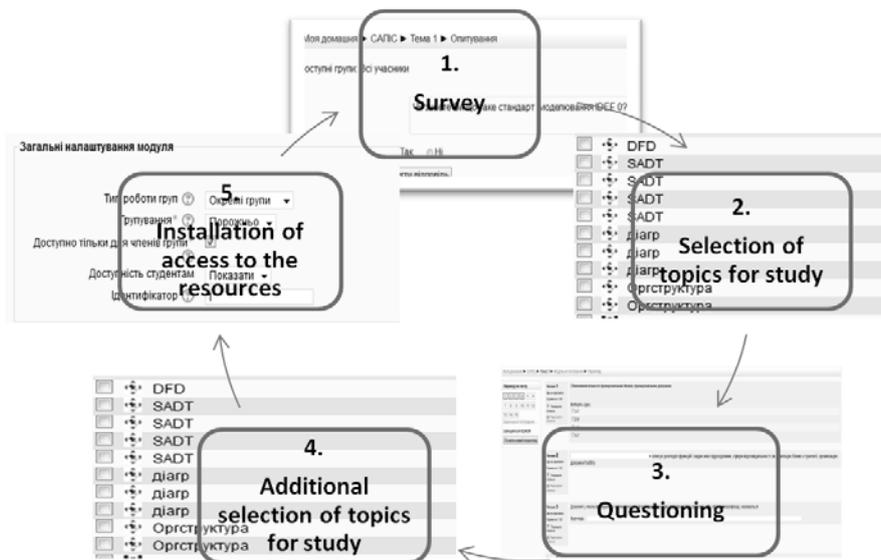

Fig. 4. Stages of the individual trajectory construction

During the experimental study of the introduction of e-learning course of the new sample for the students of the "Computer Sciences" specialty a survey was conducted for assessing their competencies on the subject under the scale: "have a good knowl-edge", "be partially familiar", "heard something", "not familiar". Then each student was offered a test for competence in the training material, which he/she "has a good knowledge of" and "is partially familiar" with. According to the survey and testing results individual learning trajectory was built for each student or group of students. In other words, sequence of learning elements of the course was chosen, which student should study. Moodle platform that we used to create the course allows to make each training element available to a particular group of students. Therefore each student or group of students receives an individual set of training elements of the course. Training course is adapted for personal characteristics of each student that allow to implement personally oriented approach and to develop an individual training pro-gram. At the same time the course itself does not changed, but the methods of presen-tation, set of tasks for performance and the tools, methods of evaluation and control are changed.

3.7 Presentation Educational Material in the Theoretical Resources of Smart Course

Peculiarity of the new model electronic course is also the diversity of the theoretical learning resources presentation forms. Besides the theoretical material must be delivered by 60-70% in the multimedia interactive form, we also note the necessity to choose the method of material delivery, depending on the level of its teaching. The theoretical material in electronic course can be delivered on the following four levels: *phenomenological, analytical and synthetic, mathematical, axiomatic* [16]. Each level has its peculiarities in the delivery of educational material (Fig. 5).
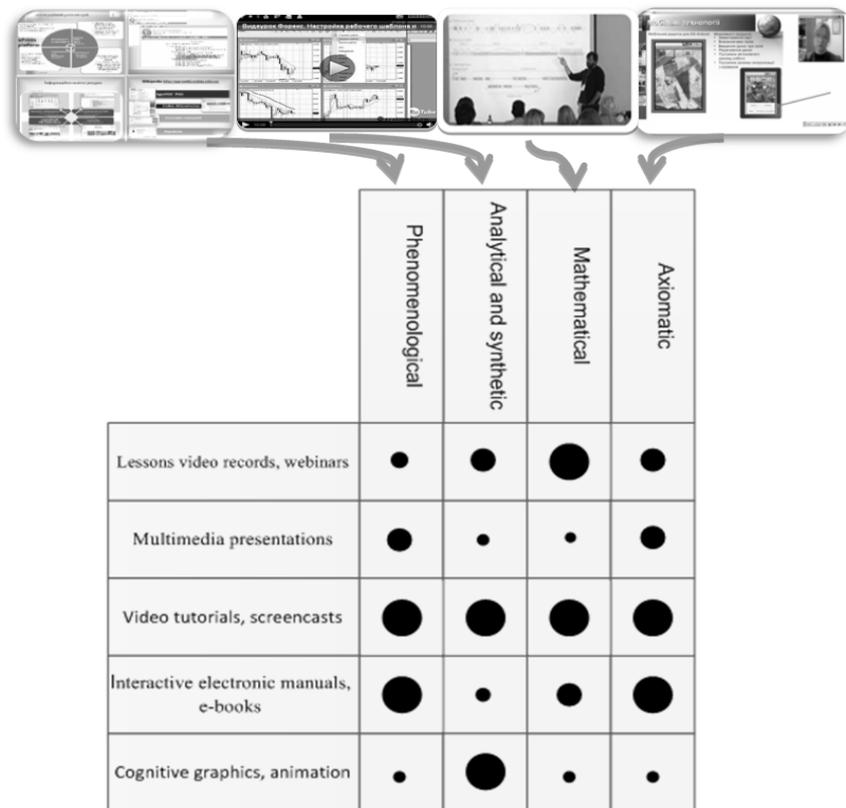

	Phenomenological	Analytical and synthetic	Mathematical	Axiomatic
Lessons video records, webinars	●	●	⬤	●
Multimedia presentations	⬤	•	·	⬤
Video tutorials, screencasts	⬤	⬤	⬤	⬤
Interactive electronic manuals, e-books	⬤	•	●	⬤
Cognitive graphics, animation	·	⬤	•	·

Fig. 5. Ratio of levels and methods of educational material presentation in the theoretical resources

Phenomenological level is characterized by the descriptive way of presenting educational material. Therefore, these materials should be delivered in the form of multimedia presentations, interactive electronic manuals with graphics, multimedia and video elements. Analytic and synthetic level is characterized by the necessity of presenting of the theory of individual phenomena in naturally logical language that cre-

ates background for phenomena and processes forecast on a qualitative level. For this level animation resources with elements of cognitive graphics should be prepared that will be able to demonstrate the nature of the phenomenon and its dynamic changes. Video tutorials with explanation and demonstration of the logic of the processes as well as sound screencasts will be also effective. The mathematical level is characterized by the use of mathematical tools for modeling, theorem proving, examples of solving problems, etc. Therefore, conventional textbooks are not enough to deliver such material. It is necessary to create resources in the form of video lectures, video lessons, and text resources should be reduced to the minimum amount – in the form of handbooks with basic rules, formulas, theorems, etc. Educational material of the axiomatic level can be presented in the form of video tutorials, e-manual and multimedia presentations. Also it is necessary to actively use the links to external resources that cover material from the considered topic. Such resources will add credibility to the course and allow students to familiarize with additional sources of educational materials.

3.8   Presentation Learning Tasks in the Smart Course

Another feature of the e-course for Smart education is the existence of elements for communication and cooperation between the students in the performance of tasks of mastering theoretical material, practical tasks, research projects, etc. Web 2.0 services, online services, social networks provide tools for organizing discussions, collaboration, counseling. These elements are embedded in the course directly through the platform that is used, or by reference to it. While performing tasks students should use modern information and communication technologies effectively. Usually for **mastering the theoretical teaching material** students (Fig.6) are offered tasks on writing essays, composition of the related bibliography, writing summaries, paraphrasing theoretical information of a small amount in the form of "question-answer", compiling a glossary of terms under the certain topic, performing descriptive works, making instructions for the implementation of various operations, plotting grid plans and schedules.

In order that such tasks become interesting for students it is necessary to use Internet resources, and present the result of the performance in the electronic form using modern information technologies.

Tasks **on mastering practical skills** include solving problems, performance of exercises, graphical works, practical works, calculated works, designing, modeling, compilation of practical situations from their own experience and on the basis of practical training, performing analysis of enterprise activity. Students should be offered to solve such tasks using virtual laboratory workshops and specialized software.

Tasks on forming **research activity** include implementation of individual research tasks, writing term papers, graduation works, participation in the educational projects. Such types of tasks involve creative activity of the students, which should be carried out by means of modern computer technologies, teamwork and communication. And one of their peculiarities is the use of formative assessment tools for their assessment that clearly guide the student to achieve learning goals in all types of educational

activity that are presented specifically, clearly and should be achievable for each of them.
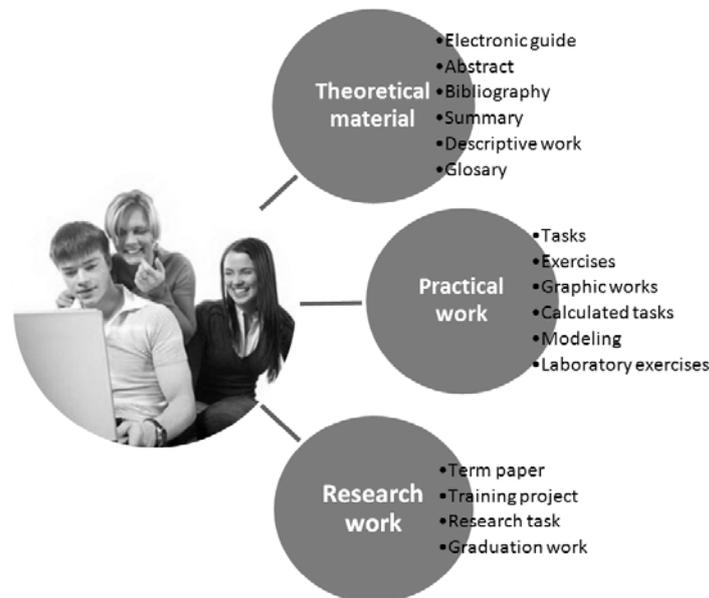

Fig. 6. Types of tasks to master practical skills

Thus, the main features of the students practical work organization using e-course in the Smart education is the availability of tools for collaboration, communication, combination of different information technologies in the performance of tasks. But we should not forget that tasks should have practical significance, and contain detailed information on their implementation, evaluation criteria and support resources. We offer such pattern for the formulation of the task in the e-course (Fig.7)

3.9 Results of Experimental Research

In the course of research conducting we proposed a new model of electronic learning course for students of shortened training period. As a result, after questioning and testing six groups of students were identified who studied in different educational trajectories, successfully completed training course and demonstrated 13% better academic progress compared to the group of students who studied in one training trajectory. At the same time, the participants of the experimental groups performed larger volume of tasks on the depth study and worked extra theoretical study material according to the references to the external information resources. In addition, teachers-participants of the experiment, indicated that the presence of distributed environment of the opened resources in the university allows to create e-learning courses applying much lesser efforts and requires lesser time compared to the case when the

course is created from the beginning. Teachers are able to use ready resources for creating elements of the course – presentations, video recordings, electronic versions of manuals and guidelines, a database of scientific publications, etc.

1. *What to do?* (clear formulation of the task)
2. *In what order?* (algorithm of task performance, progress of work, methodology of the task performance, examples of such task performance)
3. *What materials to use for the task performance?* (links to sources that contain necessary information for task performance).
4. *What tools to use for the task performance?* (standard or customized software, summary and pen, special equipment, etc.).
5. *In what form to submit fulfilled task?* (comparison table, presentation (photo album), booklet, a list of useful resources to the topic, organizational charts, graphs and diagrams, a collection of images or photos, article, cause and effect diagram, scheme of concepts to the theme, timing diagram, test questions, Web site).
6. *How performed task will be evaluated?* Criteria of task evaluation it is appropriate to spell out in tabular form:

Task element	Evaluation criteria	Number of points
Table construction…..	Properly chosen ….	5
…	…	…
Total		20

7. *What is the time limit for task execution?*
(term to which performed task should be submitted, and it is necessary to adhere to these deadlines when works test and valuation).

Fig. 7. Pattern for the formulation of the task in the e-course

4   Conclusions

Thus we note that the electronic course that has the properties required in the view of Smart education is an effective tool for nonformal and informal learning, in which most motivated students are interested now for obtaining high-quality knowledge, not only a diploma of higher education. For efficient organization of learning activity in the conditions of Smart education modern university should have distributed information and educational environment that will enable to concentrate open electronic learning resources and to move knowledge into a distributed network, actively use the Web 2.0 services, mobile technologies, management system for learning content for delivering knowledge to the students and the interactive exchange of information data and training materials with them. In the future the development of such approach is possible due to the joint development and use of the open educational content repository by the universities based on the technologies of the Smart education.

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