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UDC 378

Project-Based Learning and Research at University

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Abstract
The article analyzes the changes in practice-oriented training of stu-dents. It describes the example of making arrangements for enhancing stu-dents' motivation to conduct research and development activities while im-plementing the project within the framework of the Resolution No. 218 of the Government of the Russian Federation.

Key words: higher education, practice-oriented training, cutting tool, 3-D modeling.

The issues related to education modernization have received increasing attention in recent years. Particularly, it concerns training of engineering students, namely, specialists in machine-building industry. It is obvious that the level of knowledge of future engineers, designers, technicians, operators directly affects the future of the country, its economic potential, and independence in the field of up-to-date technologies. The basic problems faced by a modern university are as follows: methodological and technical support of the training process, faculty staff, motivation of students for effective material acquisition.

Lack of students' practical skills gives rise to the intensive criticism both in Russia and abroad [1].

In Soviet times, practical skills were basically developed during summer internships by gaining hands-on experience (fig.1). Education quality at a real workplace is secured by supervisors' interest in new employees, attraction of specialists-tutors from qualified staff of the enterprise and opportunity for students to operate equipment, machinery or motor vehicles. The memories of most experienced specialists about the first working day, the first mistakes and help of elder employees are still alive.

Since 1995 the situation has changed dramatically (fig.2).

Enterprises stop financing student internships, while qualified employees have come to consider interns as their future competitors. Needless to say, that the entire internship was reduced to the formal process: safety induction, excursion, familiarization with documents and goodbye! The interest of supervisors in interns is maintained at the stage of pre-diploma internship placement when the enterprise is striving to get at least some specialists for the opening positions. It is obvious that in this case time has already elapsed as the training process has already finished.

The obvious question arises: what to do? The situation could have been saved by conclusion of a trilateral agreement between university, student, and employer. Such agreement serves as a good motivation for all actors. However, an enterprise should have surplus funds, but it is still insufficient.

One of the powerful tools of a State to enhance the education quality is a State subside in the form of Resolution No. 218 of the Government of the Russian Federation [2]. According to this Resolution, the State should return the funds as a subside spent by the enterprise on research, development, and technological work. The main

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Fig. 1. Summer internship of students from Machine-Building University in the 1980s

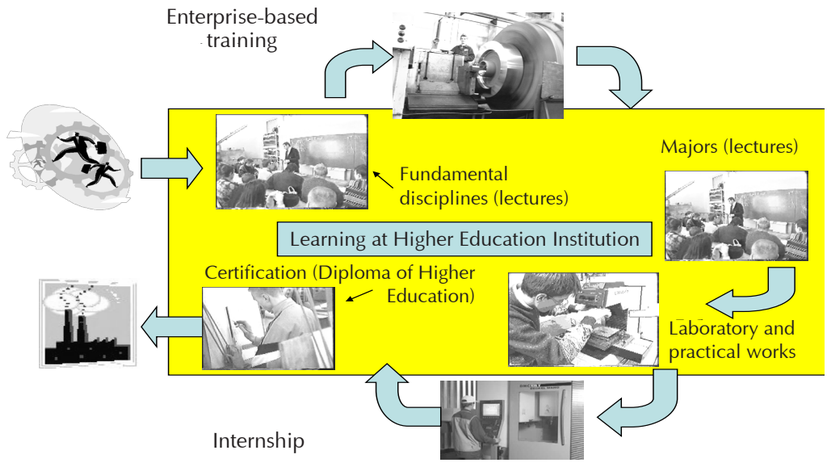
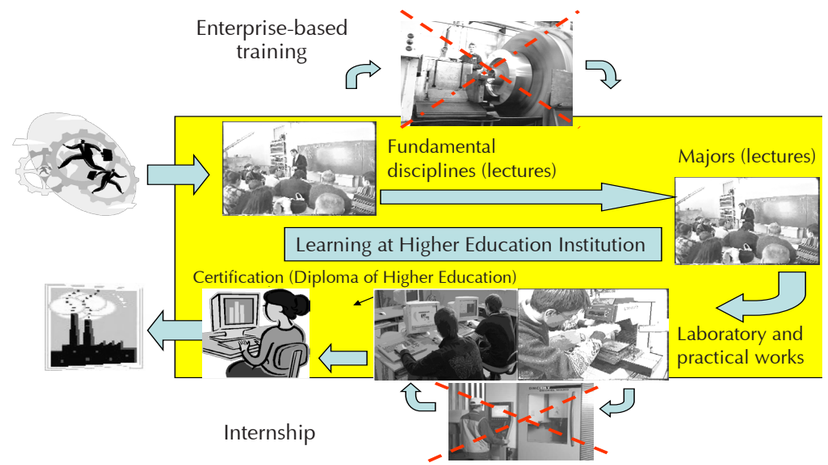


Fig. 2. Summer internship of students from Machine-Building University in the 2000s



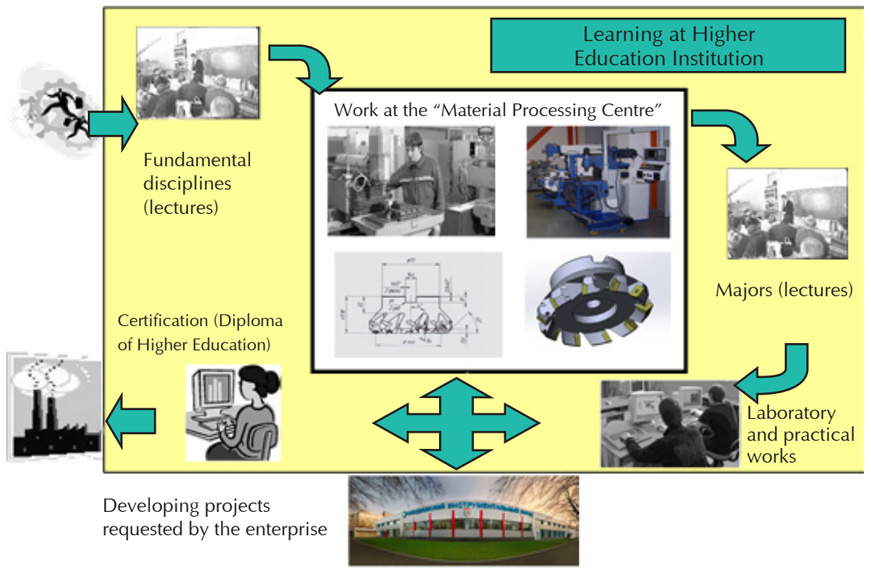
condition is that research, development and technological activities should be performed by students, faculty staff of a university on request of an enterprise. The number of students, young scientists and employees involved in the project is also specified.

As the result of the contest (2015), the project "Development and implementation of innovative industrial technology aimed at manufacturing import-substituting hollow-carrier cutting tool equipped with quick-changeable carbide blades" was recognized as a winner. The project was proposed by Ural Federal University in association with JSC "Sverdlovsk Instrumental Plant". The faculty members of Cutting Machines and Tools Department were the main carriers of the project. Such a large-scale request from the enterprise gave a true meaning to the project part of graduating papers, stimulated students' interest in the conducted research quality. As a result, 14 graduating papers accounted for more than a half of all full-time students' works were defended on the project-related issues. Most graduating papers were performed by students, members of temporal creative group, and the research was paid from additional funds. The laboratory "Material Processing Center" served as a main technological facility where there were all required computer tools and machinery. The project was supported by qualified faculty members. The example of such training process is illustrated in fig.3.

Briefly describing the project, the following characteristics are worth noting:

The main objective of the project is not just to develop a new competitive tool, but to make the arrangement for serial production of this tool including elaboration of the entire technological process, archive and documentation management, recommendations on the effective application of the invention. Thus, it is a comprehensive project, and the corresponding 3-D models, technologies, software and numeric control for each tool type are due to be completed by the

Fig. 3. Training process on the basis of "Material Processing Center" laboratory



beginning of 2018. Therefore, the students involved in the project were divided into the following groups:

- designers of hollow-carrier cutting tool for certain tool types;
- designers of changeable carbide blade archive;
- designers of case processing technologies;
- designers of monitor software;
- future marketing experts;
- designers of e-documents system who are responsible for making connections between interested department of the enterprise, etc.

Such approach is rooted in the CDIO concept "Conceive – Design – Implement – Operate" [3]. It is doubtless that motivation of project participants is much greater than that of the students who are not involved in such projects.

The following graduating papers were defended before the Qualification Commission:

- Design of assembly turning tool on the basis of JSC "Sverdlovsk Instrumental Plant".
- Design automation and analysis of assembly end-milling cutting with changeable carbide blades for production at JSC "Sverdlovsk Instrumental Plant".
- Design automation and analysis of assembly turning tool with with changeable carbide blades for production at JSC "Sverdlovsk Instrumental Plant".
- Development of system and pilot unit for metal-cutting oil ingress into the cutting zone on the basis of JSC "Sverdlovsk Instrumental Plant".
- Design of straight-turning tool with indexable inserts for rough and finish turning.
- Design of and technology development for straight-turning tool with indexable inserts for rough turning.
- Automation of spline hob design in SolidWorks environment.
- Development of the archive of carbide blades for turning on the basis of JSC "Sverdlovsk Instrumental Plant".
- Development of technologies for design of parametrized case-based element of spline hob on the basis of JSC "Sverdlovsk Instrumental Plant".
- Design of hollow-carrier cutting tool via typical 3D elements by the example of turning tools produced by JSC "Sverdlovsk Instrumental Plant".
- Design of boring unit with micrometer feed, etc.

The fragments of research results are given in fig.4.

Conclusion

The education programme is considered a main document that secures the logics and quality of students training within the machine-building industry. However, lacking sufficient knowledge of real manufacturing problems and needs, students can hardly focus on the most essential details, i.e. certain parts of lectures, lab problems and practice-related issues, and problem solving methods. Having encountered with a real engineering task, a student could demonstrate the desired readiness for his/her professional activity. Therefore, any interaction of university with an industrial enterprise in terms of solving a real engineering task should be encouraged by state subsidies or funds of sponsors interested in training new manufacturing staff.

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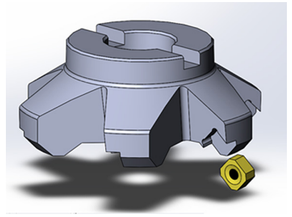
Fig.4. Fragments of students graduating projects
a) turning tool b) STP set for turning tools c) spine module-based hob d) stress analysis of the router bit e) end-milling cutting f). STP set for end-milling cutting g). assembly turning tool h). boring unit



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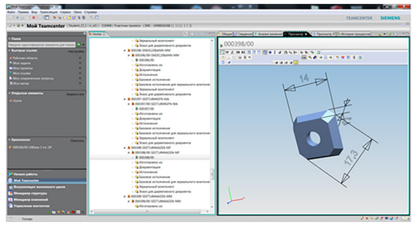

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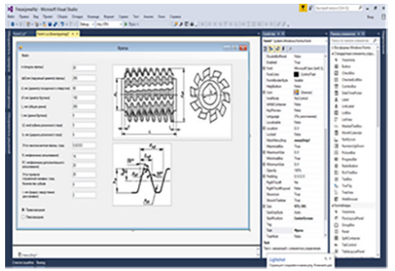

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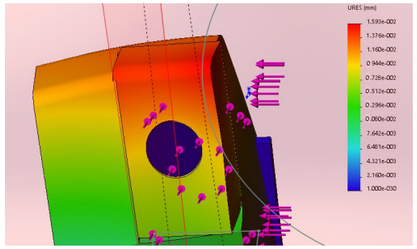

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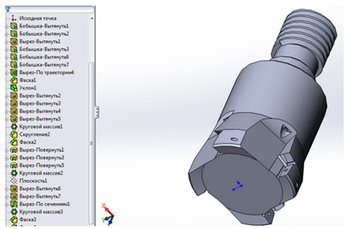

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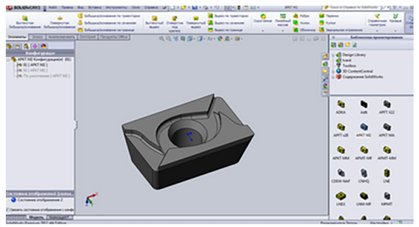

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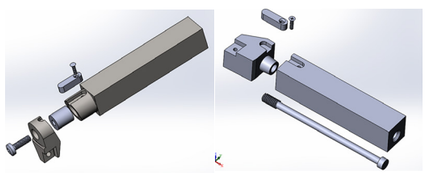

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Analysis of FSES Texts of the Last Generations of Engineering Profiles (Speciality "Nuclear Physics and Technologies", Bachelor Degree) in Foreign Language Subject

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Abstract
The article analyzes the Federal State Educational Standards (FSES) of the latest generation by the example of speciality "Nuclear Physics and Technologies", Bachelor degree programme, Foreign language course. The principle changes in the components of the FSES 3 and FSES 3+ standards are considered in the higher education system..

Key words: education modernization, analysis, FSES standards, cross-cultural competencies, professional competencies.

At the moment, engineering education is one of the priorities for the state education policy. The RF Ministry for Education and Science has launched the project "Development of engineering education" which is aimed at modernization of engineering education content, defining the hour amount of engineering staff training structure based on involvement of employers in development of admission quotas, an increase in engineering specialties' prestige.

The concept of the Russian education modernization demonstrates the necessity of education policy and education modernization for effective use: "...Education policy in Russia, reflecting the national interests in the sphere of education and presenting them for the world community, takes into account the general tendencies of the world development conditioning the necessity for essential changes in the education system: significant extension of international cooperation scale, as a result of which communicative and tolerance factors are of prime importance; as there are some global problems that could be solved only via cooperation within the international community" [1].

Modernization of the Russian education in the system of higher professional education is focused on the practical enhancement of 3-level training system (Bachelor – Master – Post-graduate), improvement of education quality, optimization of content and structure of learning process, design of new educational programmes, development of the Federal State Educational Standards (FSES).

FSES is a set of compulsory requirements for basic education programmes of higher education. The HE FSES of the latest generation include the standards of HPE FSES 3 and HE FSES 3+. The Federal State Educational Standards of Higher Professional Education of the 3-d generation were approved as a part of Government Decree of the Russian Federation of 24 February 2009, no.142, the Order of the RF Ministry for Education and Science of 18 January 2010, no. 51 and adopted for implementation in educational institutions in 2011.

S.I. Prokopieva