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INTERDISCIPLINARY RELATIONS IN TRAINING IN PHYSICS AT THE UMG

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ABSTRACT

Implementation of informal didactical process leads to necessity of planning and methodical elaboration of academic knowledge. This necessity causes a lot of actual problems, which require deep practical and scientific importance. One of the problems is creation of optimal syllabuses in all education disciplines. There are not concrete clear and accurate requirements in modern didactics for compilation of syllabuses. The traditional improvement of syllabuses to a great extent has a casual pattern.

The problem of creation of optimal syllabuses in physics in order to realize an informal training permits solution by investigation and analyzing of interdisciplinary relations with mathematics, Earth sciences and some engineering sciences.

Existing interdisciplinary relations between physics and disciplines that are studied in two specialities at the Faculty of Geology (FG) "Applied Geophysics " (AG) and "Drilling and Air and Gas Production" (DOGP) are investigated. (These specialties were selected because of the fact that they could not be obtained in other institutes of higher education (IHE). 19 syllabuses are considered for the subject AG and 22 syllabuses are considered for DOGP. Consideration of the syllabuses is based on investigation of included in them educational elements.

More complete perfection of subject syllabus presumes "optimal including of the subject in curriculum context, i.e. its coordination and integration with other subjects and with general aim of training - the specialist's model".

The accelerated development of modern society is in need of mobile education that leads to a dynamic qualification. The secondary education is not enough to practice certain professions. That is why the young people enter IHE, motivated by inner needs - to master a specialty. With regards to this arises the effect of selective activity of the student, which finds expression in different sharing out of student forces between subjects.

The investigations show that two of a lot of facts, which have an effect on successfully mastery of knowledge, are of great importance: motivation and structure of the didactic process. It is supposed that students, who enter IHE, are motivated concerning their selectivity and themselves are responsible for their education. And because the education is teaching and learning, the teachers are the persons, who are obligated to keep up and to strengthen this motivation during the different degrees of training.

A didactical process is: student activities, conducted and managed by the lecturer for mastering a system of knowledge and skills in a particular field. Implementation of informal didactical process leads to the necessity of planning and methodical development of academic knowledge. This necessity causes a lot of actual problems, which demands deep scientific and practical solution. One of these problems is creation of optimal syllabuses for all subjects, differentiated in four groups - Mathematical, Fundamental, Engineering and Additional, according to the accreditation requirement of the Canadian Accreditation Bureau for Engineering Degree - Bachelor of Engineering.

There are not fully concrete requirements for working out syllabuses in modern didactics and unfortunately lecturers are not able to use concrete methods in the creative work for creation of syllabuses. The lecturers searches are based mainly on experience and intuition. That is why their traditional improvement to a great extent has a casual pattern.

In the ordinary syllabus, which puts content of educational discipline in a nutshell, there is a lot of disadvantages:

a) Selection of the matter, included in the syllabus, is made not on criteria or rules and often depends on the opinion of the author(s) or on not enough representative group of experts.
b) In the syllabus a lot of things are supposed, but not all is clearly formulated, for example it is unclear what must to be the quantity of subject acquirement.
c) The syllabus is not comprehensible for all and is realized in accordance with the subjective opinion of particular lecturer.
d) There is no differentiation between important and secondary information and this makes the teaching process difficult.
e) The syllabus volume rarely is harmonized with the time, necessary for its learning. The way for most effective construction of the training process is not determined.

A method for solving of this problem is proposed in the specialized literature [1]. Application of this approach guarantee primary perfection of the subject syllabus – for organization of the discipline in order to its study.

Every problem needs some kind of solution. "Man now is concerned with such problems, that makes a conquest of his spirit..." (N. Bor). The problems are more important than solutions. The solutions could become out of date, but

problems stay [2, p. 25]. One solution of this problem – creation of optimal syllabus in Physics for educational and qualification degree Bachelor – is made by Prof. Ph.D. N. Djerahov, Prof. Ph.D.V. Lilkov and Prof. Ph.D. L. Drajeva, Department of Physics, Faculty of Geology, UMG.

There are three flows at the UMG, which studied Physics – a fundamental science and that is why it is necessary to use three syllabuses in Physics. The syllabuses were actualized in the first semester of the academic year 1998/99. The syllabuses are structured in separate modules according to the module principle of organization of the educational content in differentiated parts (according to Art. 40 of the Law of Higher Education). They are conformed to requirements both for specializing and general departments.

The problem of creation of optimal syllabus in order to realize an informal training permits another solution, which could be carried out by analyzing the investigation of interdisciplinary relations between physics and higher mathematics, Earth sciences and some engineering sciences.

Subject syllabuses for two specialties obtained at MGU - Applied Geophysics (AG - engineering science and design) and Drilling and Oil and Gas Production (DOGP - engineering science and design) are investigated.

19 syllabuses of corresponding disciplines are investigated for the speciality AG and for the speciality DOGP - 22.

Consideration of the syllabuses is based on investigation of the included in them educational elements. According to V. Bespalco educational elements are:

a) Objects, sites and things from a detrained field of reality;
b) Phenomena, processes or other observed interactions between objects;
c) Methods, which man uses to have an effect on objects and phenomena, i.e. man's skills and habits.

According to Prof. Ph.D. P. Galanov (Galanov, 1992; Galanov, 1994), educational elements are all compound parts of a particular educational matter - facts, experiments, phenomena, concepts, terms, physical quantities, statements, hypotheses, laws, conclusions, solutions and application of physical knowledge. Founded on these educational elements, it could be maintained that there are the interdisciplinary relations between different educational disciplines and relations could be classified into tree groups: synchronous, asynchronous and methodical. This differentiation is made with regard to the time of initiation of educational elements, which are used in different educational disciplines. The implemented investigation emphasis on relation synchronism and asynchronism, where:

There are synchronous relations when a particular educational element is initiated first in the subject, in which it is logically defined and then is used in another one.

- there are asynchronous relations when a particular educational element is used in a subject and it is not initiated in the subject to which it logically belongs.
- the conclusion about the kind of existing relations between physics and educational disciplines, studied in both specialties AG and DOGP (selection of specialties is based on the fact, that this qualification cold not be obtained in other IHE), is made on the base if investigated educational elements logically defined in physics.

The conclusion is: all investigated educational disciplines (with the exception of higher mathematics) follow in time studying the physics and therefore for existed interdisciplinary relations could maintain that they are synchronous. A new problem concerning repetition of educational elements arises In the process of relation analysis, i.e. is it necessary? Recapitulation on one hand leads to assimilation of knowledge, but on the other hand to loss of time, that could be utilized more rationally for obtaining of new knowledge and skills for their implementation in order to obtain the desired specialization. The application of knowledge shows the degree of intelligibility, as an ancient Chinese proverb says:

"What I hear - I forget.
What I see - I keep in mind
What I make - I understand."

Implementation of high effective education needs not only accumulation of academic knowledge, but gaining skills and competitions with applied and practical significance.

If a whole university course in a particular specialization will be considered, it will be found out that it is build on the base of linear and spiral system, i.e. some educational elements are studied for the first time and another are repeated. If the repetition is necessary, the differences in terms and symbols must be eliminated because the differences cause unnecessary embarrassment for students.

Mathematics as a subject is studied in three educational disciplines, respectively: Mathematics part I and part II during the first semester and Mathematics part III during the second semester. The cases, when the synchrony is breached, are established by investigation of relations between physics and mathematics.

Learning of Higher Mathematics must get ahead of teaching the disciplines, in which the obtained knowledge is necessary for learning of new knowledge and skills. The following example is conformation of that.

The following two equations are given:

$$a_1x_1+b_1x_2=c_1$$
$$a_2x_1+b_2x_2=c_2$$

About this problem mathematician will give the most common answer, that it is a system with two linear algebraic equations with two unknowns, but what exactly it expresses he can only guess.

But different specialists will answer as follows:

1. Electrical engineer - these are equations of voltage or amperage in an electric circuit with active resistance.
2. Mechanical engineer - These are equations of forces balance of levers or springs systems.
3. Civil engineer - These are equations of forces of connections and deformations of a building structure.
4. Supervising engineer - These are equations of distribution of loom loading.

In order to give such right answers it is necessary the students to be able to apply mathematics in time and quality in physics and specialized educational disciplines. This necessity is prompted by the fact that a real importance of mathematics is in its application in other sciences.

Investigation of interdisciplinary relations is a necessary precondition for perfection of syllabuses. The carried out investigation (Dimitriva, 2001) of educational loading volume in most disciplines in the higher engineering institutes in Western Europe shows that not only the number of hours is an indicator of the volume and content of studied educational disciplines. Preparing of optimal syllabuses, conformed and in detail considered on collective experts level will have an effect both on concrete training and on the complete education, the general principles, aims and takes of which must to be in the spirit of the European requirements and standards.

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