METHODOLOGICAL FOUNDATIONS OF FUNDAMENTAL ENGINEERING EDUCATION

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Abstract: In the paper, methodological aspects of nowadays high engineering education are considered. Thoughts generalizing author's long-term experience are set forth. Recommendations on the improvement of pedagogical process and training system for young teachers are given.

Keywords: fundamental education, educative process, ways of teaching, training of young teachers

I. General Statements

When solving problems of high school education, as initial one there should be considered an obvious contradiction between a huge and still increasing scope of human knowledge and limited terms of student learning. The contradiction noted above had been seen already by Socrate who lived in V century B.C. That is why he has worded his well-known sentence: "A student is not a vessel to be filled in (roughly speaking, to cram with – *Y.S.*) by a knowledge, but he is a torch to be inflamed". It follows from this that a main thing at high school is to teach a student to think and gain knowledge in its own way, by giving him a solid background. Namely such a background must constitute contents of the vessel. Otherwise the torch will not burn. Of course, any specialist has to learn during all his life. But study at high school should give a mold and a powerful impulse for the post-graduate student to be able to work on his own on the basis of fundamental background gained by him.

Unfortunately, recently at many technical universities, a trend of essential bias from the main goal of high school education pointed above is observed. The number of specialities being received by post-graduate students has sharply increased. This has entailed a lot of small courses, in order to justify the presence of corresponding specialities. The number of disciplines studied at a number of departments sometimes reaches 50 and more. Obvious disadvantages in such a plenty of courses being sometimes very small are as follow:

1. Narrowing of basic training of students, because the time for all the courses appearing additionally is being taken from that for basic disciplines.
2. Essential lowering of a level of department's methodological work. How can be discussed the improvement of principles when giving this or that course if only one teacher gives lessons on the course?
3. Sharp narrowing of the possibilities for young teacher to grow, because under a great deal of disciplines at a department, young teachers have to give practical and laboratory lessons on several subjects at once.
4. Essential enhancement of duplication of coupled disciplines. Moreover teachers often do not know contents of lectures being given by their colleagues at their department. It should be noted here that the duplication in giving these or those questions of different disciplines (one should not confuse it with some necessary covering of the material for succession) is one of most serious shortcomings of the high school educative process. As my long-term experience shows, it is very difficult to do without duplication. In order to slacken it, it is necessary, first of all, to intensify methodical relations between departments and those teachers who give similar questions in their courses (sometimes even within the same department). Usually teachers have lack of time for this. And nevertheless the duplication must be ruled out in any way. Apart from the fact that the duplication leads to the noticeable loss of study hours, it also muddles a student up, as different teachers set forth the same questions in different ways, sometimes even using different terms.

Insertion of a plenty of new specialities and a great number of associated new disciplines which appear to be mostly reflection of fast technological progress. Somebody has decided that it is needed to tell students about all the novel things. If such a tendency lasts, then in 10-15 years, the number of subjects in our study programs will increase by a couple of dozens else. But the matter of fact is in that growth of the technological progress rate does not need many specialities and a plenty of new courses to be inserted, but demands just *vice versa* – preservation and even enhancement of the fundamental base for post-graduate students.

By the way, only in this way one can speak about realization of a concept of the Bologna declaration. How can we join the Bologna program, if we have 70-80 disciplines for these or those specialists in the high school program?

The main conclusion following from the told above is an exigency to shorten the number of disciplines planned for study. One must very carefully and conservatively consider the increase in the number of disciplines to be studied and changes in contents of basic courses.

It is necessary to note here that strengthening of student fundamental training is far from only decreasing the number of specialities and disciplines. Each course and each lecture contain principal questions constituting foundations of the science as well as statements to be replaced by novel technological solutions. Correct classification of the material is a personal duty of each teacher. It is necessary to teach young teachers to make such a classification, because in the near future, the responsibility for a level of high school education will lay on their shoulders.

II. On Some Features of Educational Process

A problem of strengthening of student fundamental training puts high requirements for the educative process itself. Let us point out these requirements.

1. At lectures and associated practical and laboratory lessons, to set forth mainly fundamental questions of this or that discipline and used approaches and methods. Sure, this does not mean that in the course of the educative process, concrete solutions, schedules and design have not be studied. Correct definition of proportions between fundamental questions and narrow engineering knowledge is the most important duty of each teacher.
2. Students should be taught to smartly simplify a problem. With this aim, one should thoroughly analyze assumptions and limitations accepted when considering these or those questions, as well as the domain of applicability of the results obtained in this case.
3. It is necessary to attract students' attention, when solving a problem, to a choice of an adequate mathematical apparatus and to smart usage of computing facilities. On one hand, a post-graduate student must not fear to use a rather complicated mathematical apparatus, when it is necessary. Along with this, he should be taught to have the engineering mode of thought – to be able to comparatively simply obtain an approximate estimate of this or that effect.
4. One should strive to set forth science in dynamics of its development, attracting attention of students to questions not solved yet, to give his view about possible ways to solve it. Namely such an approach teaches a student to think and turn over in his mind. It should be applied more and more often while a student is coming to under-graduate courses. Otherwise a student will not be morally ready for serious degree research, and moreover to work on his own after graduation from the institute.
5. A student, first of all, should be taught to solve intricate problems. Namely on the complicated material, it is convenient to teach a student to think and analyze these or those phenomena, to illustrate the material used for a discipline under study.

It should be noted here the following. Today some teachers have a dangerous tendency to lower a level of lessons (first of all, lectures) to adapt them to an average student (and sometimes to the backward one). This is unacceptable. A teacher must draw a student up. Further, namely this will make easier first steps of student's self-dependent life.

This question borders with that on attitude to talented students. Quite often in practice of our high school, when working with students, a teacher spends time mainly for drawing up backward students and sometimes even the careless ones. And this is being done in prejudice of personal work with strong students. Without doubts, this is a great mistake. Peculiar attention must be paid to strong students. Namely they will favour the development of science in the future and determine rate of technological progress. On average, there are several such students per year. Don't miss them. Modes of the work with them can be very different, beginning from extra tasks at practial and laboratory lessons and including the joint scientific work with consequent invitation of them to post-graduate course. I will give an example of this. In his time, academician V. A. Fok was giving a special course for 2 (!) students. And he was preparing to the lectures as if he had the entire group of students in front of him. And efforts of Vladimir Aleksandrovich were not wasted: both the students further became prominent scientists.

Sure, all the points noted above should be implemented not extemporaneously. They must be previously thought out while teacher is preparing to lessons.

III. On Training Young Teachers

The importance of the question is determined by that future of any institute depends on how young teachers are being trained, in particular during their study at post-graduate course. Namely on this reason, questions of training skilled workers must be based on the clear and well thought-out system. The system, in spite of the obvious things – preparation to post-graduate examinations and scientific work in the field of the own dissertation theme – should encompass the following:

- the increase by post-graduate students of their level in mathematical and engineering learning;
- an active participation of post-graduate students in scientific-research and methodological work of the department;
- attendance by post-graduate students of lectures of skilled teachers giving basic courses;
- gaining by post-graduate students of a certain pedagogical experience.

When fulfilling all the points, it is needed, on one hand, to provide the necessary help for a post-graduate student, and on another hand, a strong control of his work.

All this is a copybook truth, but it is not done in due way anywhere and ever. And this noticeably worsens quality of training young teachers.

Conclusions

In my paper, I paid main attention to how engineering high school education should be built, and correspondingly in what direction efforts of leading and teaching personnel of high school should be directed. The main thing is preservation and even strengthening of fundamental basic background of students. Namely this was a glory of the best higher education of the USSR. Everything must be done in order these traditions to be saved.

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ABOUT THE EXPERIENCE OF DEVELOPING INTERACTIVE DYNAMIC ILLUSTRATIONS FOR EDUCATIONAL E-MATERIALS

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Abstract: Publication describes the author's experience in the development of illustrative dynamic materials for eLearning courses. The presented illustrations offer multiply interactive possibilities for a student and powerful flexibility in creating theoretical or control pages for a teacher. Both specialized and universal ways for illuminating of educational materials are discussed. All interactive dynamic illustrations are realized as Java applets, although it is emphasized, that basic ideas are helpful for any other similar technology.

Keywords: education, eLearning, interactive illustration, dynamic illustration, electronic educational materials, Java applet.

ACM Classification Keywords: K.3.2 Computers and education - computer and information science education; I.6.3 Simulation and modeling - applications

Introduction

Although distance learning originally arose from conventional «paper» materials, now this process cannot be envisioned without computer technologies [1–5]. Educational materials in an electronic form (e-materials) became an essential element of modern education even in its intramural forms. The amount of computer educational