ISSN 0798 1015

REVISTA ESPACIOS

HOME Revista ESPACIOS ÍNDICES A LOS AUTORES

EDUCACIÓN • EDUCAÇÃO • EDUCATION Vol. 38 (Nº 25) Year 2017. Page 11

Network Educational Resources in the Research Student Training

Recursos educativos de la red en la formación de estudiantes de investigación

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Received: 09/03/2017 • Approved: 15/04/2017

Content

ABSTRACT:

The article presents "a resource model" used in a technical college for implementation of the basic educational program, which is focused on the introduction in the educational process of the functional model of the research training of students. The author discusses various aspects of the network educational resources in the research training process of the engineering higher school students. The author defines the effective use conditions of the Educon Educational Support System in the research training of the engineering higher school students. The author considers in detail the technology of using the electronic educational resource (the Educon System) in the learning process (lectures, laboratory practice), curricular and extracurricular work (tasks system, term papers), during the e-testing of various disciplines, which provides accurate, systematic, comprehensive and timely information about the students' achievements, as well as the state, functioning and development of the higher school education system.
Keywords: engineering education, research activity training, resource model, network educational resources, Educon System

RESUMEN:

El artículo presenta "un modelo de recursos" utilizado en un colegio técnico para la implementación del programa educativo básico, que se centra en la introducción en el proceso educativo del modelo funcional de la formación en investigación de los estudiantes. El autor discute varios aspectos de la red de recursos educativos en el proceso de formación de la investigación de los estudiantes de ingeniería superior. El autor define las condiciones de uso efectivo del Sistema Educativo de Apoyo Educativo en la formación en investigación de los estudiantes de las escuelas superiores de ingeniería. El autor considera en detalle la tecnología de uso del recurso educativo electrónico (Sistema Educon) en el proceso de aprendizaje (conferencias, prácticas de laboratorio), curricular y extracurricular (sistema de tareas, ponencias) durante la prueba electrónica de diversas disciplinas, Que proporciona información precisa, sistemática, completa y oportuna sobre los logros de los estudiantes, así como sobre el estado, funcionamiento y desarrollo del sistema de educación superior.
Palabras clave: educación en ingeniería, capacitación en actividades de investigación, modelo de recursos, recursos educativos en red, Sistema Educon

1. Introduction

The quality of engineering staff is "one of the key factors in the competitiveness of the state, the basis for its technological, economic independence, the driving force of technological transformation of society" (Putin 2012). The "Research and Innovation Development Concept in the Russian Higher Schools" (Development Concept of Research and Innovation Activities in the Russian Universities, 2011) and the "National Doctrine of Engineering Education of the Russian Federation" (National Doctrine of Engineering Education in the Russian Federation, 2000) state that the engineering staff should be focused on working with the up-to-date technologies, the implementation of research activities, the research of problem situations and finding technically competent solutions. Specificity of engineering, introduction of a competence approach to the engineering education, the Federal State Educational Standard (FSES) for Higher Education, the adoption of professional standards fundamentally change the view of the training methods, identifying the need to find a model of the educational process in the engineering higher school focused on training graduates for the research activities. It should serve as a basis for building innovative didactics of the engineering higher school that allows us to realize the FSES, form a competence complex, contributes to the development of students' creativity, their research capabilities, and the formation of functional research skills as universal ways of contacting with the outside world.

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2. Methods

Theoretical (research, analysis and synthesis of pedagogical, social, engineering, economic literature on the issue; the subject analysis; modeling of the learning process; generalization of research results); empirical (normative documents searches, observation, interviews, tests, self-assessment, documentation analysis, study of the activity products, instructional design); experimental (pedagogical experiment, mathematical methods of data processing).

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3. Results & Discussion

The development of information technology has given rise to a new form of education that is e-learning, i.e. learning using information and communication technologies. The basis of e-learning is electronic learning resources (Bashmanchikov & Bashmanchikov 2003). The Federal Law "On Education in the Russian Federation" (Articles 13 and 15) (Federal Law No. 273-FZ "On Education in the Russian Federation", 2012) defined the network form of educational programs, which provides the basic professional educational programs development by the students using the network of educational resources of organizations.

The study and analysis of the foreign experience of students' research training allowed us to identify a number of provisions, which are advisable to take into account in engineering higher schools of Russia; among them there are close cooperation with the production facilities, provision of free access to information resources, provision of laboratories and auxiliaries, providing computer hardware and software of the highest level (Glotova 2005; Medvedev 2010).

During the implementation of the functional research training model, "a resource model was used in higher school", according to which agreements on comprehensive cooperation with a number of enterprises were concluded. These enterprises are considered as basic including Surgutneftegaz, Nefteservis North, Neftebur, Gazprom-Surgut and others (Gorshkova 2016).

The network form application of educational process organization contributed to the improvement of education quality through the formation of competencies demanded by employers; the students' motivation to the learning process; creation of a research educational space in higher school; the cooperation expansion with representatives of the core enterprises and their participation in the research training of students of the engineering higher school; students' and teachers' access to modern technological processes, equipment, business

resources in the learning process; development of practice-oriented tasks for all forms of activity; creation of special forms and means of extracurricular activities; organization of all types of practices; implementation of a focused distribution of graduates, organization of training courses for teachers.

In the Tyumen Industrial University (TIU), step-by-step introduction of the Educon Electronic Educational Process Support System is carried out in order to improve the training quality. This system is focused on strengthening the educational process informatization that includes the network educational resources development, uniform information educational space infrastructure development, advanced training of higher school staff in the use of information and communication technologies, their introduction into the educational process, the educational institution management.

The Educon System contains electronic educational and methodical complexes of disciplines (EEMCD). Their structure corresponds to the modular structure, so a breakdown of course content into thematic sections is performed in accordance with the FSES content, which provides flexibility in learning content and the educational process focus on the individual learning.

The effective use conditions of the Educon Educational Support System in the research training of the engineering higher school students include the following:

- Interactivity, allowing us to develop activity-related educational forms in the lectures, laboratory and practical classes, independent work during preparation of the term paper.

- Multimedia as a demonstration of learning objects in different ways (using diagrams, photos, videos, animation and sound);

- Modeling as a simulation with visual and audio expression of the form changes, the essence, the quality of processes and objects, instead of describing them in symbolic abstraction forms; representing the imaginary or real world fragment;

- Communication, ability to communicate with the teacher, the use of on-line communication between the students (team projects, tasks); quick access to the educational resources;

- Availability of results control and the possibility of adjusting them.

During the research training of the engineering higher school students, the use of electronic educational resources helps to ensure that the teacher performs the function of a coordinator; much attention is paid to the organization of the students' activities, formation of their research position; at the same time, learning information is used as a means of research organizing; the student is the subject of activity, one of the main educational goals is the development of a student's personality. He is actively involved in the preparation of the individual trajectory of discipline development, chooses the task completion order and rate, and determines the learning material development order.

During the lectures, the electronic educational resources allow us to introduce the student to the real problem situation, increase efficiency by a virtual visit to the laboratories, companies, institutions; show unique or fast (slow) occurring phenomena, processes or their virtual models; expansion of demonstration opportunities on the summarizing lectures, excursion lectures, dialogue lectures and interviews; switching attention and use of emotional and visual, as well as rational and logical thinking, change activities. During the lecture, they put tasks, define the requirements for the results, determine action structure and methods of their implementation, create the conditions for the perception and activity assimilation of theoretical material.

The "ways of students' working, close to the actual research activities that simulate real professional situations" are the research training process basis (Verbitskiy & Ilyazova 2011). During the laboratory practical works, the principle of co-creation is implemented, as well as the students' and teachers' joint research activities, the classes are exercised in the context. The students feel the increase in the complexity of the tasks (tasks are offered in levels 1, 2, 3

with different evaluation rating, task system is presented in the Educon), experience positive emotions on the success. Initially, the laboratory work is made using ready reference cards, which show how to perform the task. At the next step, students are offered the reference cards, which are filled partially; they finish work by their own and present the results. In the development of work with the reference cards, their content becomes minimized. The students perform an independent search for the necessary information. This organization promotes the formation of the students' generalized way of organizing the research activities.

The development and use of virtual laboratory works, practical works and workshops are due to the fact that they allow us to access a unique laboratory equipment, technical facilities, scientific and technological experiments contributing to the research training of students. They are designed to provide access to the electronic laboratory resources in the engineering education system; they can solve the problem of obsolescence of laboratory equipment and inadequate financing on its development, improvement and duplication.

Demonstration of the material using laboratory facilities, installations, equipment is very important in the discipline study of the engineering higher school. Working with the computer models is extremely important, as students can put multiple virtual experiments, observe technological processes, and conduct their research. In the virtual work, the students observe the images of the real equipment and its operation; progress and data processing correspond to the actual conditions that cause their interest and enthusiasm for the research process with possible research on the basis of the unique equipment of industrial enterprises, research institutions, and other schools (with which cooperation agreements have been signed).

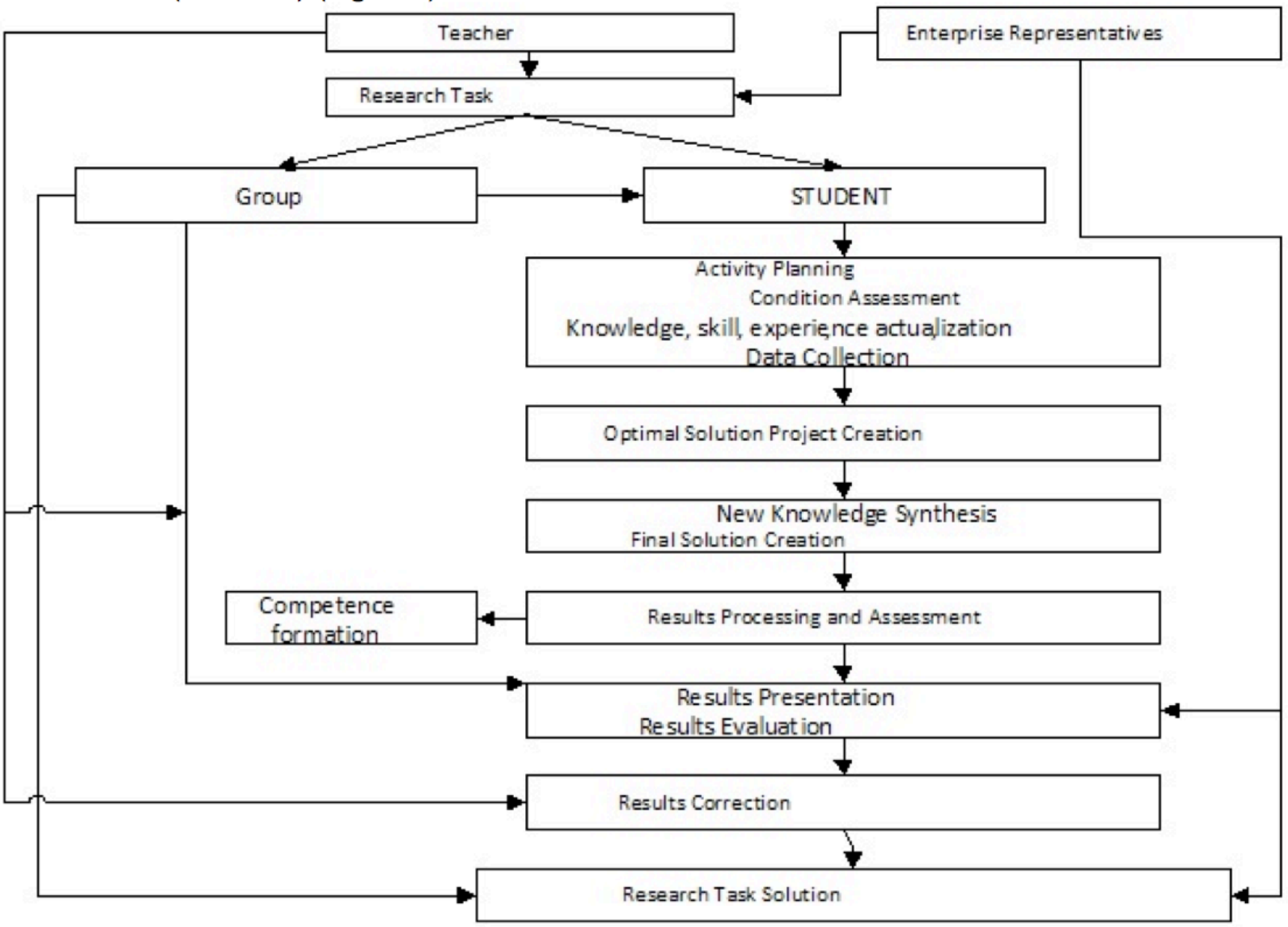
When performing laboratory and practical tasks, the students develop research skills, the utilization of the interaction network form with the basic enterprises also contributes to such development; electronic (web) educational resources to observe the studied processes, hypothesize, collect material for research, model objects and processes, find optimal solutions. The laboratory practical work organization includes individual and team modes; the students are given schedule, the experiment regime, identification data (username and password).

The independent work provides the assimilation of the research activity experience and its content, promotes self-realization, self-organizing, self-development of the student. A special role is played by the system of tasks posted in the Educon. The students' research activities are defined through the use of research tasks of different types and levels that are classified according to the following criteria: the nature of cognitive activity (intellectual and reflective, information and receptive, basic and projective, design and empirical, research units); level of difficulty (selected by students); the number of students participating in performing the task; exercise form, degree of independence. The tasks implementation is provided by curricular work (laboratory and practical works), extracurricular work (off-site laboratory works, independent work), networking in the Educon System. The possibility is assumed for involvement of each student in an active educational research process, their practical application of the knowledge and a clear understanding of where, how and for what purposes, they can be applied, that forms their activity position.

The methods for solving the research problems are formed in stages: initially, the information and receptive methods are used; further the student learns the ways of practical activities, often using them in a similar situation in order to create improved skills. To gain the experience of creative activity, the student is faced with new challenges; the action was translated into the internal (mental) form.

Particular attention is paid to the didactics of solving the research tasks. At the same time, the following measures are taken: formulation of the task, the assessment of given conditions; definition of result requirements; research planning (ideas search), choice of research methods and determination of the action structure, checking the results, their assessment (reflection) (Figure 1).

Figure 1. Diagram of student activities in the performance of a research task



In the process of network utilization, the students' extracurricular independent work technology changes in order to achieve their personally meaningful goals and values, with the priority of the students' values, motivation, interests. The Educon Electronic System includes a section "Practical Work for Problem-Solving", which shows the different units of tasks: Unit 1 – intellectual and reflexive unit includes tasks with contradictions in conditions; tasks that specify redundant (incomplete) data; tasks aimed at familiarizing with the concepts of research activity, research competence, readiness for research activity, research task, task situation, problem, etc.; Unit 2 – information and receptive unit includes tasks aimed at the development of information skills: information decoding when reading; allocation of text parts at different levels; scheduling the task, etc.; Unit 3 – basic and projective unit includes tasks aimed at the dismemberment of the task structure, the implementation of the synthesis, analysis, identification of key existing conditions, matching them with requirements, design of independent research; Unit 4 – design and empirical unit focused on the research tasks aimed at obtaining of the information product as a result of activity (article, report, database, etc.); Unit 5 – research unit includes tasks providing a comparative analysis of existing theories and concepts; study and analysis of new scientific areas; representation of independent problem solution based on the analysis of existing experience.

The research and educational activities of students are set by gradually complicated tasks of various types. Realizing the goals and tasks of independent work, the students have the choice of variants of tasks, resources, communications, work options with the possibility of external support and assistance (by the teacher, other students). Performing the independent tasks, the student identifies possible solutions to the problems, has some responsibility for the results. The Educon System allows them to solve the tasks jointly (in team). The results of each user are uploaded to a network service and stored there for a certain time, can be corrected. The total cumulative solution (project) is obtained as a result of the interaction of students.

One effective means of the research activity readiness formation is the project implementation.

At 1-2 courses in the framework of project activity, the projects of initial (basic) level are used, allowing to master the basic knowledge, form general cultural (organization and self-organization of project activities, project technology, results presentation culture, presentation of results in accordance with regulations), professional and special competences. The increased level of projects (scientific and research work of students, term papers, graduation qualification work) requires a search, analysis, arrangement, of information and new data, a longer time to prepare, therefore, they are performed in extracurricular time. For such projects, initiative groups are created at academic departments. Summing up the performance of creative tasks, projects is carried out at conferences, seminars, round-table discussions with representatives of core enterprises including interactive communication via network resources.

The team papers and graduate qualification works are important forms of the student's research training. For their successful implementation, the guidelines include corrections made with a focus on preparation for the research activity (methodical instructions, tasks are placed in the Educon System). The use of cross-cutting research activities is a feature of training of the technical higher school students (when the term papers, projects, graduate qualification works, the topics were linked to the demands and activities of specific industries, the material was selected during practices).

The Educon System allows the teacher to review the control and term papers of the students in electronic form, to advise students when performing tasks. The papers presentation in electronic form is provided, "Report on the term paper (project) implementation".

In the research activity training, the students can create a portfolio in the Educon System, which along with tracking the results of study and research activity "contributed to their self-determination, self-organizing, self-knowledge, self-development, reflection, formation of research skills" (Pinskaya 2009).

Using the network educational resources in the learning process contributes to a proactive, initiative, responsible person oriented to the research activities. "A student deliberately chooses his or her strategy and tactics in the educational process and is able to effectively implement it" (Laptev & Noskova 2013).

In modern conditions, the education quality problem is one of the urgent issues of higher education in Russia. In order to solve it, an objectified knowledge control system operates in the TIU. The system involves electronic testing in all disciplines, provides accurate, systematic, comprehensive and timely information about the students' achievements, as well as on the state, functioning and development of the educational system at higher school. To accompany the testing procedures, the Educon System is applied, in which the task banks are placed, which are a set of questions of different types assigned to the course, and using which the teacher creates various tests. The test tasks are presented for the different difficulty levels (typically there are 3 levels), designed to test the residual knowledge of the input, intermediate, final control. An external examination of test materials was conducted by petroleum universities of Ufa and Ukhta in accordance with the agreement on inter-university cooperation with the TIU. The advantage of the Educon System includes a provided opportunity to the students to see the ratings log with information on the GPA, which allows them to timely monitor and analyze their achievements in order to take corrective action, if necessary.

The results obtained in the assessment experimental work on a functional model for the engineering higher school students' research training involving the use of the network interaction form capabilities with the core enterprises; electronic (web) educational resources to observe the studied processes, hypothesize, collect material for research, model objects and processes, find optimal solutions; the Educon Electronic Educational Process Support System confirmed the assumption that its integration contributes to the development of students' creativity, motivation, value attitude to the study, willingness to actively participate in innovative engineering processes, the ability to develop new ideas, solving the research production tasks and making the non-standard solutions. The total number of participants involved in the experimental work was 1,520, including 1,390 students and 130 teachers. The

functional model effectiveness assessment can be traced through the identification of occurred formation dynamics of the students' readiness to the research activity (Table 1).

Table 1. Formation dynamics of readiness to research activity, %

Personal Component *Motivational*	2010-2011 ac. yr		2011-2012 ac. yr		2012-2013 ac. yr		2013-2014 ac. yr	
	Exp.	Ctrl	Exp.	Ctrl	Exp.	Ctrl	Exp.	Ctrl
Highest	0	0	3	0	3	1	3	1
High	0	0	27	2	37	3	45	9
Medium	5	2	25	10	28	15	40	26
Low	53	38	30	58	29	61	10	54
Null	42	60	15	30	3	20	2	10
Reflective								
Highest	0	0	3	0	3	1	3	1
High	0	0	27	2	37	3	45	9
Medium	5	2	25	10	28	15	40	26
Low	53	38	30	58	29	61	10	54
Null	42	60	15	30	3	20	2	10
Cognitive Component								
Highest	0	0	3	0	3	1	3	1
High	1	0	25	4	38	7	50	19
Medium	4	2	25	18	32	25	40	38
Low	52	36	30	48	24	50	7	40
Null	43	62	17	30	3	17	0	2
Activity Component								
Highest	0	0	3	0	3	1	3	1
High	0	0	26	1	42	1	49	9
Medium	5	2	27	20	35	30	40	43
Low	55	28	29	39	15	48	7	44
Null	40	70	15	40	5	20	1	3

Changes in the experimental groups are stable in all components. Positive changes in the control groups mean that in the framework of traditional training, there is an increase in the level of the students' readiness to the research activities with experience of learning and research work, but the process is not sufficiently intensive. The analysis of the experimental work results shows stable growth rates in all components for the students from the experimental groups compared to the results of control groups, which allows us to speak about the effectiveness of the developed functional model for the research training of the students.

4. Conclusion

The present stage of the engineering education development is dominated by the problem of research activity training of the engineering higher school students. This activity requires a rethinking of the goals and objectives of the engineering education, the formation of the conceptual foundations of the educational activities of engineering higher school. Using the network educational resources is an integral part of the research training process of the engineering higher school students. Their application is possible in all forms of the curricular work, independent work and in carrying out research tasks and projects. We have taken into account that modern students use mobile communications, social networking, ICQ. "Here-and-Now style appears in the younger generation life, to be always in touch" (Laptev and Noskova 2013). This is one of the grounds for the use of the network educational resources in the research activity training of the engineering higher school student, as well as the use of the network resources contributes to the orientation of students to independent learning, performing tasks, problem solving, professional student formation, with the aim of implementation of the "lifelong learning" strategy.

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Revista ESPACIOS. ISSN 0798 1015
Vol. 38 (Nº 25) Año 2017

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