FORMATION OF THE PROFESSIONAL MATHEMATICAL COMPETENCE OF ECONOMISTS USING EDUCATIONAL ELECTRONIC RESOURCES

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The authors examine methodological systems of teaching mathematics at the University of Economics. They consider an object of teaching as a system of professional subject competences. They propose to use educational electronic resources in teaching as new educational resources. They single out a structure of an educational electronic resource and examine the model and technologies of the formation of professional mathematical competences using educational electronic resources. The authors of this article produce the criteria of the evaluation. They talk about the expediency of its use.

There are continued disputes of how effective this systems now and what is necessary to change or preserve to increase quality of studying according to the requirements of the labour market in conditions of reformation of system of higher professional education. There is a necessity for a complex analysis of methodological system of studying to estimate the situation and reveal anything lacking. In this article we appeal to questions about the analysis of process of studying mathematics at Economic University, and these discourses and conclusions can be referred to other subject spheres also.

Every methodological system of studying can be constructed on the basis of hierarchical aggregate of models, defined goals, contents, methods, forms and means of studying[1] (Fig.1).

Thus, after analyzing and planning of the methodological system, the lecturer, first of all, must answer the most important questions: why, how, what, what form, by using what we can study. In this article we consider four of these, ignoring the question of selection of content of education, e.g. it is the subject of fundamental investigation.

Defining the goals of studying, we follow a competence approach, which is more suitable to new concepts of development of high schools. According to this approach there the tendency to a transfer from the term "qualification" to the term "competence", as more appropriate result of high professional education to new conditions. Competence is a wide term, which shows not only learned knowledge and skills of the specialist, but also their ability to be implemented in professional activity on the basis of development of the necessary personal qualities, motivation and intellect[2]. According to the considered segment we enter the term "professional mathematical competence of economist", which is about complicated phenomena, displayed ability/readiness of post-graduate student to appropriate use of mathematical methods in professional activity for the purpose of

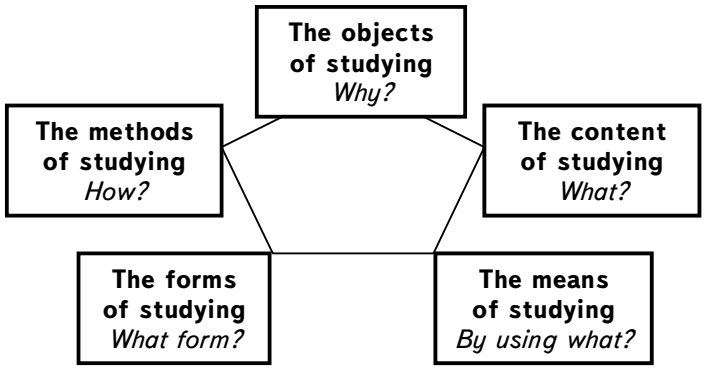

Fig. 1. **Methodical system of studying**

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effective implementation. Competence can be defined as a characteristic of person, formed as result of the assimilation of complex requirements, which are called competences. Thus, the *aim of study of a student-economist is the formation of professional mathematical competences for an economist.*

Competences can be defined, for example, according to results of the professional-graphical investigation. Analysis of job description leads to the following conclusion. Professional mathematical competence of economist (PMCE) is a system of interconnected components: substantial, in professional activity, technical, intellectual and motivational-purposeful (Fig.2). Notice that the separated elements of structure must be considered as parts of a single system, e.g. the relation between them is obvious.

The basis of this system is substantial competence, namely ability/readiness of specialists to operate fundamental mathematical knowledge and skills. The volume (minimum) of this knowledge is established by the State Educational Standard. Substantial competences are showed by the estimation of theoretical basis of mathematics, skills of using this knowledge when solving mathematical tasks and substantiation of qualitative conclusions.

Component in professional activity, understood as ability/readiness to implement a substantial component significant in profession skills is shows the estimation of economic-mathematical, mathematical-statistical and econometrical methods, and also skills and methods of mathematical modeling.

Using mathematical apparatus in econometric investigations must be used with calculated techniques. Learning mathematical disciplines is not possible without appropriate technical support, using study of specialized programs and other electronic educational resources. Accordingly, professional mathematical competences of economist include technical components, the basis of which is the ability/readiness to use computer techniques and technology to implement substantial and active components. Technical competences are shown as mastering skills of computing of mathematical information with using computer techniques and using specialized mathematical and statistical programs for solving professional tasks.

However, beside good knowledge, graduates of High Educational Institute need to have personal characteristics such as developed mathematical thought, mathematical intuition and skill to solve task creatively. Mathematics is very important in forming algorithmic thought, making skills to act according to algorithm and constructing new skills. The process of solving tasks as a main kind of studied activity develops creative and applied sides of thought. Thus, in the structure of professional mathematical competences of economist it is necessary to create the intellectual component.

Key competences predetermine input to structure of PMCE of motivational-purposeful component. The motivation of studied activity, considered as aggregate, system of psychological factors, determined behavior and activity of person, stimulates active educational activity. Understanding the necessity of mathematical study in professional education determines striving for full mastering of studied program, creating such personal characteristics as care, hard-working, persistence in achievement of results, educational activity.

The problem of single-minded formation of professional mathematical competences for students of economic high educational institutes cannot be solved by limiting traditional systems of mathematical learning. It is necessary to create a new approach that requires serious changes in the content of education, methods of implementation of studied process and thought process of students and lecturers.

Accordingly, we have the next question - by using what do we study? There are electronic means (in other words - informational) to help the classical means of studying educational resources (EER). In modern conditions EER is a complex mean of studying, developed on the basis of State Educational Standards, provided *all* spheres of studying activity and allowed to provide individual-activity approach to process of single-minded formation of professional competences in the appropriate subject sphere. This understanding of this term allows us to consider EER not as aggregate of separate program products of didactical encyclopedic or applied appointment, but as systemic object of complex appointment, namely oriented interactive sphere, universal mean and method of organization and supporting of studied process of different forms and levels[3]. Components of this electronic complex can be ac-

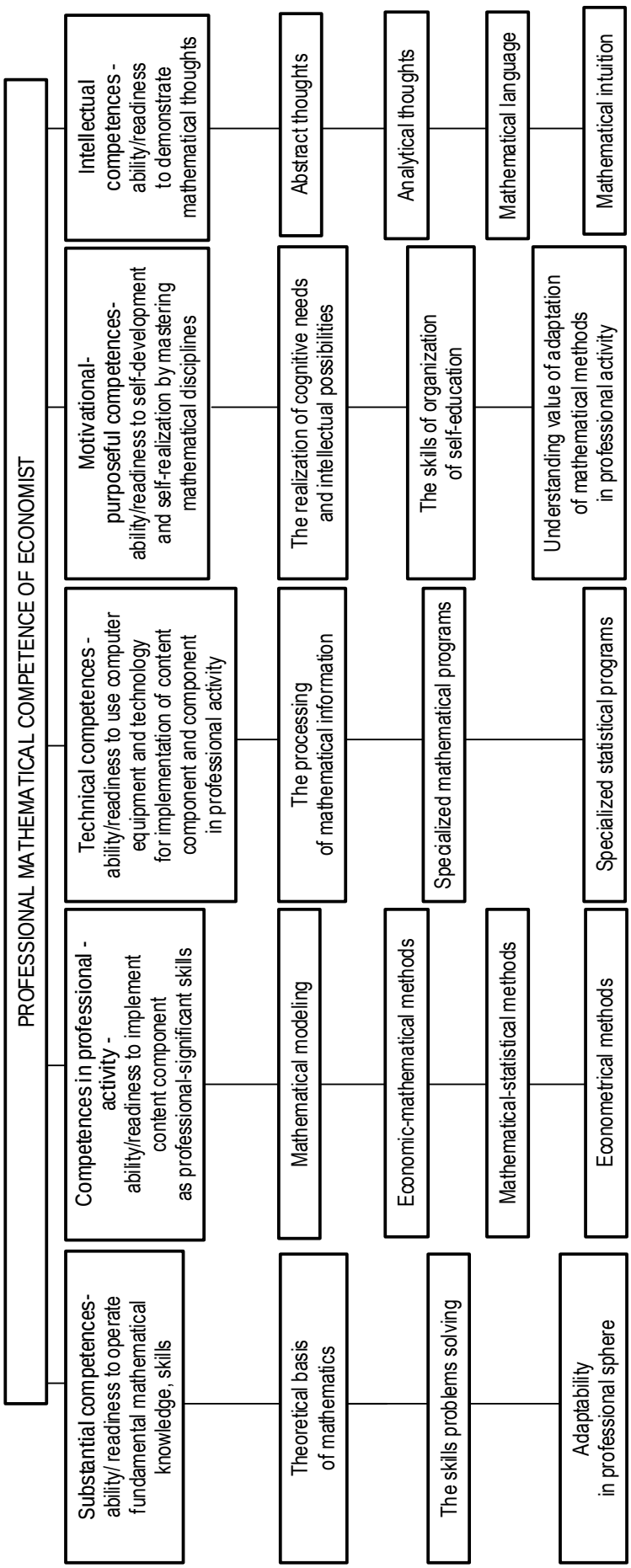

Fig. 2. **The structure and content of professional mathematical competence of economist**

commodated on external transmitter or in a computer network. In our opinion, the structure of informational educational resources consists of the following components (Fig.3):

1) provisional components, which consist studied plan, working program for this discipline, qualification requirements for specialty. As additional information we have methodological recommendation for learning discipline etc.

2) substantial component, which consist informational resources, supported by efficient stage of didactical process:

♦ electronic textbook, consisting of studied information in hypertext form, which contains theory which was necessary for making exercises and demonstration examples;

♦ electronic notes of lectures, made as presentations;

♦ practicum, consisting of many examples with solutions and exercises for individual deciding;

♦ laboratorial practicum for deciding mathematical, economic-mathematical and statistical exercises using computers;

3) control component, allowed to organize control and self-control of mastering knowledge, which can consist of tests of different kinds both for separate subjects, parts of studying course and general course, which are in free access or limited access;

4) reference-informational component, consisting of different reference information (tables, formulas, references to site);

5) scientific component is a more interesting paper, reports of student scientific conferences, exercises of student Olympiads (sometimes with solutions), works of participants of scientific club, subjects of scientific groundwork of departments etc.

It can be noticed that EER is a means of interaction with its own system of navigation and the possibility of choice of using regime according to modern technical requirements.

Next question is how do we study? There is a new means of studying, so new methods must be defined in the near future. Definition of goals of study allow us to make educational processes on the basis of a technological approach, e.g. according to principle "from expected result". Then the process of forming professional mathematical competences can be as it is show in scheme model (Fig. 4). Technological direction allows us to allocate 3 parts of the process: informational, procedural, estimated-correctional. Informational part of model describes activity of students on organizational stage of studying process. The basis of this is a realization of goals of studying activity and conditions of their achievement, forming motivation of realization of studying information, planning of studying process. Procedural part shows the activity of the efficient stage: learning fundamental mathematical knowledge, forming mathematical knowledge in professional activity, mathematical thought, skills of using computer techniques for implementation of mathematical methods in solving professional tasks. Estimating-correction part is a completion of the cycle, consisting of control, analysis of results and efficiency of process. Link of structure components of model show their functional unity. Means of realization of model of this process is the technology of forming professional mathematical competences for students of Economic Institutes. It is based on stage realization of process in joint single-minded activity of lecturer and student. Using informational educational resources in every stage of studying process allow us to talk about direction of technology and its individual direction.

Full learning PMCE by student requires consecutive implementation of four levels of learning for every competence: perception, reproduction, implementation, creative work (fig. 5). On the stage of perception students get information and remember it on the level of identification; lecturer of lessons or practical lessons communicate with the purpose of giving information to students, using electronic resources (presentations, demonstration materials etc.).

Part-time students work with electronic textbook on this stage. Next stage of reproduction is characterized by mastering studying material, ability of student to repeat actions and solve tasks. Improving skills is provided by leadership of lecturer or by using computer technologies. Intermediary between student and lecturer can be multimedia programs, components o informational educational resources. Further learning competences are provided at the stage of use, characterized by the ability to operate, method and form that which was learned, but content and conditions are the above are new such as solving of applied tasks, mastering methods, using

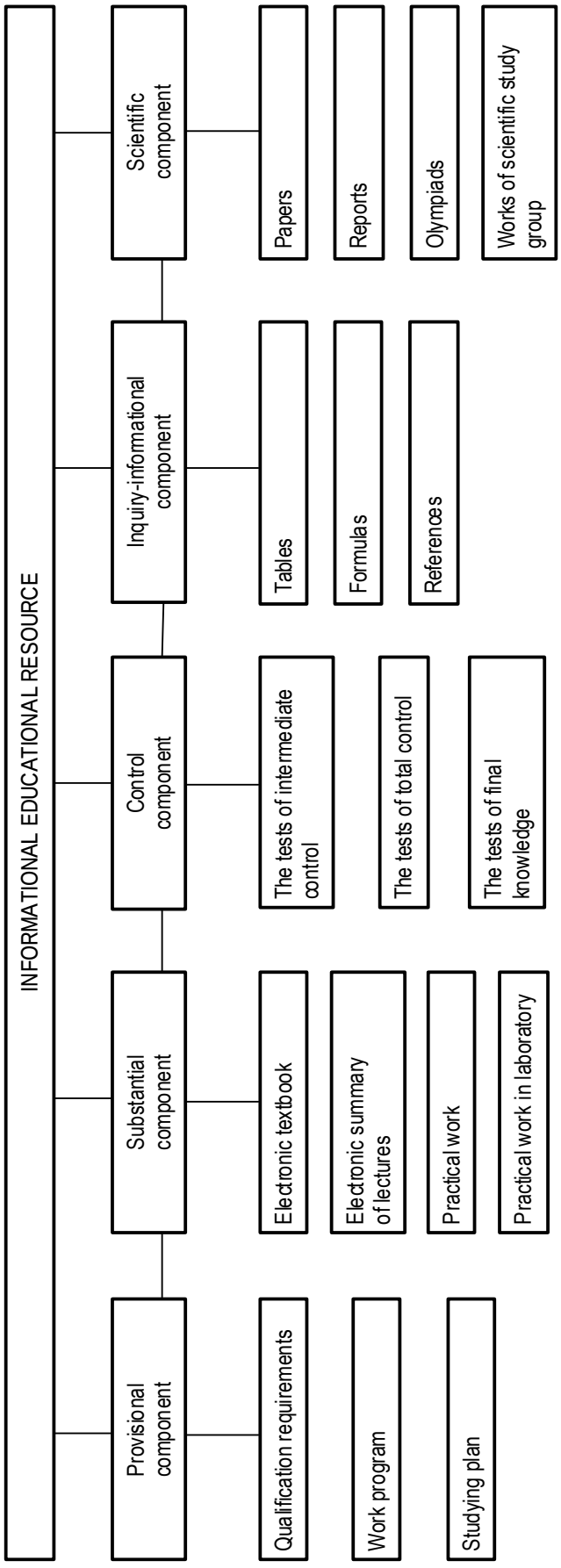

Fig. 3. **The structure of informational educational resource, which decides the organization and supporting of study process at University of Economics in "Mathematics"**

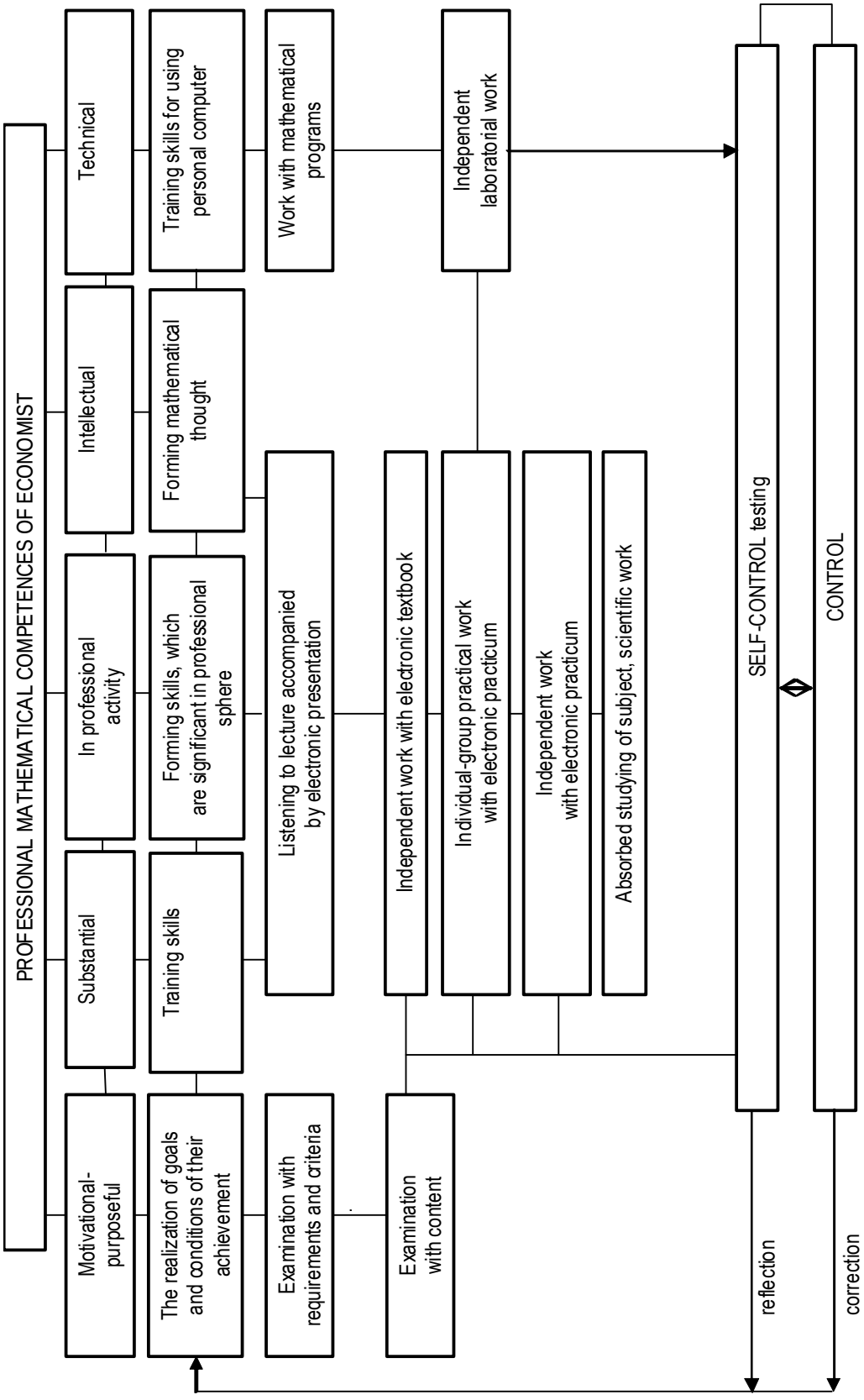

Fig. 4. **Model of forming professional mathematical competences for students of Economic High Educational Institution by using informational educational resources**

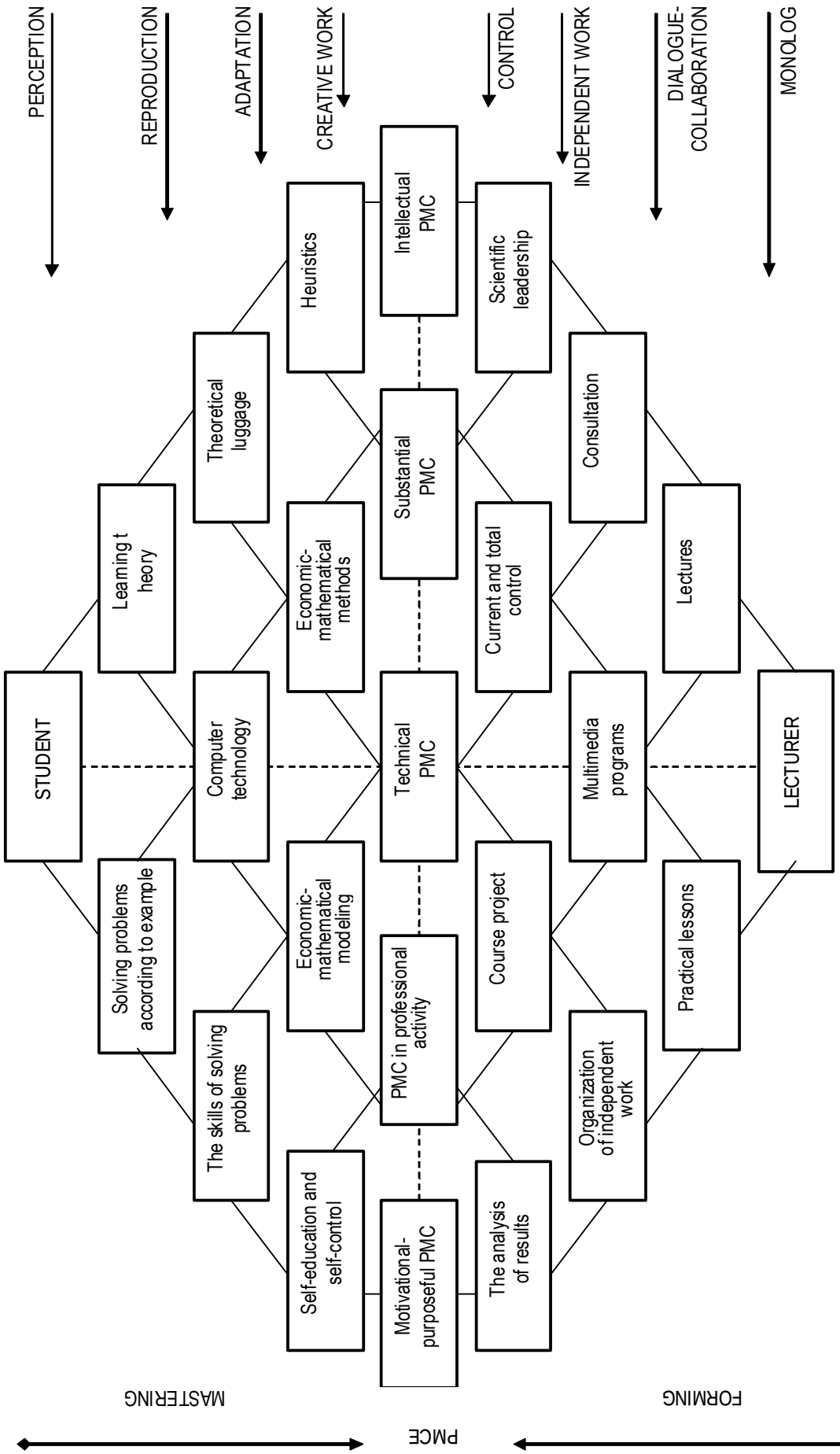

Fig. 5. **Symmetrical model of forming professional mathematical competences (PMC)**

	Substantial PMCE	PMCE in professional activity	Technical PMCE	Motivational-purposeful PMCE	Intellectual PMCE
Reproduction	Can reproduce information	Can reproduce actions (solve решает примеры по образцу)	Posses the skills of editing, design, search of mathematical information	Know goals of studying of discipline, program of course, requirements	Show abilities of verbal adaptation in mathematical sphere
Understanding	Understand and can explain information	Understand and can explain actions and results	Know basis of functioning and realization of mathematical algorithms	Realize the necessity of the mathematical education and self-education	Separate class for aggregate of features and generalize the subjects of class
Adaptation	Can use information in different situations	Can provide actions in non-standard situations	Solve professional-applied tasks with using specialized programs	Realize motivational settings in active studied activity	Can compare, see interrelations of the terms, compare, systematize
Creative work	Can analyze, synthesize, estimate information	Can analyze, synthesize, estimate actions	Create programs for using in professional and methodical goals	Plan and organize process of education and self-education	Realize discourses, which are basis of new arguments

Fig. 6. **Criteria of estimation of level of mastering of professional mathematical competences of economist (PMCE)**

in professional sphere. Lecturer has a role of consultant, who organizes the independent work of student. Previously students have a productive creative activity, which is subjective and objective novelty, and took part in investigations, Olympiads, conferences etc. Lecturer provided control, individual work with students etc.

Separate interest is represented by a problem of organization of control of level of mastering of competences on different stages. Here we can and need to use possibilities of computer techniques (in addition to traditional forms). It allows us not only save work time, but also to study regularly individual working students and provide the objectivity of estimation, and define statistics of errors. It is important to think about a system of criteria marking by developing tests (Fig. 6). Notice that here we talk about mark in a wider understanding: not traditional mark for solution of exercise, but index of level of mastering competence. Level of formation of professional mathematical competences for a student can calculate the basis of estimations of level of mastering every component.

The above mentioned considers the place and role of computer techniques in the process of studying exact sciences. A computer cannot replace a lecturer or live conversation and free communication. Furthermore, the extra passion of computer programs leads to superficial understanding of material and other negative effects. When we talk about using electronic educational resources, we suggest diversifying the means, forms and methods of studying, rationally combining them and using in those cases where it corresponds to educational goals.

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