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## The Role of Descriptive Geometry in Student's Personality Formation

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*This article specifies and explains the influence on the formation of personal and professional skills of a future architect. The method of constructive approach to the solving of geometry sums and the opportunity to solve life situations and problems with constructive methods are described.*

*Students study descriptive geometry during the first semester. It serves as the launching pad for acquiring professional skills in the chosen field. Having entered the institute the majority of students suffer from insufficient graphic literacy. They face various problems when performing tasks on descriptive geometry that should be in compliance with GOST requirements. Overcoming these difficulties brings up diligence, patience, accuracy, discipline in students.*

*Working on tasks, students learn to argue, analyze and connect logical parts. It promotes development of their logical thinking. The same prudence is useful when dealing with various problems at work and in real life.*

*An architect is a creative profession and advanced creative thinking is an integral part of becoming an expert in this area. Constructive problem- solving helps to develop such creative thinking. The experiment initiated by the Department of Geometrical Modeling and Computer Schedules, Institute of Architecture and Design, has shown that those students possessing creative thinking proved to have less difficulties with understanding and solving complex tasks and demonstrated better performance. In the end of article the opinion of students on the role of descriptive geometry in educational process and its influence on formation of their personality is given.*

*Keywords: Descriptive geometry, personality, situation, thinking, literacy.*

Education of a personality during training is an integral part of a pedagogical process. Works of Najnish (2000), Patrina (2005), Samsonova (2005), Rusinova (2007), Krajukhina (2009), Bugajeva (2010) and other authors are devoted to didactic bases of training and education of students. And in some works the researches based on the example of teaching descriptive geometry in professional – pedagogical and technical

colleges were carried out. Authors of the article give their point of view on this problem generated as a result of long work with architect students, studying extended versions of descriptive geometry

Descriptive geometry is a discipline that a former applicant starts studying at a threshold of a student's life. Also it is very sad, if this threshold becomes insuperable for him. So,

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what are the difficulties the first-year student faces with?

First and foremost it is a transition from secondary school training system to higher educational institution training system. At higher educational institution the emphasis is made on “do-it-yourself” performance of a student. The student himself is entirely responsible for his time distribution, moreover he is responsible for submission of all tasks in due time. Such change is a hard job to comply with. Another difficulty is that the majority of students at school were not engaged in draftsmanship. Descriptive geometry is a graphic discipline. The students not keen in drafting have to re-do the drafts until they meet the GOST standards. And these standards are uniform as for both hand-made, and/or computer-made.

And finally, the basic difficulty is that school graduates often lack logical thinking. Geometry is paid insufficient attention at school. The time allocated to spatial geometrical problem solving and theorem proving is not sufficient. School students are mostly engaged in abstract algebraic formulas and calculations. Therefore they can hardly “see” the space. They have limited skills in the field of spatial thinking.

Thus to overcome these difficulties is the common task for the student and the teacher. Such important qualities as patience and persistence are necessary for the student to master the discipline, and the teacher requires the same qualities to encourage the student to achieve positive result. Overcoming these difficulties brings up diligence, accuracy, discipline, ability to concentrate on study in general what is necessary for the further successful study. And the task of the teacher is to think over further improvement of teaching techniques of the discipline.

Descriptive geometry teaches the ways of presenting elements of space on a plane with

the use of geometrical models and manipulating with them. But thus it is a very important task to teach the students to solve a problem even the simplest one. In fact before giving an answer to the question it is necessary to analyze overall conditions, build up logical chains or reasoning, perform the analysis, and then to make up the final decision.

Let's consider the following examples.

**Example 1.** On an orthographic distribution diagram we have a direct line projection  $m$  and two points  $A$  and  $B$ .

The task is to determine belonging of points  $A$  and  $B$  and direct line  $m$  in space.

To answer the question it is necessary to use an attribute of belonging of a point of a direct line: «In space the point belongs to a direct line if on a distribution diagram the projections of a point belong to the same projections of the direct line.»

Looking at the drawing, we analyze the condition and build up a logical chain.

On distribution diagram  $A_1 \in m_1$ ,  $A_2 \in m_2$ , therefore in the space  $A \in m$ .

On distribution diagram  $B_1 \in m_1$ ,  $B_2 \notin m_2$ , therefore in the space  $B \notin m$ .

**Example 2.** To construct a line of crossing of a cone and a torus.

To construct a line of crossing of two surfaces means to construct a set of points belonging to each surface simultaneously. There are two possible ways of obtaining such points: by means of auxiliary intersecting planes, or by means of concentric or eccentric spheres.

*Analysis.* The direct circular cone is given. It is a surface of rotation. We mark its axis with the letter  $i$ . Torus is also a surface of rotation with an axis  $j$ , where, an axis  $i \perp \pi_2$ , an axis  $j \perp \pi_1$ . Any surface of rotation can be crossed on circles with planes, perpendicular to its axes. However, in that case the cone should be crossed with horizontal planes, and the torus with frontal planes. At such

arrangement no plane crossing both surfaces simultaneously on a circle can be found. Hence, the method of auxiliary intersecting planes cannot be applicable.

For the surfaces of rotation it is possible to use auxiliary spheres. Axes of surfaces are not crossed. Since crossing of axes is a necessary condition of application of concentric spheres they cannot be used for problem solving in this task. But the torus surface can be crossed with planes on clumps of circles. Both surfaces have the common plane of symmetry parallel to  $\pi_l$ . Thus, we have all conditions allowing for application of the method of eccentric sphere

So, the decision is found. The problem can be solved by the method of eccentric sphere.

Having carried out such reasoning, the student can find a correct way of solving the task.

Sometimes students can find a correct way based on their intuition. But the intuition leaves place to doubts. The intuitive way is a pace of trials and errors. The performed analysis and precisely built logical chain provide the definite answer to the question on the applicable method to be used to solve the problem in each case.

The same approach is true for solving various vital life problems and situations

Imagine you have decided to go out. You would definitely think over your plans, chose the places to visit etc. Any sensible person will look for the information on cultural events available and pick up those that meet his/her interests to the best: a performance, a cinema, a concert, dances, museums, exhibitions, etc. Then based on the information received he/she will make the plans, chose the route and transport means, concurrently he will be dealing will many other issues related to his choice including finance issue. The above serves as an example of day-to-day analysis of various situations. On the basis the analysis carried out the decision is made,

which is to be implemented. Now, the person can realize what transport is necessary to reach the required destination and implement his/her plans.

Another **example**. You come home with the intention to make a dinner. First, you find out, what products are available. Then find out, what dish you can make of them. Then you decide, whether you need to go to the shop and buy some extra food.

All described procedure represents the analysis of the situation. Based on the analysis you set up a plan of action building a logical chain with your reasoning. Let's admit you have rice and vegetables. You think: «If I buy meat I can cook pilaf. If there is no meat, I shall buy oil and I make boiled rice with vegetables».

By solving geometrical problems the student should put forward two questions: what is to be constructed? And how he/she can implement it? The answer to the first question gives the analysis of the condition, whereas the answer to the second one – the plan how he can do this based on the analysis performed. Such approach to problem solving is called the constructive approach. It facilitates development of logical thinking with students. If the student proceeds directly to the second question (*how to build?*) going around the first one (*what to build*) it often drives him to nowhere, the problem remains unsolved as no constructive chain has been built beforehand. It is as if you have taken the first bus that arrived to the bus-stop, without a clear idea of its route and its final destination.

An architect is a creative profession and advanced creative thinking is an integral part of becoming an expert in this area. Constructive problem solving is the driving force behind development of such creative thinking. The student with creative thinking demonstrated the ability to assimilate better to the situation, possibility to solve complex tasks easier and

demonstrated better performance. We received the evidence to this in course of the experiment carried out by the Department of geometrical modeling and computer graphics, Institute of architecture and design.

According to the tradition established during the recent decades constructive problems were studied at the end of the first semester. By this time such topics as constructive problems and shadows in orthogonal projections (Suprun, 2009) had been already taught. In the academic year 2010-2011 we decided to present the concept of constructive tasks and to consider a technique of their solving in the beginning of a semester after studying model of a point, a direct line, a plane and their relative positioning. The individual task «Designing of a flat figure» was offered to each student. The task provided for using parallelism, perpendicularity and crossing of a direct line with a plane, crossing of planes and definition of full size of a piece.

Students were warned that the task would be complex for them as their level of development of logical thinking is insufficiently developed. The purpose of the task was not only to consolidate the material learned by the time, but also acquire

a skill of construction of logical chains. The task was to write down the analysis of the problem accompanied with its figures, then make up the plan of its solving on the basis of the analysis and perform the constructions on the drawing. The process moved ahead with difficulty. It took much more time than it had been planned. We analyzed and looked into various similar examples together, gave individual consultations. Eventually, the majority of the students coped with the task. This preliminary process had greatly facilitated further communications with students at studying other topics. The students passed the end-of-semester exams better, than in the previous year. On fig. 1 below the diagram presents the results of examinations in descriptive geometry for last three years. So in the academic year 2008-09 progress was 85 %, quality – 63 %, mean score – 3,7; in the year 2009-10 the progress was 87 %, quality – 57,8 %, mean score – 3,8. In the year 2010-11 progress has risen up to 90,7 %, quality has considerably increased, it has made 85 % and a mean score was 4,2.

This experience was taken into account at development of the working program on descriptive geometry of the third generation.

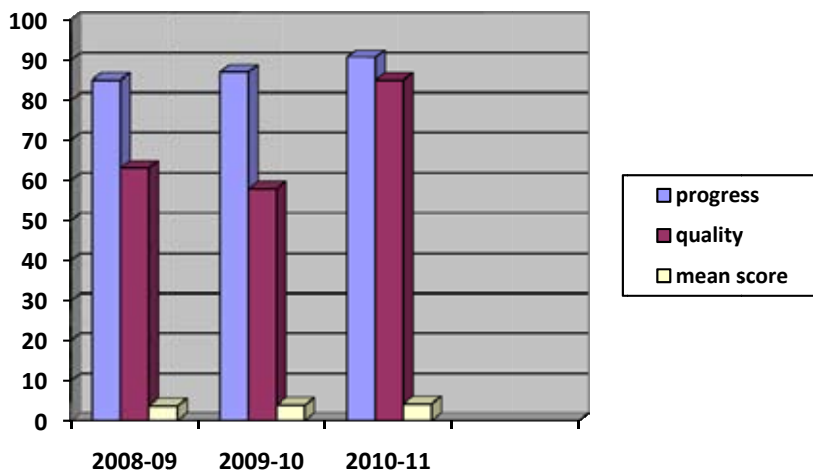


Fig. 1 Comparative results of the examination in descriptive geometry taken by students specializing in architecture

The approach to solving geometrical problems, acquired by students during the first semester, will help them in studying other disciplines at the senior courses, and with decision-making of any vital and industrial problems and situations. And this is a valuable experience for formation of the personality in general and would-be expert in particular.

The answers of the 1-4-year students (major in «Architecture» and «Design») held in the year 2010 to the questionnaire (Suprun, 2010) proved the importance of impact of the discipline descriptive geometry on training and education of the personality and development of professional skill. Below the generalized results of questioning in part are specified.

Studying descriptive geometry promoted development of assiduity, diligence, attentiveness, accuracy, discipline. It has expanded their mental outlook and arranged their perception of world around.

Development of creative thinking helped them with their perception of volumetric models of figures, to cut them, twist and rearrange. It improved their skills of visual-spiral orientation of various bodies, they can more precisely represent sections of various bodies in space, their joints with each other and the form of a line of crossing of volumetric figures. They have learned the explanation to the facts that they had perfected at the level of intuition before. Also they have learned to analyze objects of space and their shadow from the point of view of geometry. The knowledge of laws of construction of shadows and prospects allows to present any shape of an object and its shadows in space prior to the beginning of work on the project. For the project the most complex forms and planes are chosen. The students are capable

to create various form-building elements being the components of designing competently, qualitatively and quickly. It is an excellent « brain work ».

Descriptive geometry gives the basic knowledge and skills in professional area. It is “basement” to development of academic projects, 3D models, competent submission of ideas. The first step to a profession of an architect. Knowledge of descriptive geometry allows to facilitate and improve educational process, brings it to a higher level and makes it the important, exceptional and very attractive subject.

### **Conclusions.**

1. Descriptive geometry it not just a discipline, but also an important point in education, training and formation of the creative personality of the future expert. The key task is to combine training with process of education.

2. The successful experiment should be consolidated and developed. In fact at studying any topic the student can be suggested to design geometrical images according to the given conditions, and then to perform necessary operations with them.

3. Students of architectural specialties study descriptive geometry simultaneously with architectural designing, putting into practice the gained knowledge. It is high time to combine descriptive geometry with computer modeling, however not substituting one for another. A person with creative thinking should be able to foresee the result of the operation which is obtained with the computer, for this he should know its theoretical validation investigated in descriptive geometry. To achieve it the methods of teaching descriptive geometry should be improved.

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## **Роль начертательной геометрии в формировании личности студента**

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*В статье даётся пояснение и обоснование того, как изучение начертательной геометрии влияет на формирование личностных и профессиональных качеств будущего архитектора. Приведена методика конструктивного подхода к решению геометрических задач, и показана возможность разрешения конструктивными методами жизненных ситуаций и проблем.*

*Начертательную геометрию студенты изучают в первом семестре. Она является стартовой площадкой для приобретения профессионализма в выбранном направлении. Большинство студентов, поступив в институт, недостаточно владеют графической грамотностью. Выполнение заданий по начертательной геометрии с соблюдением требований ГОСТ даётся нелегко. Преодоление этих трудностей воспитывает у студентов трудолюбие, терпение, аккуратность, дисциплинированность.*

*Работая над заданиями, студенты учатся рассуждать, анализировать, выстраивать логические цепочки. Это способствует развитию у них логического мышления. Такая же рассудительность пригодится и при разрешении служебных проблем и любых жизненных ситуаций.*

*Профессия архитектора творческая. Поэтому, чтобы стать хорошим специалистом, необходимо иметь развитое творческое мышление. Этому в значительной степени способствует решение конструктивных задач. Эксперимент, проведённый на кафедре «Геометрического моделирования и компьютерной графики» института архитектуры и дизайна, показал, что студент, обладающий творческим мышлением, легче усваивает материал любой сложности.*

*В конце статьи приведено мнение студентов о роли начертательной геометрии в образовательном процессе и об её влиянии на формирование их личности.*

*Ключевые слова: начертательная геометрия, личность, ситуация, мышление, графическая грамотность.*

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