PEDAGOGY

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**The formation of goals and learning results of financial mathematics to students
of the program "Bachelor of mathematics and economics"**

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Abstract. The developed system goals and expected learning results of financial mathematics to students of the program "Bachelor of mathematics and economics", considered with program results and competencies, classification formulated goals, in particular on the basis of the taxonomy by B. Bloom.
Keywords: competence, financial mathematics, goals and learning results, taxonomy purposes, teaching methodic

One of the most effective ways to be formulated in the Law of Ukraine "On higher education" (No. 1556-VII, from 01.07.2014) the basic principles of the state policy in the sphere of higher education, in particular " straight combination in the educational process of educational, scientific and innovative activity", in the context of understanding the educational process as "intellectual and creative activity in the field of higher education and science, is in a higher educational institution (academic institution) through the system of scientific-methodical and pedagogical activities and directed to transfer, learning, enhancement and use of knowledge, skills and other competencies in students, as well as forming harmoniously developed personality", in our opinion, is the optimal integration of fundamental scientific and professional practical training. For students of mathematics majors various majors this can be achieved by the study of relevant disciplines that belong to the so-called applied mathematics. One such field is financial mathematics.

Relying on article 2.1.Pedagogical European Constitution, which interprets "teacher education as a system of transfer current basic and applied knowledge in the course of activities of educational institutions of different types and forms of ownership, aimed at training teachers preschool, primary, general secondary, out-of-school, vocational education, professional activity is the training and education of children and youth", we will try to identify the main approaches to the formation of goals and learning results of financial mathematics to students of mathematical specialties of pedagogical universities.

The problem of forming the purposes of training and education was and is always relevant. Even Ya. Komenskiy considered a big disadvantage of pedagogical activity, the absence of clearly defined pedagogical goals [9].

Learning objectives we will consider as pre-planned result of the training activity, which is achieved with the help of the content, methods, learning tools, etc. It is a major component methodical system, which is influenced by the social order of the society, the level of development of science and teaching methodic, learning environments and affect the choice of other components of the system, because it gives the answer to the question: why (for what purpose) to teach?

Today, in the conditions of implementation of competence-based approach, there is a shift from process to outcome of education in the activity measurement, the shift from accumulation of normative knowledge, skills and abilities in the formation and development of competencies. In this context, learning goals are formulated in terms of learning results and competently.

On today uses a number of terms to denote the "learning results" and "competences" (competence). They have different shades of meaning and multiple different spheres of reference. But in any case, they all refer to what the learner will know, understand and can do at the end of the learning process. Their widespread use is part of the changing paradigm, according to which a person learns, placed in the center of the educational process in higher education. This change is the basis for the European higher education area, the Bologna process and ECTS.

1. In the frame of qualifications of the European higher education area (Bologna framework) learning results (including competencies) are treated as General learning results. The frame is based on the Dublin descriptors developed in the framework of the Joint initiative quality. These descriptors contain General statements of typical expectations or the level of competences of academic achievements and abilities associated with the Bologna cycles. The term competence in this case is used in a broad sense, allowing the gradation of skills [5].

2. The European qualifications framework for life but distinguishes between knowledge, skills and competence (competence). It uses the following definition: "competence means the proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development. In the context of the European qualifications framework, competence is described in terms of responsibility and autonomy". In this case, the term "competence" is understood in a more limited sense as the ability to transfer knowledge into practical actions [3].

3. The Tuning project (harmonization of the educational structures in Europe) allows to draw a clear distinction between learning results and competences to define the different roles the most important participants of the educational process: teachers and students/trainees. Competence in "Tuning" represent a dynamic combination of knowledge, understanding, skills, abilities and attitudes, and are divided into subject-specific and general. Fostering competences is the task of the educational process and educational programs. The Tuning project the results of the study indicate the level of competence obtained by one who learns. The learning results are formulated by the faculty, preferably on the basis of data received from internal and external stakeholders [4].

In the Law of Ukraine "On higher education" the following definition of "competence is a dynamic combina-

tion of knowledge, skills and practical skills, ways of thinking, professional, ideological and civil qualities, moral and ethical values, which determines a person's ability to successfully implement professional and further training activities and is the result of learning at a certain level of higher education" [11].

By definition, the Tuning project: learning results– statement of what is expected to know, understand, be able to demonstrate the student after graduation. May deal with individual module of a course or period of study (first or second level) [12].

That is, the learning results reflect the expectations of teachers regarding the results of their educational activity. According to the methodology of Tuning the learning results are formulated in terms of competences. In turn, the competences represent a dynamic combination of knowledge, understanding, skills, abilities and capabilities. The development of competence is the goal of the curriculum. Competence are formed in many different academic disciplines and assessed at different stages [12].

In the common European framework of qualifications, competency and learning results are formulated in accordance with the Dublin descriptors: knowledge and understanding; applying knowledge and understanding; the formulation of judgments; communication; learning ability [2].

Between learning results and competences there is a basic difference lies in the fact that the learning results are formulated by the teachers at the level of the educational program, as well as at the level of individual disciplines and competencies acquired by individuals who learn. Learning results specific the fact that they, unlike competencies can be measured.

Consider common approaches to the design of program competencies and learning results.

We will consider the classification of competencies in two types: General and special (professional) competence. Under the General competencies will understand common concepts are not tied to any subject area. This is, for example, learning ability, creativity, knowledge of foreign languages, basic information technology, etc. Special (professional) competence depend on the subject area, so they define the profile of the educational program and future qualification graduate. It is special (professional) competence transform educational program on professionally-oriented.

Table 1. The learning results for content modules financial mathematics

Code LR	The student who scored the module:	The wording of the learning results for modules of content
Content module 1. Operations building and discounting using simple and compound interest		
LR 01.01	Has knowledge	basic financial concepts: interest and discount rate, the initial capital cost of money over time, the purchasing power of
LR 01.02	May exercise	the process of inflation in determining the cost of capital schemes simple and compound interest
LR 01.03	Know how to calculate	the current and future value of money
LR 01.06	Can perform	the operation of the building and the discounted cash assets in the schemes simple and compound interest
Content module 2. Financial highlights: cash flow, rent, loan calculations		
LR 02.01	Has knowledge	key financial indicators: cash flow, rent, loan calculations
LR 02.03	Know how to calculate	the main parameters of the cash flows, deferred, perpetual, continuous annuities, annuities to the changing rate of payment
LR 02.04	May develop	the debt repayment scheme
LR 02.05	Able to determine	modern and future value of annuities post and prenumerando
LR 02.06	Can perform	the calculations for the conversion and consolidation of debts
Content module 3. Financial operations and instruments		
LR 03.01	Has knowledge	primary and derivative financial instruments
LR 03.02	May exercise	selection of specific tools and instruments for the proper management of cash assets
LR 03.03	Know how to calculate	current and full yield financial transactions
LR 03.04	May develop	business plan activity of the investigated object
LR 03.05	Able to determine	the parameters of the financial transactions when certain conditions
LR 03.08	Can predict	the dependence of the rate bonds from interest rate
Content module 4. Mathematical methods and models in the study of the securities market		
LR 04.01	Has knowledge	basic mathematical models of financial analysis: percentage calculations; probabilistic models and risk assessment methods; optimization models, in particular models of portfolio securities; forecasting models
LR 04.02	May exercise	the choice of the best model of optimization of the investment portfolio
LR 04.03	Know how to calculate	the main parameters and results of operations with securities
LR 04.07	Knows how to use	computer technology with the aim of finding the optimal solutions of the mathematical model
Content module 5. Elements of actuarial mathematics		
LR 05.01	Has knowledge	theoretical basics of building insurance rates
LR 05.03	Know how to calculate	the rates in the contracts of property, personal insurance and liability insurance
LR 05.05	Able to determine	the probability of occurrence of the insured event; the frequency and the expected value of the damage
LR 05.08	Can predict	trends in insurance costs

Pedagogical European Constitution in article 2.2. determines that the "center of teacher education and various forms of teacher training in the framework is the formation of the personality of the teacher – man high level of education, cultural training, high spiritual and moral qualities, capable of training and education of children, youth and students in accordance with the requirements of the XXI century" and highlights the 7 core competencies, which should possess a teacher of the XXI century (article 6.2) [10]:

1) communicative competence (in particular, the modern teacher must be fluent in several European languages);
2) competence identity;
3) the competence of justice;
4) leadership competence;
5) research and analytical competence;
6) the ability to learn throughout life;
7) empathy – the ability to understand the experiences of the student or student and empathy in the process of communication.

In this regard, the most important competence of the teacher of the XXI century, which promotes the well-being of each person and creates its rich spiritual world is defined by the ability to ensure that the learning environment.

Thus, the learning results are measurable, they are key indicators of the level of knowledge of students competencies.

Learning results as a result of educational activity, require a certain classification and measurement of learning achievements of students.

The common experience of assessment recommends to describe learning results multilevel taxonomy, such as taxonomy B. Bloom, D. Bocc, J. Guildford. B. Bloom identifies six levels of mastering the content of education: knowledge, comprehension, application, analysis, synthesis, evaluation [1]. D. Boccand, J. Guildford have developed a three-dimensional model of the taxonomy that allows us to consider a hierarchy of goals and levels of training and has identified the following levels: content, products, and operations, each of which includes the types and categories. In the post-Soviet space, the most widespread taxonomy Bespalko V.P. [8] and Simonov V.P. [13]. Bespalko V.P. has developed a taxonomy that contains four levels of learning: the level of recognition, the activity in the standard situation, activity in non-standard situations, activities in new areas (research). This classification is hierarchical, and each level includes the previous one. Simonov V.P. has identified five levels of learning, where each successive level of learning also includes all previous: recognition, memorization, understanding, basic skills (reproductive level), level of creativity.

The course of financial mathematics, which is taught to the students profile "mathematics and economics" in the NPU named after M.P. Dragomanov, consists of the following content modules:

1. Operations building and discounting using simple and compound interest.
2. Financial highlights: cash flow, rent, loan calculations.
3. Financial transactions and instruments.
4. Mathematical methods and models in the study of the securities market.
5. Elements of actuarial mathematics.

The creation of such tables matching the contents of the educational discipline and provided to the program learning results will allow the teacher to adjust the learning process and to determine the optimal list of content modules.

In general, by setting the relationship between the learning results with the semantic module, you should find out the relevance of the results to the training program learning results. To do this, we will construct the following table 2.

Table 2. Relationship of learning results with meaningful modules with software results

№ LR	Software learning results	The relationship with PH
1.	Knowledge and understanding of fundamental mathematical concepts of algebra, geometry, mathematical analysis and differential equations, probability theory and mathematical statistics, etc.; the ability to reproduce these concepts, to establish the linkages between them, to interpret, give examples.	LR 01.01, LR 02.01, LR 03.01, LR 04.01, LR 05.01
2.	The ability to formulate and prove mathematical statements that establish the basic properties of the fundamental mathematical concepts and illuminate the relationships between them.	LR 01.01, LR 02.01, LR 03.01, LR 04.01, LR 05.01
3.	Ability to apply mathematical methods to the solution of various types of theoretical and applied problems, build, and study mathematical models of real processes and phenomena, including economic.	LR 01.02, LR 03.02, LR 04.02, LR 01.03, LR 02.03, LR 03.03, LR 04.03, LR 05.03, LR 02.05, LR 03.05, LR 05.05, LR 02.04, LR 03.04, LR 05.08, LR 03.08
4.	Basic knowledge and understanding of special courses on the student's choice: algebra and number theory, geometry, mathematical analysis, differential equations, probability theory and mathematical statistics, applied mathematics, methods of teaching mathematics, Economics, computer science, with the aim of further specialization and the development of interdisciplinary approaches.	LR 05.08, LR 03.08
5.	Ability to perform computer calculations, using appropriate software, to create their own programs to solve problems of different types, using different programming languages, skills analysis and display of results.	LR 01.03, LR 02.03, LR 03.03, LR 04.03, LR 05.03, LR 01.06, LR 02.06, LR 04.07
6.	Mastering the skills to work independently (coursework, thesis or with a group (laboratory work), ability to get results within a limited time with an emphasis on professional honesty and preventing plagiarism.	LR 02.04, LR 03.04, LR 05.08, LR 03.08

The analysis of this table gives the teacher information about the possible improvement of the content and structure of the educational material of each content module.

Considering the general and professional (scientific and subject-specific) competencies highlighted in the program bachelor of mathematics and economics, the content of educational material on financial mathematics, its place and role in the training of specialists and interdisciplinary communication, we have formulated 5 competencies that must be formed among the students in the learning process of financial mathematics:

C_1– knowledge of basic concepts, facts and methods of financial mathematics, their ability to formulate, for examples, interpret, compare and establish the linkages between them;

C_2– ability to formulate, prove, and apply basic mathematical statements expressing properties of underlying financial instruments;

C_3– the ability to apply mathematical methods to solve theoretical and applied problems in financial and actuarial mathematics;

C_4– ability to apply mathematics, in particular analytical, probabilistic, statistical, correlation, regression and variance, methods of creation, analysis and study of mathematical models of financial-economic objects, processes and phenomena;

C_5– the ability to apply modern information technology to address theoretical, practical and applied problems.

Then we have the following learning results for the entire course in financial mathematics:

LR_1– demonstrate knowledge and understanding of essential facts, concepts, principles, theories and methods of financial mathematics;

LR_2–to apply acquired knowledge and skills to solve various types of educational tasks;

LR_3– to create a mathematical model of the real process or phenomenon, to parse it, to plan a strategy decisions, to interpret the results;

LR_4–to use information technology for data processing;

$LR5$ –to learn to objectively evaluate and present scientific results;

LR_6–to plan, to design, to predict future results.

Table 3. Matrix relations learning results (LR_n) and competencies (C_m)

Competence Learning results	C_1	C_2	C_3	C_4	C_5
LR_1	+	+	-	-	-
LR_2	-	-	+	+	+
LR_3	-	+	-	+	-
LR_4	-	-	+	+	+
LR_5	-	+	-	+	+
LR_6	-	+	+	+	-

Table 3 shows the relationships of learning results (LR_n) and competencies (C_m) in the form of a characteristic-correlation matrix, i.e. the matrix elements (+ or -) indicate the presence or absence of a relationship (and not its essence).

According to the representation of the relationship between learning results and competencies are clearly set group learning results, responsible for the formation of specific professional competencies.

Thus, summarizing all the above, let us turn to the formulation of learning goals, financial mathematics on the basis of this analysis, our stated competencies, learning results and the defined relationships.

Table 4. Learning goals of financial mathematics in the cognitive sphere
(classified in the taxonomy B. Bloom, V.Bespalko, and G. Klaus and J. Piaget [7])

Categories of educational goals (B. Bloom)	Learning goals of financial mathematics	Category of educational goals V. Bespalko	Categories of educational goals, G. Klaus and J. Piaget
Knowledge	The student has basic concepts, facts and methods of financial mathematics, able to identify and reproduce in the simplest situations.	Introduction (identification)	A primitive form of perception
Understanding	The student understands, is able to reproduce and to prove properties to prove the assertion, for examples, to interpret, to compare and to establish relationships between concepts, facts and methods of financial mathematics.	The application (in typical situations)	Initial understanding
Application	The student is able to apply methods of financial mathematics to the solution of theoretical and applied problems.		Meaningful (formation of knowledge, skills and beginner)
Analysis	The student can analyze the real financial and economic phenomenon, to establish the adequacy of the data characterizing it, to build a mathematical model to distinguish relevant and irrelevant parameters, variables and steel, deterministic and stochastic characteristics.	The application (in new situations)	
Synthesis	The student is able to establish relationships and build on their basis of a mathematical model, plan investigations, select and use a variety of methods to get the result, interpret, summarize and present the results.		Practically meaningful (transformation knowledge)
Assessment	Student evaluates the adequacy of the constructed models of real processes or phenomena, the importance of the obtained results, their accuracy and reliability; compares and evaluates different methods of problem solving.		

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Гончаренко Я.В., Сушко А.С. Формирование целей и результатов обучения финансовой математике студентов профиля «бакалавр математики и экономики»

Аннотация. Разработана система целей и ожидаемых результатов обучения финансовой математике студентов профиля подготовки «бакалавр математики и экономики», согласованная с программными результатами и компетентностями, предложена классификация сформулированных целей, в частности на основе таксономии Б. Блума.

Ключевые слова: компетентности; методика обучения; таксономия целей; финансовая математика; цели и результаты обучения