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UDC 378. 016: 744

Development of Creative Graphic Skills

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Received: 02.05.2017 / Accepted: 02.10.2017 / Published online: 31.12.2017

Abstract
The article considers the current problems of teaching descriptive geometry for engineering students at the Russian universities. The key objectives of descriptive geometry course are shown. Modern conditions of teaching the course are described in terms of Russia's accession to the Bologna process.

Key words: graphic problem, art, individual approach, extracurricular work, Bologna process.

The history of science of projecting things on a plane or surface originates in the remote past. Ancient people of not only Egypt, Assyria ... but also Yakutia drew the things surrounding them on the walls of their houses and rocks. Most often these were the drawings of animals and birds, hunting which was a source of human livelihood. For instance, nowadays there is a picture of horseman depicted on the Lena cliff that later became the State Emblem of the Sakha Republic (Yakutia).

By the end of the 18-th century knowledge of drawing methods had been highly estimated and theoretically grounded, but it was only due to French scientist Gaspard Monge (1746–1818) whose contribution made descriptive geometry a science. He consolidated all scattered data of descriptive geometry into one system and is deservedly considered one of its founders as a science.

Monge understood that it is necessary to create a rigorous scientific, mathematically strict system of graphic drawing, by means of which one could transfer spatial structures to a plane and, vice versa, represent a design appeared in an architect's or engineer's mind and depicted on a plane in a real material and real conditions. This idea based on the human ability to visualize information was rather perspective and influenced the development of higher engineering education for the next 250 years. Monge was a geometrician of wide range – the first among the greatest geometricians of the 19-th century who transformed completely this ancient branch of mathematics.

Like any other science, descriptive geometry originated in human practical activity. Being one of the geometry branches, it has the same goal as geometry in general, namely, to study shapes of surrounding real world, establishing definite regularities and apply them for solving practical problems. Therefore, descriptive geometry immediately became firmly recognised by engineering school as one of the basic disciplines of engineering education.

Descriptive geometry is a language necessary for an engineer. Its second task is "to deduce all facts that inevitably result from their shape and relative positions from accurate description of a figure. In this sense it is a means of searching for the truth, it produces numerous examples of transferring from known to unknown spheres". After that: "Public education will be given the perspective trend, if our young specialists get used to applying descriptive geometry for graphic constructions necessary in

many spheres and use it to design parts of machines, by means of which a man, using forces of nature, reserves the option to develop his mind". Descriptive geometry is a universal subject.

Modern course of machine and mechanism theory rooted from the course of machine construction, and is genetically related not to mechanics, but geometry, namely, descriptive one.

Monge's teaching methods include design of manuals on not only subjects of theoretical and applied knowledge, but also on engineering sciences, which at that time were only at the beginning of their development. In this regard Monge's essential role is connected with his role in organization of higher education on the absolutely new terms.

Descriptive geometry is a major subject among the graphic disciplines and theoretical basis for engineering design.

It is one of geometry sections, where space figures presenting a set of points, lines and surfaces, are studied in terms of their projection reflections. It is based on the projection method used to deliver images of space figures on a plane or surface.

Under the condition of modern scientific and technological progress, the necessity to have comprehensive information on a wide range of this or that area of science and engineering including the area of engineering graphics is obvious.

Ancient Greeks called human experience and skills "technique" (techne). Later on, it was also referred to the tools developed by skilled people.

Machine building, electrical engineering, radio engineering, instrument making, chemistry, oil and gas industry – all these are branches of modern engineering. To acquire knowledge and participate in their development, one should be able to accurately and clearly express the ideas by means of drawing and present them spatially using plane figures, signs, and numeric symbols.

Creative work is various, but its forms are interconnected in many aspects. For example, engineering art is inconceivable without design, as both functional quality and view of the product are important for consumers. Architecture is also assessed from aesthetical point of view. The common link connecting most types of creative work is graphic image, first of all, drawing, therefore, the drawing course incorporates great potentials to develop personal creative skills. However, application of this theory to practical problems requires sufficient development of such human skills as spatial awareness and logical reasoning. It should be kept in mind that spatial awareness is not a special gift, it is in everyone, as everyone is able to imagine a pyramid, cube, cone, parallel and perpendicular lines.

Karl Marx pointed out the fact that labour ends in some outcome that has been in the laborer's mind at the beginning of the process. "A spider performs operations similar to those of weaver, and a bee puts to shame some human architects by building its wax cells. Nevertheless, even the worst architect differs from the best bee by the fact that before building a cell, he has had it in his mind" [1].

As for logical reasoning, it is enough to have ability to concentrate, be attentive and consistent to develop this skill. To correctly design the problem solution, one needs to know the way of performing graphic construction and be able to draw them – which is not the same. Only doing regular exercises one can develop skill of correct problem solution by the descriptive geometry methods.

There are four stages of knowledge acquisition in pedagogy: understanding, memorizing, application of knowledge and solving creative problems. However, the stages of knowledge acquisition are reflected in definite activity: recognition, reproduction, solving typical problems, solving non-typical problems requiring application of skills in new conditions. Consequently, application of skills in new conditions is a necessary stage of learning.

Learning descriptive geometry requires great attention and concentration, all the

more since discipline bases are mostly taught using abstract, "purely" geometric elements – points, lines, planes, surfaces, geometric bodies. Any real body has an immense variety of properties, but any science has to abstract from most of them and consider only part of their properties included in its subject. "Pure mathematics, – wrote F. Engels, – has space outlines and quantitative relations of the real world as its object, hence, – it is a real material. However, to be able to study these outlines and relations in pure form, one needs to completely separate them from the content, putting the latter aside like something neutral; in this way we will obtain points without measurements, lines without thickness and width, different **a** and **b**, **x** and **y** – constants and variables..." [2].

The course 'Descriptive geometry, drawing, and computer graphics' is one of the basic general engineering disciplines for engineering training. Besides, acquired knowledge is necessary for studying other general science and special engineering courses.

The primary objectives of descriptive geometry course are: *to study theoretical bases of projection, techniques of imaging special forms on a plane and solving the problems related to those forms in terms of their projections.*

Knowledge and skills acquired in studying descriptive geometry are one of the bases for future engineer's development. It strongly contributes to the development of spatial awareness, necessary for any branch of engineering activity.

The founder of descriptive geometry Gaspard Monge called a drawing *"a technician's language", which is an international language* equally explicit for all technically literate individuals regardless of speaking language. The logic of problem solution in descriptive geometry is expressed in the form of algorithms showing a definite sequence of graphic operations.

It is presented as a foundation for drawing. Developing this idea, the Russian scientist, graphic artist, author of the first Russian textbook V.I. Kurdyumov (1853 – 1904) wrote: "While drawing is an engineering language, descriptive geometry serves as a grammar of this international language, as it teaches us to understand other people's thoughts and express our own thoughts using only lines and points as elements of image for words".

Monge's method of parallel projection provides expressivity, conciseness of solution, reliability, visualization, high accuracy, and well-measured images on a plane, it was and is the main method of technical designs.

The course "Descriptive geometry" is traditionally regarded by the students as one of the most complicated, hard to understand courses. Learning descriptive geometry, the percent of academic performance and learning quality are always lower than for other courses. It has been well joked: "Pass descriptive geometry – you can fall in love, pass material strength – you can marry".

However, the challenges expecting students should not be exaggerated. If they have minimal mathematical culture for mark satisfactory, they will muster this subject.

To create a single European Higher Education area, in 19 June, 1999, in Bologna Education ministers of 29 European states adopted the declaration of "European Higher Education Area" at the conference.

Russia joined the Bologna process in September, 2003. After Russia's joining the Bologna process the Russian universities adopted the two-level education system – Bachelor and Master degrees, i.e. the university training period was reduced for a whole year. Bachelor degree is an incomplete higher education, being only the first stage of higher education. One should tell it like it is. People should not be misled! Master course is a main and last stage of higher education. This is a complete higher education.

Fast development of science and technology has resulted in new branches of knowledge and, as a consequence, new disciplines, which are introduced into curricula. As a result, the hours for general science curricula, which are the basis of engineering education, are significantly reduced.

For this reason, all curricula were reviewed. Moreover, whereas in the past the number of class hours was approved by the Ministry for Education and Science of the RF, now it is performed by a graduate department. University graduate departments immediately initiated the reduction of class hours for descriptive geometry without any explanation.

This tendency is observed in other institutes and departments of the university. Several departments of Mining Institute have twice decreased the hours for descriptive geometry. Whereas in the past the course took 2-4 terms, now it is studied for 1 term. In the 1950's mining students learnt descriptive geometry for 4 terms. Institute of Physics and Technology (North-Eastern Federal University) has moved even further. From the following chain: descriptive geometry, engineering and computer graphics the theoretical part was completely eliminated – descriptive geometry, leaving only engineering and computer graphics, whereas department of solid state physics deleted this course from the curriculum at all.

The recently published textbooks on the course recommended by the Education and Science Ministry of the RF for Bachelor students devote to the theory – descriptive geometry - the most minimal part in contrast to the classical textbooks published in the past (less than at the university of the Soviet time!) [3].

It is explained by a number of objective and subjective causes.

The necessity of such detailed gist of descriptive geometry in the article is mainly caused the fact that elimination of descriptive geometry from the curriculum has led to the situation when one could not speak about pedagogical bases of artistic graphics. Descriptive geometry is greatly richer than the facts described here.

It is difficult to imagine teaching Russian or foreign languages without **Grammar**. However, in case of descriptive geometry, it is possible, in the curricula designers' opinion.

The hope is that our voice for descriptive geometry will be heard by the designers of engineering curricula at Russian universities.

To sum up we use the words by NEFU professor A.A. Burtsev: "We should not train engineers who can only set a conveyor and produce consumer goods, and not architects who can design only standard buildings, and not doctors who treat not a man, but only a decease, but we should train specialists capable of taking a creative approach" [4].

REFERENCES

1. Marx, K. Capital. Moscow: Gosizdat, 1967. V. 1. P. 189.
2. Engels, F. Antidyuring [Anti-Dьhring]. Moscow: Politizdat, 1967. P. 33.
3. Georgievsky, O.V. Inzhenernaja grafika: ucheb. dlja vuzov [Engineering graphics]. Moscow: Izdatelstvo ASV, 2012. 280 p.
4. Burtsev, A.A. "Gumanitarizacija" tehnarej i "otehnarivanie" Gumanitariev ["Humanitarization"of engineering students and 'technization'of humanitarian students]. Nash universitet [Our University] 2010. 18 September.

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