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Particularities of Self-Study within "Electronics and Nano-Electronics" Education Programmes

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The paper considers the ways to organize student self-study within Electronics and Nano-Electronics education programs. The case-study is analyzed in terms of process approach to education and program interdisciplinarity.

Key words: student self-study, Master degree training, nano-electronics.

The successful progress of Russian enterprises in developing competitive products and solving import-substitution tasks is impossible without highly-qualified personnel and skilled workers who are adaptable, well-targeted, ready to self-improvement, self-training, and nonstandard solutions.

Today the most urgent problem is the lack of target-focused specialist training resulting in the necessity of "re-adjusting graduate training" for overheating of high-tech enterprises [1]. This primarily concerns the enterprises within the special technology development economic area (STDEA) "Zelenograd". The task focused on training nanotechnology specialists is complicated by such facts as the interdisciplinary principles of problem-solving, relatively fast changes and ultra-fast emerging information from different sources, which, in its turn, stipulates the development of advanced personnel training programs oriented on the specific targets of this or that enterprise.

The characteristic feature of the Master degree program "Electronics and Solid-state Electronics" within the framework of education program 11.04.04 "Electronics and Nano-electronics" [2] is oriented on solving technological problems in the domain of both microelectronics and nano-electronics. In this case, the important factors involve technological equipment proficiency, participation in R&D (micro- and nano-electronic device project development). The location of the University of Electronic Technology MIET in the special economic area and possible university profile development according with the Federal law 217, dated 02.09.09 set specific goals in training specialists, i.e. establishing new requirements for Master degree programs. The complex of education programs "Electronics and Solid-state Electronics" includes in-depth study of not only sophisticated technology for materials and electronic devices production, but also the development and establishment of the technology infrastructure, production metrology support and investigation of micro- nano-electronic units, as well as quality assurance. Practice-oriented programs, implementation of updated learning technology, development of "mobile" disciplines, being sensitive to the current research results, offer highly-qualified training for the graduates who will be involved either in leading positions or within the education and science domain and/or innovation activities. This could be promoted by well-developed infrastructure designing innovation SEA products, including business-incubator "Zelenograd Nano-technology Center", which supports those entrepreneurs who strive to commercialize their project results within the domain of nanotechnology and

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other fields by organizing an in-house company.

Developing and shaping graduate competencies, achieving learning outcomes and, as a result, improving education quality are impossible without the active participation of a student. This determines the significance of Student Individual Work (SIW) in generating quality of education.

The effective management tool for any activity is the process approach. According to Standard ISO 9000 requirements [3-4], any activity applying resources and transforming "input" into "output" could be considered a process. Implementing the process approach into the quality management system (QMS) for both activity management and resource management, **"makes it possible to achieve effectively desired results."** Implementation of the process approach implies the definition of such concepts as input and output, resources and specifying the roles of those who are involved in this process.

IDEF0-model process of Student Individual Work (SIW) is illustrated in fig. 1. This model shows that the main inputs are student competencies providing his/her readiness for corresponding SIW tasks, for example, acquisition of prior information; designed teaching techniques, multiple-task questions, etc. The basic outputs are knowledge acquisition, skills and/or their self-realization.

To effectively apply the process approach, it is important to determine not only the process inputs and outputs of corresponding resources but also those who are involved in this process, in particular, the role of students in this process and in the learning process as a whole. Implementing the competency-based approach enhances the possible changing of the passive student attitude in the learning process, which, in its turn, determines the product quality (result) of the education activity as graduate competencies shaped throughout the education program implementation.

Comparable to the typical **"external customer"** the typical **"student":**

- is hardly free in selecting the attained "product and/or service"- universities organize a strict incoming test, enrolment competition, individual student records, etc.;
- rarely pays for rendered services as it is more often government funding, parents fee and/or enterprise contributions;
- is unable to put forward demands to the learning results; however, in many cases he/she has the possibilities of some supporting facilities, accommodation, extra-curricular activities, etc;
- should constantly certify his/her rights on obtaining education services;
- will be pleased if classes are canceled and, visa versa, a customer could be unsatisfied if he/she received a service denial (or even in some cases, deny in delivery);
- is unable to evaluate the quality of rendered services;
- to achieve qualitative results the student should not be passive comparable to a customer.

However, the student is interested in the acquisition of knowledge, skills and competencies, resulting in learning outcomes which define a student's competitiveness in the labor market.

Principle characteristic difference between a student and external customer is the fact that a student can be positioned as an internal customer of some processes. The student is also an important performer in the key learning process, especially SIW process.

Within the framework of the discipline "Technology fundamentals in developing integrated electronic instruments on flexible substrates" SIW involves project execution, while this approach enables solving several strategic problems in specialist training, i.e. quickly and with minimal loss adapt oneself within an enterprise. The project reveals not only generated creative thinking, but also having good grounding experience in innovative business-models.

The project targets are:

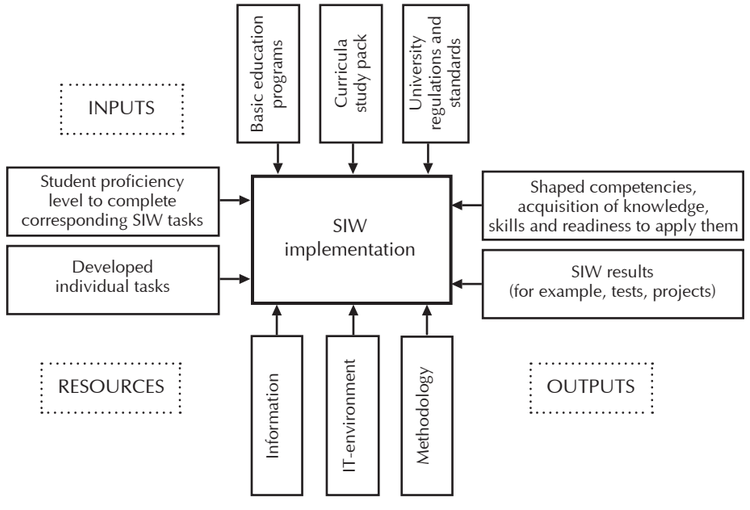
- shaping innovative activity skills;
- developing creative innovative thinking;
- shaping communicative skills with interested partners.

First project phase: designing an innovation project via advanced technology. For example, it can be projects based on breakthrough technology in developing innovative products, integrating sophisticated technology, developing updated materials in one specific domain of electronics. This teamwork includes such methods as brainstorming and case studies which are focused on not only the development of strategic and efficient teamwork, but also generating critical thinking.

Second project phase: representation of intellectual activity results at Research and Practice Seminar. It is well-known that any project requires investments, i.e. investors. At the same time, the development of such technology is closely connected with effective information background. At this phase the students executing the project present all required documentation for potential investors (for example, participating in Youth Scientific Innovative Competition Program) by themselves and, at the same time, could be experts. Youth Scientific Innovative Competition Program includes 3 assessment-variants for each project, the first two involve student-experts who evaluate this or that project in view of its prospects comparing with other presented projects. The participation in such a seminar-competition shapes the student's presentation skills, as well as abilities to evaluate objectively external projects, reveal weaknesses and suggest solving methods which furthers communication skills within the professional domain.

To implement technological process into this or that enterprise, practical inherent capabilities are applied through statistical process control methods. This SIW type involves end-to-end solution throughout the semester with one set of statistic data of different methods, plotting a pilot process management map, identification of

Fig. 1. Model process of Student Individual Work



variation sources, proposal development of cause-effect variants, estimation of process indicator indexes, etc. This also embraces interdisciplinary interaction, including the staff of different departments.

The above-described examples could be of practical application, and obtained theoretical skills and abilities could be used in R&D. At the same time, these practical results could also be applied in theory acquisition.

Resources used in SIW process including information, methodological and technological resources should change the student's role in this process. Human resources in this process -highly-qualified teachers- should respond to the set targets, develop absolutely new innovative solutions and generate student autonomy and self-dependence.

Thus, apart from the integrated innovative SIW content, development of technology and methods enhancing the student activities, the following factors are necessary:

- improve interdisciplinary components not only within the discipline itself but also within profile modules of the education programs, eliminate the fragmentation between science, mathematical and professional disciplines and core disciplines;
- provide individual training and learning track diversification.

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Modern Approaches to the Assessment of Soft Skills and Professional Competences: Interdisciplinary Aspect

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This article discloses three approaches to understanding the structure of competences as an object of assessment. The key problems faced by teaching staff, when assessing competences, are underlined. The role and place of various means for diagnostics and assessment of competences are presented. The key development trends of different form, methods and means for competences assessment are determined in line with the interdisciplinary approach.

Key words: structure of competences, competences assessment, methods and means for competences assessment, aspects of competences assessment.

The execution of the competence-based approach faces a number of objective and subjective problems in spite of a vast expertise on the matter. One of the main problems is the problem of monitoring and assessment of soft skills' and professional competences' level of formation. It is this stage of the educational process, where teaching staff faces significant difficulties that, in our opinion, occur due to the contradiction between the interdisciplinary nature of competence, on the one side, and the on-going focus of the study process on formation, monitoring and assessment of disciplinary knowledge, skills and attitudes, on the other side. There is a certain level of vagueness in understanding the essence and structure of competences, and, therefore, the means and methods of their monitoring and assessment among the HEI faculty. Sociological studies indicate that 65.1% of faculty underline as a problem the lack of durable and convenient methodologies for competences assessment [1, c.25-26].

Whenever competences are deemed as the subject of an assessment, the issue of unveiling such elements of competences' structure that could be diagnosed and assessed impartially, become of the most importance. The conducted analysis allowed singling out three approaches for determining the structure of competences.

The adherents of the **first approach** (Kon E.L., Freyman V.I., Yuzhakov A.A., Kon E.M.) regard to competences as an integrative whole of knowledge, skills and attitudes. In order to formalize the understanding of each component of the monitoring, the following forms as determined: for **knowledge** – principles, models, processes, methods, algorithms, terms, definitions, etc.; for **skills** – application of methods, approaches; modeling, etc.; for **attitudes** – modeling and choosing research methods for models, processes, phenomena, etc., preparation of a set of documents (project's passport, technical and economic feasibility study, etc.) and other [2, c.37-41].

In the context of this approach another option is to put basis on the modified Bloom's Taxonomy of Objectives (developed by L.W. Anderson and D.R. Krathwohl in 2001), in which every educational objective can be described by

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