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DESIGNING OF AN EDUCATIONAL RESOURCE "THE MICROPROCESSOR TECHNICS"

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Abstract

By the problem of research we have defined revealing pedagogical conditions for formation of the future engineers' readiness to productive and innovative activity in educational process of the university. During research the adding each other methods were used: the content-analysis of the scientific literature and other carriers of the information, generalization of pedagogical experience, analysis of results of patent-information search, modeling and pedagogical experiment. The educational resource on the interdisciplinary training module "Microprocessor technics" in the conditions of introduction the competency-based approach as the variant of a problem decision is offered.

The theoretical importance of the offered decision consists in development of the technological approach, which, as is proved in pedagogics, most productive with the point of view of reliability

the training results. The scientific novelty of the offered decision consists in allocation of the teacher activity elements in the process of designing an educational resource: constant interaction with professional environment of activity in the form of researches and (or) applied development, selection and systematic ordering of a material from various sources of the information, adaptation of this material to the learning process, creation and development the means of training. The practical importance of work is defined by that the decision of a problem is considered on a concrete example of training module "Microprocessor technics", i.e. carries a practical-focused character and can be used in activity of the educational establishments' teachers of a various level.

Keywords: competency-based approach, educational resource, microcontroller workbench, microprocessor technics, programming, training module.

Introduction

The all-European tendency in vocational education is that the modern economy makes new demands to graduates of university which do not keep within traditional concept of professional qualification. The priority of requirements to the intellectual, communicative, reflective and moral qualities allowing graduates of university to organize the professional work successfully is increasing. Therefore a concept of competence becomes more adequate.

The competency-based approach (C-approach) became a new methodology of working out of the standards in Russian higher education. It assumes reorientation of the content of education and the change of technology of its realization from passing on of set of knowledges and skills to formation of competence.

The structure, the content and the formulation of competence/competent were considered in publications of many Russian and foreign researchers: V.I.Bajdenko, G.E.Belitskaja, V.A.Devisilov, I.A.Zimnjaja, S.V.Korshunov, V.V. Kraevsky, P.F.Kubrushko, Dj. Raven, N.M.

Rozina, J.G. Tatur, A.V. Hutorskoy, N. Homsky, V.D. Shadrikov, K. Bain, L. Dee. Fink, B.E. Walvoord, M.E. Weimer, etc. New principles of designing of educational programs and the organization of educational process on the basis of the C-approach were discussed in such magazines as "Higher Education in Europe", "Higher Education in Russia", "Higher Education Today", "Engineering Education", etc.

Time of development of the C-approach in the practice of engineering education has come. We have tried to develop an educational resource on the basis of the training module "Microprocessor technics" which enters such disciplines as electronics, automatics, computing and measuring technics, etc. We consider the training module as the functional unity of the content of training and technology of its mastering.

Designing of an educational resource for studying of the training module "Microprocessor technics"

The actuality of the module is especially high due to several reasons:

1) it is interdisciplinary and potentially innovative. Innovations in the technician and technologies are created now on an interdisciplinary basis as a result of integration of knowledge from various areas;

2) it is actually innovative. The last achievements of engineering and science are embodied in its content. Studying of this content involves using of information technologies.

It is pertinently to quote prophetical words of the professor of Oxford University C.A.R. Hoare, said in 1984: "I am sure, that in our branch, as in no other, theoretical ideas of strictness and

elegance will be off-set as much as possible - reducing expenses, increasing productivity and directing great computing strength of a silicon crystal on use and the welfare of the person ".
However, now Russian pedagogues mark a backlog demand for means and methods of training in the field of microprocessor technics and the general tendency of lowering the quality of the textbooks that aggravates the situation.

As known, designing of the educational module on the basis of the prognostic results of training expressed as competences, is finding a solution of a "back task" in the conditions of interaction of the C-approach with other approaches developed in pedagogic and psychology. We will consider one of solutions of the problem. Concerning the purpose and results of training we will lean on the C-approach; the content of training – on the system-based approach; the organization of the training – on the technological and person-centered approaches; means of training – on the system-based and structure-based approaches.

The training purposes at the C-approach are set by the competences which are formed by studying of different disciplines (modules) of educational program. These competences are defined as the result of decomposition of the universal and professional competences and they are formulated in narrower terms of knowledges, skills and experience. In other words, the disciplinary competences represent the results of training expressed through such components as knowledges, skills and experience.
To gain the competences on the training module "Microprocessor technics" the student should *know*:

- appointment and scope of microprocessor devices;
- the basic types of microprocessors and architecture of computers;
- microprocessor systems and microcontrollers;
- programming languages the Assembler and (or) C;
- the integrated medium for creation and debugging of programs.

Should *be able:*

- to carry out the proved choice of the microprocessor (microcontroller) for the solution of an engineering problem in the field of measurement, management and automation of technological process;
- to project the microprocessor device (its hardware and software);
- to debug its work.

Should *own*:

- skills of working out the microprocessor device for the solution of an engineering problem in the field of measurement, management and automation of technological process.

The C-approach orientation on the results makes comparable only qualifications, whereas the content of education including separate discipline (module) is defined by each university on its own, as Y. E. Babichev notices. The competences orient a teacher on selection in the contents of discipline (module) of the practice-focused problems developing the student in the professional and social plan.

As the integration mechanism providing transition of the content of training from a product of social experience to the personal experience, we used pedagogically designed educational resource which includes the textbook reflecting structure and the content of the training module, and the complex of hard- and software - the microcontroller workbench, allowing to develop practical skills of solution of creative engineering problems (fig. 1).

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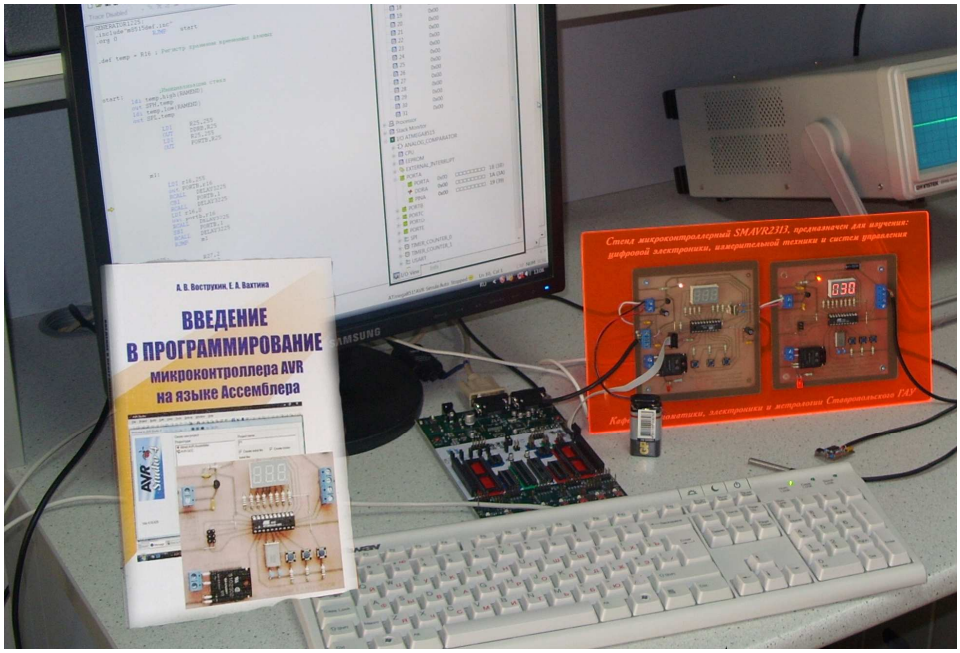

Fig. 1. Appearance of the educational resource "The microprocessor technics"

About selection of the content of an educational resource. Solving this question, we based on factors known in the pedagogics, determining the content of training: the purpose and personal activity in the training process.

The purposes of the considered educational module are described above. Each of them corresponds the block of the content. We will define the dominant purpose which will unite these blocks. As in the future almost all technical devices will work under control of the microprocessors, which work on the basis of a software, so it becomes a necessary part of engineering activity to work the software out. C.A.R. Hoare wrote about it convincingly and figuratively: "Actually the nature and consequences of discovering of programming is even wider. It is like discovering axiomatic geometry by ancient Greeks - the basis for geodetic and

cartographical activity, and then for designing and erection of buildings and bridges. It is like discovering of Newton's laws and differential calculus - the bases for astronomy, and also for such practical undertakings as navigation and management of artillery fire. It is like discovering the resistance of materials - the basis for reliable and an economical building of the ferro-concrete buildings, bridges and oil storages". Programming is often compared with art - its ability "to inhale life and intelligence into a dead semi-conductor crystal". Therefore it is necessary to study the programming first of all. The textbook, in which the questions of programming in the Assembler language of the AVR-microcontrollers of Atmel Corporation were considered, has been written for this purpose. We will explain such choice of the content.

The microcontroller (MC) of the AVR family of Atmel Corporation represents the 8-digit single-crystal micro-computer with the restricted (reduced) instruction set. It is intended for management by various objects and processes. MC contains the processor, the memory, parallel and serial ports of data input-output, a set of the peripherals: timers/counters, analog-to-digital converters (ADC), pulse-width modulators (PWM), analog comparators (AC), etc. It is possible to construct on the basis of MC a multipurpose program-controlled digital system with inclusion of a minimum quantity of additional components.

According to Internet interrogation (http://radioded.ru/), which is held regularly since November 2007, MC of the AVR family of Atmel Corporation have received the greatest distribution. They take the first place in the world on a correlation the price/productivity/energy consumption and become the industrial standard. Programming of these MC can be carried out in two languages the Assembler and C in the medium of AVR Studio, which is free and always accessible on site of Atmel Corporation <http://www.atmel.com>.

It is impossible to disagree with the opinion of the leading Russian scientists in the field of microprocessor technics - V.B. Brodin and A.B. Kalinin, that "the professional systems of

designing should be used as training means, because the use of purely educational means deforms a designing technique and leads to necessity of the subsequent restudying". Therefore we use the Assembler language as the basic tool for the professional working out of programs. This language provides detailed elaboration at level of instructions, what allows using resources of the crystal as much as possible. MC ATtiny2313 complexity is suitable for initial stage of studying. This MC is clear and professionally described by Belov A.V.

We have considered the fact that students receive a different level of education at the same content of training. A.A.Verbitsky explains it like, if the training content is defined by products of social experience, that the education content defines that level of development of the person, his subject and social competence, which is formed in the process of fulfillment of training-informative activity and can be fixed as its result at present time. In his concept of contextual training he offers at preparation of specialists "consistently model the content of professional activity of specialists with of its subject-technological side (a subject context) and social side (a social context) in forms of students' activity".

Therefore we offer to study programming in the training module on a concrete example of an automatic regulator of temperature (temperature regulator) - the microcontroller workbench. Temperature is the most often met quantity which is controlled in various technological processes. It is not of the principle difference what quantity to control. Distinction consists only in sensors of corresponding quantities and actuation mechanisms. On the basis of a temperature regulator the realization of the basic typical functions of control systems is possible: input of the information from the sensor and the keyboard, processing of the information and its output on the indicator, the control by an actuation mechanism, and fulfillment of various laws of automatic regulation.

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The Starter Kit (STK 500) of Atmel Corporation is known among specialists as hardware debug kit. It is successfully used in engineering and research practice. But its functionality is limited to debugging. We chose a way of creation of the microcontroller workbench representing model of the personal computer - classical microprocessor system, which possesses the universal functionality, allowing projecting, debugging and receiving ready devices for inclusion in manufacturing. Besides, the cost of this microcontroller workbench is 3 times less than the cost of STK 500.

A student is given an engineering task - to develop the concrete device. Solving this problem he should use fundamental and applied knowledges from various adjacent areas: physics, computer science, electronics, metrology, automatics etc. Getting a practical result in the form of the working device shows that the competences claimed by modern works are formed.

CONCLUSION

So, we see, that the teacher simultaneously with selection of the necessary contents of training solves the problem of its mastering means: by a choice the perspective from available, designing and creating the lacking. It is very important for development of the modern educational practice. Only in aggregate of contents and means of its mastering: learning, control and self-checking can be considered as the educational resource. Only then it creates to any student, or learner necessary and sufficient conditions for mastering by the certain subject sphere necessary in his professional or social activity irrespective of time and place, which he will choose.

As a result of approbation and introduction of the educational resource "The microprocessor technics" in the learning process of StSAU a number of measuring devices for non-electric quantities (temperature, humidity, dielectric permeability, frequency of rotation, etc), which are patented in Russia, are realized on its basis.

In the conclusion we will notice, that the educational resource of the training module «Microprocessor technics» represents set of the content stated in the textbook in the form of an innovative practice-focused problem with qualified didactic support of stages of its solution and the toolkit - the microcontroller workbench. Correctness of the chosen solution is proved by examples of modern educational practice in the field of development of microprocessor technics. The variety of Russian and foreign scientific schools supposes a variety and uniqueness of solutions in creation of such resources. The optimum correlation of the price and quality will define the best among them.

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