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УДК 378.1:004

Model of Students' Practical Training Processes in Institutions of Higher Professional Education

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The article deals with the model of students' practical training processes, its unit-by-unit description of processes and relationship between them. It forms the basis for subsequent development of a monitoring model.

Key words: process management, resource technological base, the quality and efficiency of education, the rate of rationality, information-analytical system.

Problem statement. One of the most relevant trends in the improvement of contemporary education is the development of information and analytical resources (IAR) that reflect its actual status and can be used in management system design [1. p.7-9]. Adequate solutions, management objects and algorithms, for example, quality of student's practical training, allow effective management in the educational process, the major constituent of which is academic-research-production base and, as a consequence, answer the question: "Whether expenditures for practical training justify high quality education of a highly -qualified and competitive engineer?"

IAR are developed on the basis of integrated monitoring. At the preparatory stage it is reasonable to design a model of students' practical training processes to consider in detail the sequence and integrity of the processes in which the problem of IAR development is solved, to evaluate the quality and effectiveness of students' practical training at all learning stages and set management functions [2, p. 10-13; 3, p. 22-25].

Results analysis. High quality of professional education is profound fundamental training based on the latest scientific achievements. These two principles have become academic-research-production base, which defines the resource potential of a university and conditions the opportunities of training sessions, research, and development, their results and quality of students' practical training. At present, the development of academic-research-production base is performed through the implementation of high-tech, modern equipment and development of new technologies and forms of training. Both trends form a complex: innovative education system grounded on academic-research-production base, which is appropriate to term a resource technological base (RTB) of education. It is clear that RTB, its state and development, is a crucial factor of HPE quality [4, p. 31-35].

Competence approach is taken as a basis for HPE FSES. Defining the competence functions in training supports the main essence of competence approach – to enhance the practice-oriented training. Therefore, a distinctive feature of the modern HPE development stage is the significant increase of students' practical training. This peculiarity promoted the formation of innovative training systems based on RTB, for instance, resource centers academic-research centers, research-academic clusters, etc. The design of such innovative systems provides a guarantee for high quality learners' practical training [5, p. 114-116].

At the moment, the quality management system (QMS) in universities has been established and certified, which is based

M.A. Tarasova

on the international quality standards of ISO 9001: 2000. Development and introduction of QMS is focused on initiating institution-economic thinking: if authorities seek to fund educational activities from their funding sources, provide commercial services for training and qualification upgrading, it is necessary to develop a well-functioning management system. Hence, it is important not only to develop university QMS and its certification, but also maintain the system in working conditions, initiate the process of continuous quality improvement (PDCA cycle implementation – Planning, Going, Checking, Acting developed by W.E. Deming). The relations of the Deming cycle stages are possible if there is a complex monitoring and quality assurance system in the university QMS, which assists in performing the adequate managerial functions [6; 7, p. 62-67].

The distinguishing features of new education system management are defined by the fact that it has a complex structure consisting of some subsystems, which interact between each other and other public life spheres. Therefore, principles of management consistency and integrity are the most important ones for education system [8, p. 75-77].

RTB as a university subsystem includes a network of educational laboratories (training, research, production), equipment service center, marketing centers of labour market, equipment, pedagogical technologies, and learning outcome monitoring and management [4, p. 20-21].

In modern conditions education management is, first of all, its development process management. One of the fundamental statements of the standard ISO 9001:2008 – process approach: an institution has to present its activity as a chain of interrelated processes.

The university activity consists of the following basic processes:

- academic;
- research;
- development of research, production, and teaching materials.

Each of the above- mentioned processes includes the processes of authority management, resourcing, processes of production life cycle, measurements, analysis, and improvement. The process performance indicator is reflected through its "overall efficiency". To make management decisions, the most useful information can be obtained via directly measured indicators [2, p. 25-28].

The author of the work [9, p. 96-98] proposes to develop a system of indicators reflecting the relations between expenditures (investments) for training with RTB and quality of competence development at every level of training, which, in its turn, is based on multilevel monitoring and quality and effectiveness assessment of student practical training. The indicators system of corresponding training level can be referred to as "effectiveness". It includes directly measured IAR intended for management system development for student practical training and is focused on solving the formation problem of innovative education system based on RTB, which would provide high quality engineering graduate practical training in rational investments into its design.

Model of student practical training processes. Studies in state and development [4, 5] of HPE have allowed formulating the ideas, with the support on which the conceptual model of student practical training processes is developed using RTB.

1. A university produces "goods", which include graduates, as well as research, production, and teaching products; university educational activity has much in common with any engineering process with the only difference- the duration of training engineering process, which is 4–6 years.

2. According to Selezneva N.A. [10, p. 17]:

- Quality of higher educated specialist training (quality of higher education in a narrow sense) is a balanced consistency of highly educated specialist training (both results and process) to the diverse demands (state, society, person), targets, requirements, norms, standards";
- Quality of educational processes is defined by the quality of curricula and their content, potential of teaching staff and entrants, teaching methods, resources (information, teaching, physical).

The conceptual model of student practical training processes using RTB is shown in Fig. 1.

Model description. The presented model was developed on the basis of requirements of GOST R ISO 9001:2008 standards and corresponds to the traditional process model of PDCA cycle [6, 7]. Let us present unit-by-unit description of the model processes and show the relation character among the processes.

Users are university authorities and the teaching staff. They define the requirements for resources, quality and effectiveness of a product **(unit 1)**. In current research the product is a student of definite major. The initial data for product design are standards of federal and industry levels, university standards and QMS, as well as resources (human, physical, information, etc.). University QMS is to include the mechanisms of consumers' demand and expectation monitoring and provide the development of products of required quality. Hence, users' requirements are to correspond to the demands and expectations of products consumers. Users' demands form the basis for product design and production.

At the design stage **(unit 2)** users' demands presented in consumer's terms are transformed into product's informative characteristics: engineering, ergonomic, cost and others, setting the qualitative values for parameters. Informative characteristics define the product's designed characteristics **(unit 3)**. The designed characteristics serve as a basis for the development of measured product characteristics at monitoring. Information on designed characteristics is delivered to **unit 15**, where the inconsistencies between designed and measured characteristics are revealed.

Product life cycle processes are a set of actions which are necessary to take in obtaining products of designed quality and performance. The product life cycle processes include: arrangement process **(unit 5)**, educational process **(unit 6),** resource supply process **(units 7, 8)**. In this case, the basic one is educational process, but the other two are supplementary processes. Educational process consists of three subprocesses: academic, research, and production (internship at enterprises). These processes follow each other over the whole study period:

Arrangement activity is regulated by normative-legislative framework of federal, industrial, university levels, QMS documents **(unit 4)**, which defines the product quality at the design stage. Its main purpose is to improve the arrangement of academic process and teaching activity in university.

Resource supply consists of a set of human, physical, and information resources. University has to guarantee the availability of adequate resource environment of high quality product (ISO 9001:2008).

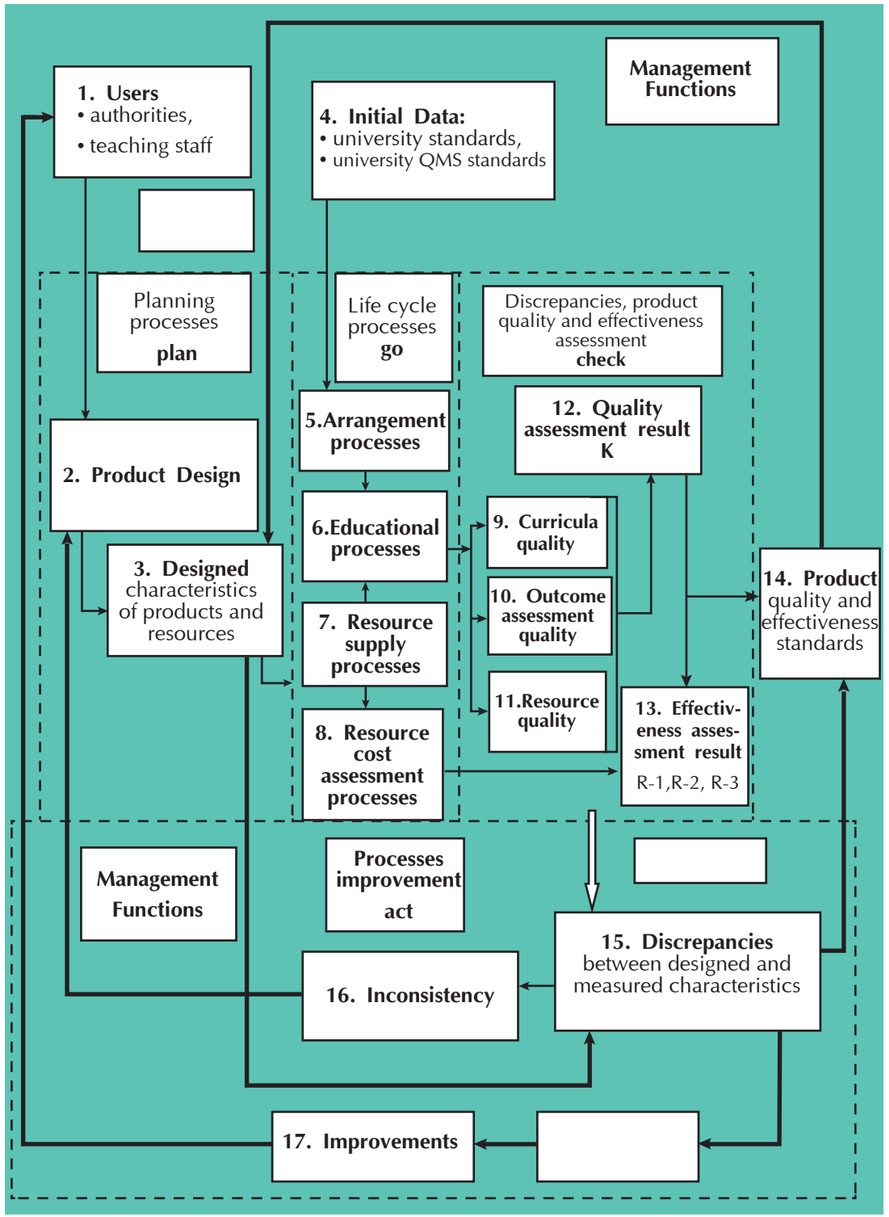
Unit 8 is used to evaluate the cost of resources for students' practical training. Information comes to **unit 13** to calculate the effectiveness of student practical training at every educational level.

The quality of educational process is preferable to be presented as a quality with the following constituents:

- curricula and their content **(unit 9)**;
- teaching aids for outcome assessment **(unit 10)**;
- resources **(unit 11)**.

The quality criteria of curricula concerning practical training: informative education, technical support. The quality criteria of resources supply are: staff, resource, information, teaching, arrangement.

Fig.1. Model of student practical training processes (R-1, R-2, R-3 – indicators of effectiveness in academic, research, and production RTB)



The quality criteria of methodical aid for learning outcomes assessment are: validity, test reliability; techniques of credit-test, exam, and interview task development, university rating system, etc.

The quality of educational process components defines the results of quality assessment and practical training assessment effectiveness **(units 12, 13)**, as well as their compliance with quality requirements **(unit 14)**.

Quality standards **(unit 14)** is a developed and registered system of requirements for product quality and effectiveness (as an outcome, as a process, as a system, in general) corresponding to the identified needs. Norms are developed on the basis of previous monitoring measurements and results of assessment and current surveys. Deviations from the standards are registered by the management functions for designed characteristics to be corrected and/or to eliminate deviations [11, p. 63].

In **unit 16** the information on inconsistencies revealed in **unit 15** is accumulated. Management functions are sent to **unit 2** for analysis and decision taking on product design.

Information on effectiveness indicator, which is minimal of the three (R-1, R-2, R-3), comes to **unit 17**. The minimal value of effectiveness indicator shows the fact that there is low effectiveness of student practical training at the given level. Management function is directed to a user to make decision for product improvement.

Conclusion.

In conclusion, it should be underlined the characteristic features of the developed model of student practical training processes.

Firstly, process objects correspond to management objects. In our case, all objects of the processes: users, design process, life-cycle processes have management functions in the form of which the process results are used.

Secondly, it corresponds to the model of continuous improvement process principle, which coincides with the new concept of process – "is a set of interrelated and interacted types of activity transforming inputs into outputs. In an institution, processes are planned and performed in regulated conditions to add the value" [6].

Suggested and described model of student practical training processes can serve as a basis for the development of integrated monitoring model.

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UDC 621.81

Multimedia Lectures on Discipline "Machine Parts"

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The method of development and implementation of the multimedia lecture course on discipline «Machine Parts» into the learning process is considered in the article.

Key words: multimedia lectures, machines elements, computer technology, learning process.

Over many years Machine Parts and Pick-and-Place Devices Department of Volgograd State Technical University has been developing and implementing computer technologies [1] into the academic activity in three main areas:

1) development of virtual laboratory works for computer classes;

2) design of techniques and special methodical support for testing in the course «Machine parts» performed in the platform «Moodle»;

3) development of multimedia lectures.

The multimedia lectures were based on the authors' series of lectures on the course «Machine parts and bases of design» [2, 3] initially amounted 51 hours. The first version of multimedia lectures started at the department as soon as 2010. Enormous preparatory work had preceded the lectures [4].

Firstly, it was necessary to systematize and structure the content of lectures. As our experience showed, the most suitable form of course presentation is its modular framework. To arrange the modules' interaction and manage them, a flexible set of hyperlinks was developed. It made the multimedia lectures universal and diverse. The universality of the given course consists of its multimedia use by the students trained in different specialties and majors. In this case, the main content of lectures remained unchanged, but specific feature of each major was included in definite modules, which were referred to by the hyperlinks.

For example, lectures for the students studying the major 241 000.62 «Energy- and resource efficient processes in chemical engineering, petrochemicals, and biotechnology», and referring to the necessary hyperlink, one can show in the screen the slides demonstrating parts and components of machine and devices for chemical production. Such an approach is particular useful for a lecturer delivering lectures for students learning different curricula in the same term. Moreover, the hyperlink system allows the amount of hours to be changed from short course of 8 lecture hours (for part-time students) to 51 hours.

Secondly, a large amount of photo- and video aids was required to make lectures visual. Not only lecturers, but also students of different specialties and majors were involved in collection and preparation of such materials. As a result, the department collected resource of visual aids including more than 300 photos and videos. To design them, the outdoor photos and videos of different machines, parts, components, and their failures were made; methods of computer graphics, animation, Internet were used.

Application of computer technologies in development of multimedia lectures not only provided modern attractive design, but also made possible to perform

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