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ELECTRONIC EDUCATIONAL RESOURCES AS INNOVATIVE TECHNOLOGIES OF ENGINEERING EDUCATION

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Abstract. The development of electronic educational resources is an important direction in the education system. This article details the sequence of electronic educational resources creation using an example of the discipline "Building Thermophysics" included in the module "Fundamentals of building microclimate".

The project development begins with the developing of an application for the electronic educational resources, which includes the following sections: General information and goals for the electronic educational resources creation, terms of electronic educational resources creation, and the characteristics of electronic educational resources".

The section of general information and goals for the electronic educational resources creation includes information about the head and members of the creative team, a resource type and working language, a target group, the mode of study and expected educational outcomes.

Terms of electronic educational resources creation sector comprises information about materials availability and the ability to perform and implement the project at stipulated time.

In the section of characteristics of electronic educational resources contains the concept of the electronic educational resource. The authors should provide a list of electronic materials for the development of electronic educational resource such as teaching aids, guidelines for design and calculation, the number of slides, illustrations and examples of problem solving.

On agreeing and introducing the needed changes and corrections, the electronic educational resource is integrated into a single shell, reviewed by an expert commission and uploaded on the university's website. The learning outcomes include the following skills: to collect, process, analyze information for drafting of technical specifications on heat and gas supply and ventilation system design; to develop project and working documentation; to perform calculations of elements and equipment of heat and gas supply and ventilation systems.

1 INTRODUCTION

Nowadays, the information and telecommunication technologies intensively develop and widely apply not only in science, technology, but also in education. Today we are faced with a rapid transition from physical reality to virtual one. Therefore the task of the university is to teach students to live at the level of the most progressive ideas, to master the ways of continuous acquisition of new knowledge and the ability to learn independently; master the skills of working with any information, with heterogeneous, contradictory data, form the skills of an independent type of thinking [1].

Modern universities need a new educational process organization, it is necessary to transform the role and functions of the department and the teacher, change the ways of creating and updating the educational and methodological complex for each discipline.
Electronic technologies are a means of creating the most adequate conditions for the realization of the student and teacher abilities in the educational process, individualizing and improving the learning process [2,3].

In 2011 Russia adopted the bologna process for the creation of a common space in the field of higher education in Europe [4]. The development of new teaching technologies using electronic educational resources (EER) is important for the successful implementation of new educational programs. The modern electronic educational resource is not simply static materials. EER today becomes the environment for the interaction of its users where new knowledge concentrates and born.

2 THE DEVELOPMENT OF ELECTRONIC EDUCATIONAL RESOURSE

The center for new educational technologies (CNTS) of the Ural federal university (UrFU) creates electronic products, for example the creation of the EER for the discipline of building which was included in the module of fundamentals of microclimate of buildings. This creation marks a successful cooperation between the department of heat and gas Supply and ventilation of the institute of civil engineering and architecture, UrFU and CNTS [5].

The course “Building Thermophysics” is designed to provide knowledge about the thermal, humidity and air conditions of the building that is necessary for the rational designing of external enclosing structures of buildings. New thermal insulation, facing and structural materials with different physical properties are used for the building construction. In addition, the discipline "Building Thermophysics" gives information about physical principles and methods of calculating the processes existing in external enclosing structures of buildings [6].

The creation of the resource begins with the drawing up an application, which includes the following sections: "General information and goals for the EER creation", "Terms of EER development", "Characteristics of EER".

The section of general information and goals for the EER creations includes the members and the head of the creative team, the resource type and language, and the target group (bachelors, masters, specialty, and supplementary education programs). In addition, the mode of study, the profile and name of the module and discipline are also indicated. The expected educational outcomes should also equally be presented. The aims for the creation of EER for the discipline of building thermophysics are presented as thus:

- To provide the educational process with main and additional methodic materials in electronic form;
- To motivate, involve in the creative process and intensification of student activities;
- To improve the materials renewability and modernity;
- To intensify the interaction between participants of educational process through the Internet;
- To enhance team work;
- To develop communication with employers and to participate in technological processes;
- To develop educational content mobility (availability at any time, and on any device);
- To improve information visibility;
- To solve professionally-oriented tasks.

The "Terms of EER development" section demonstrates the material availability and the ability to perform and implement the project on time. The status of the project is proposed to be evaluated according to the following options:
- The resource is planned to be developed;
- The author's materials are ready;
- The resource is ready for expert evaluation.

During development of EER the authors materials such as methodic and educational editions were presented in [6, 7] and recourse was ready for expert evaluation.

The section "Characteristics of EER" contains the concept of EER. The concept for the discipline "Building Thermophysics" is presented as an example:

The electronic educational course on the discipline "Building Thermophysics" has a modular structure and includes:
1) Lecture demonstrations (72 slides, 100 illustrations);
2) Methodical recommendations on the calculation of thermal protection and thermal conditions of buildings and structures.
3) Questions for exam, term glossary, examples of problem solving

The main tasks are to increase the effectiveness of educational process; provide visible demonstration materials; possibility of usage modern regulatory documents and recommendations on energy saving, including these for the student’s independent work.

The structure of EER is presented in the Table 1.

Table 1. The EER structure of the “Building Thermophysics”

Section	Content
1. Thermal protection problems	Aim: to be able to analyze the factors affecting the heat protection of buildings. Information material (4 illustrations): - basic terms - schemes of internal and external influences (fig. 1) - schemes for developing the building thermal regime (fig. 2) - List of literature for the study of discipline.
2. Stationary heat transfer. Types of heat transfer	Aim: to be able to draw conclusions of the basic design dependencies for the basic methods of heat transfer. Information material (3 illustrations): - basic terms

	- physical basis of heat transfer (fig. 3) - The basic design dependencies. Practice: to calculate the heat flux through enclosing structures transmitted by heat conductivity, radiation and convection.
3. Heat transfer through external enclosing structures	Aim: to be able to analyze the ways of heat transfer from the internal air to the outside, to determine heat flows through external enclosing structures. Information material (5 illustrations): -basic terms -resistance to heat transfer -thermal resistance of heterogeneous structures -thermal resistance of air interlayers -the basic design dependencies. Practice: to calculate the heat flux through the enclosing structures.
4. Normalization of heat protection	Aim: to be able to calculate the resistance to the heat transfer of external enclosing structures based on regulatory, economic requirements and condition of energy saving. Information material (6 illustrations): - basic terms (2 illustrations) - the scheme of human heat exchange with the environment - normative materials (2 illustrations) - the basic design dependencies. Practice: to calculate the resistance to heat transfer based on sanitary and hygienic requirements, economic requirements and energy saving conditions; to determine the insulation layer thickness.
5. Nonstationary heat transfer. Heat absorption.	Aim: to be able to analyze the factors determining regimes of non-stationary heat transfer. Information material (4 illustrations): - basic terms - temperature change along the enclosing structure thickness - thermal inertia - the main design dependencies. Practice: to calculate the heat absorption and evaluate the heat resistance of the room.
6. Humidity conditions	Aim: to be able to assess the humidity conditions influence on the burning characteristics of enclosing structures. Information material (4 illustrations): - the basic design dependencies - phase transition diagram - humidity conditions in the thickness of enclosing structures - technique of calculation. Practice: to calculate the temperatures in the thickness of enclosing structures, to plot the partial pressures, to analyze the room humidity conditions.

7. Air permeability	Aim: to be able to calculate the enclosing structures for air permeability. Information material (5 illustrations): - scheme for thermal pressure determining - scheme of flow around the building - technique of calculation air permeability - the basic design dependencies - technique of calculation of enclosing structures for infiltration. Practice: to calculate the external enclosing structures resistance to air permeability, to determine the heat consumption for outside air heating.

The educational outcomes include the following skills: to collect, process and analyze information to draft technical specifications for heat and gas supply and ventilation system designing; to develop project and working documentation; to perform thermo-technical calculation of external enclosing structures of buildings, analyzing thermal, humidity and air conditions.

In addition, a course project plan and practical exercises, including the individual task selection, the calculation of thermal protection, heat, humidity and air conditions and the typical tasks solution according to the discipline sections was created.

Thus, a student receives a possibility to obtain independently all necessary information via EER. The educational outcomes are achieved with the help of:

- availability of theoretical material, visibility of demonstration materials;
- availability of normative and reference information used in the design process (all Union State Standards, questions for exam preparation, glossary of terms);
- simplicity of searching information with the help of references;
- availability of lecture demonstrations, both in the University and during the independent work of students;
- possibilities of discussion by means of network interaction and the choice of a constructive solution.

After agreeing and introducing changes and corrections, the EER was integrated into a single shell, downloaded to the website and adopted by the expert commission of the University.

3 CONCLUSION

Electronic educational resources contribute to more effectively organization of the educational process and creating new directions in professional development, distance and additional education.

The electronic educational resource is constantly being updated, not only by the authors, but also in the process of students' work. The resource is based on cloud services; it is integrated with social networks, services for collaboration and users communication. Any activity of the trainee within the framework of the resource can be fixed as a result of training, the storage of which is an obligatory function of the systems providing the learning process.

The electronic multimedia educational resource "Building Thermophysics" has received approval in distance education, specialty construction, and in the professional

development specialty termed “Energy Saving". The EER "Building Thermophysics" user group is up to 100 people per year.

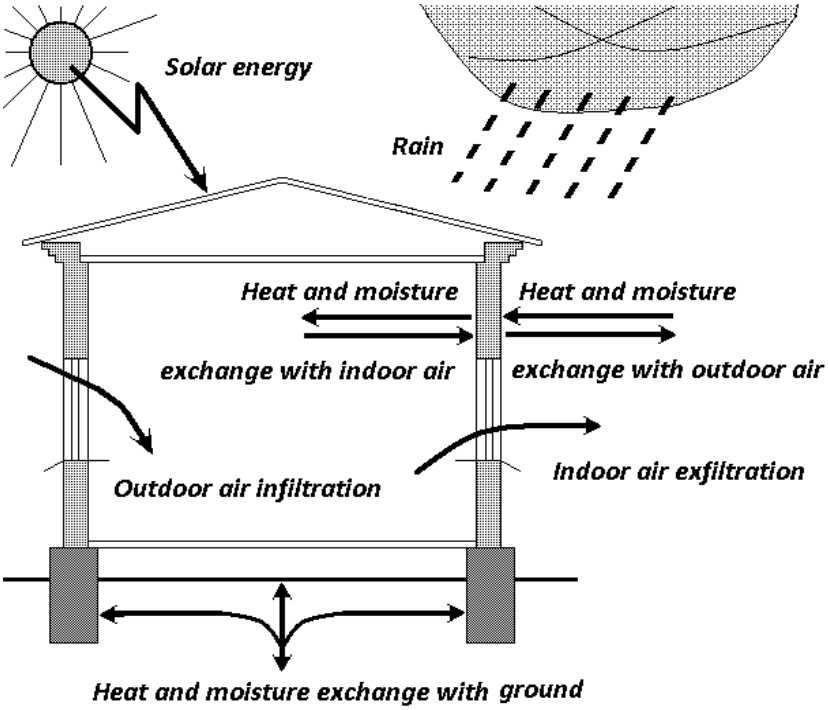

Figure 1. Scheme of internal and external influences

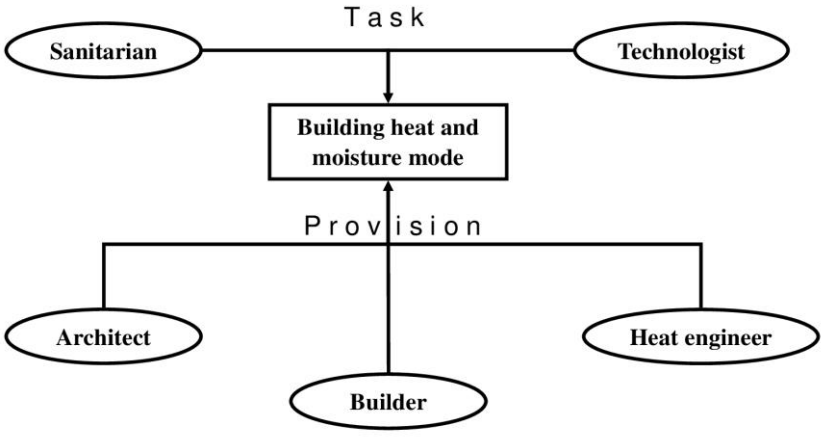

Figure 2. Scheme for developing the building thermal regime

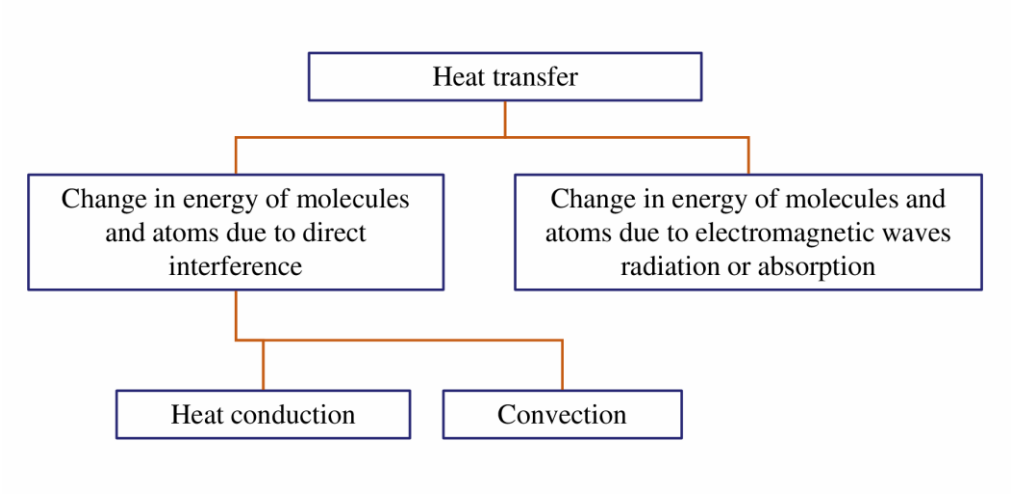

Figure 3. Types of heat transfer

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