PERFECTION OF TRAINING BY "ENGINEERING AND COMPUTER GRAPHICS" AS A PLEDGE OF STUDENTS INVOLVEMENT IN RESEARCH WORK

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Abstract

Paper devoted to issue of perfection of training by "Engineering and Computer Graphics" as a pledge of students involvement in research work.
The concept of «Descriptive geometry, the Engineering and Computer Graphics» teaching under conditions of physical and mathematical training intensification necessity have been considered.

Modern manufacture requires highly skilled engineers and designers (constructors) so requirements to graduates of corresponding higher education institutions constantly increase. The Minister of Education and Science of Ukraine professor I.Vakarchuk at meeting «Modern physical and mathematical science and education: tendencies and prospects» on October, 30th, 2008, noticed that for experts of a technical profile physical and mathematical sciences are essential part of high school training. It is proved that while studying these disciplines the future expert acquires not only methodological, but also the psycho-physiological base of systematic, logic and critical thinking which is extremely important for future performance.

In this connection specific weight of such mathematical subjects as descriptive and analytical geometry increases, as far as they make grounds for spatial thinking of the future expert – in other words, drawing and descriptive geometry at the present stage should be treated as computer-mathematical disciplines, rather than as purely graphic disciplines. It is necessary to consider that geometrical training as the component of general mathematical training is a basis for geometrical modeling and computer design. To be competitive on a labor market the modern engineers should not only have thorough special knowledge in their field, but also possess the whole set of skills connected with computer designing, practical use of computer systems of engineering graphics. Nowadays requirement – being able to perform all kinds of project and design works using modern computer facilities, create the design related and technological documentation and presenting it on corresponding magnetic carriers in the mathematical models and computer programs recognized at world level.

One of the causes of difficult situation in the higher school at the moment is on the one hand reduction of learning hours to study geometry and the engineering graphics, especially considering absence of corresponding training at secondary schools; on the other hand – absence of basic knowledge among first-year students on such classical engineering disciplines as drawing and descriptive geometry. Thus almost one third of school graduates do not know basics of geometry, geometrical constructions not only in space, but even on a plane. It is confirmed by results of entry level test conducted by department throughout last five years – we see the further decrease in basic knowledge in geometry among first-year students.

Reasons stated above raise the complexity and urgency of problems which are to be solved by teachers of the former department of descriptive geometry and drawing, and now – department of engineering and computer graphics and bases of computer design where students are trained in methods of creating mathematical models of various geo-

metrical images.

Solving such problems requires the serious methodical work, constant updating of the primary goals and course tasks, increasing (renewal) amount of learning hours for in-class studies, checking of graphic works, assigning current and total tests.

The primary goal of «Descriptive geometry, the engineering and computer graphics» course – is acquiring knowledge, developing skills and abilities of the future expert (the engineer, the constructor) in the field of new technical elements design. For this purpose it is necessary to develop their spatial imagination, logic and to give basic training to present spatial objects on a plane (drawing), and solve positional and metric tasks on this drawing. As it is known, the drawing is language of technics, and descriptive geometry – grammar of this language.

Specificity of disciplines "Descriptive Geometry", "The Engineering Graphics", "The Computer Graphics" consists in acquisition not only certain amount of theoretical (declarative) knowledge, but also developing skills and abilities of reading and creating the drawing, constructing the details. To get such skills and abilities during the course of training is possible only by performing calculation and graphic assignments. To check up quality of performing these works, to give appropriate feedback and specify errors made by student, to teach how to use reference books – are the primary goals of the departmental teacher – it is the groundings for further learning majority of technical disciplines.

In the conditions of the further implementing and improvement of Bologna Process particularly in assessing students' performance by means of testing, this important point (performance and check of drawings) has no corresponding reproduction in the planned methods of quality monitoring. Carrying out tests allows to assess only declarative knowledge of students, but does not give possibility to check, whether they have acquired main principles, logic and algorithms of the problem-solving, or can apply requirements of standards, etc. It can be checked only while performing corresponding graphic works.

Results of remaining knowledge control showed that in half a year the quality indicator of knowledge decreases almost to half. In our opinion it is caused by following disadvantages in organization of educational process:

• The general reduction of learning hours on discipline studying;
• Cancellation of the final control (examination) and its replacement by assessment on separate modules. For the final control (examination) the student usually repeats the whole material, has possibility to rethink it, to establish connections between separate parts (themes) of discipline which are given by possibility, to better comprehend and remember main concepts and methods of the problem solving;
• Besides, it is necessary to notice that the part of workloading part is transferred to graduating departments as some special courses. At the same time mastering of special courses is usually not so effective due to absence of basic knowledge. Such reduction of learning hours is one of factors decreasing the quality of education.

However it is necessary to keep in mind that in spite of all doubtless utility, automatization of engineering work in educational tasks not always leads to improvement of actual engineering training quality. Students sometimes do not receive enough of even that knowledge of technical objects properties which was given by traditional pre-computer training. Besides relative easiness in receiving results using computer reduces the motivation and interest in the result. Purposeful search and error training in finding the optimal or rational decision in design tasks is much more interesting and instructive for the future engineer, than receiving only one optimal design which cannot be improved and could not be compared.

Hidden calculation processes provided by computers also disserve engineering training purposes. Many calculations which we quite often declared to be routine work, have a strong training effect as far as they allow to track and understand connections of technical object's variables values and its characteristics. This particular circumstance also

is in some cases the reason of the cautious attitude of engineering teachers towards using computers in educational process. Skilled engineers think it can be a problem with computerization of training – it can negatively affect development of such important engineering qualities, as intuition, constructing thinking, ability to perform deep analysis of technical objects and processes properties. Traditional training techniques aimed at the development of these engineering qualities, based on educational calculations and design without using computers, due to lack of intensity and little prestige, do not meet current requirements any more.

Summarizing the issues discussed above, it is possible to draw a conclusion that, along with the future engineers' mastering new information technology, and training computerization it is necessary not only to keep, but also to strengthen traditional engineering training using computers in the certain subject domain, based on professional intuition, knowledge and understanding of fundamental physical principles of technical objects and processes construction and functioning. It is obvious that in solving the problem the important role belongs to the computer graphics. It is no coincidence in saying that the engineer thinks with images. The exclusion of classical sections of engineering training in particular, "Descriptive geometry" from curricula is unacceptable.

To improve educational process department of Engineering and Computer Graphics suggests following.

1. It is necessary to reconsider learning curricula and renew the status of an engineering and computer graphics considering both structurally-logic schemes, and amount of learning hours for this discipline in the block of standard disciplines. It is reasonable to increase amount of learning hours to teach both basic categories of descriptive geometry and engineering graphics (displaying methods, classification and drawing curves and surfaces in space and on projections, profound studying of standards of ESKD), and modern methods of computer design. At the same moment it is necessary to provide a continuous training in graphics for future experts.

2. To establish necessary quantity of calculation and graphic assignments – one for each module. In the curricula of the discipline 3 modules in section "descriptive geometry", 3 modules in section «engineering graphics» and 2 modules in section «the computer graphics» are planned. For each module the amount of learning hours should be planned (according to corresponding normative 0,5 hours for 1 assignment) for checking, explanation of made errors and defending the works. Exclusion graphic assignments from curricula will lead to losing practice supply for tasks, it will also emasculate the discipline, will reduce it to tests and guessing the right answers. The control of each module mastering should consist of declarative knowledge tests (40 % of estimation) and assessing procedural knowledge and practical skills in performing drawings by traditional means or using computer graphics software.
Besides, the offered norms for learning hours spent on module control is significantly lower than the ones planned for pre-examination tutorials and exams. And unlike for the majority of other disciplines this control provides graphic tasks performance.

3. Teachers should not be oriented only on making students to memorize certain abstract algorithms, but also should organize and facilitate self-directed search, conducted by students. One of opportunities for such work should can be students' work on some design problem in small groups where they conduct the analysis and work out of the defined construction.

4. It is reasonable to increase amount of learning hours to study basics of geometrical modeling and computer graphics at mechanical and road-building departments, at least up to 36 hours along with maintaining continuous training (for example, with means of university elective disciplines).

5. Besides, it is desirable to find hours for teaching a profound special course on «Computer methods of parametrical modeling and design» for the future Master students. Essential result of fundamental training in graphics is stage-by-stage forming the students' ability to implement fundamental mathematic and geometric knowledge and skills of geometrical modeling using computer and perform course, degree projects and scientific researches.

6. To increase and order the level of knowledge for entrants and first year students, adaptation course for secondary school program in graphics should be implemented and developed.