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METHODICS OF FORMATION OF THE PROJECTING AND CONSTRUCTING COMPETENCE IN THE PROCESS OF GENERAL ENGINEERING TRAINING

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***Abstract**: The authors of the article have proposed and experimentally tested the method of formation of the projecting and constructing competence in the process of general engineering training. It provides a set of approaches (competence, systemic, personality-oriented, and acting), general didactic and specific principles of learning; methods (problem statement, partial search, research, discussions); techniques (analysis, cognitive search, hypotheses writing, planning, forecasting); forms of training organization (lectures, practical and laboratory classes, self-study and individual work); means (graphic programs); implementation of graphic development tasks, implementation of educational projects based on ICT usage.*

***Keywords**: projecting and constructing competence, principles, means, methods, learning approaches, graphic tasks, ICT, engineer*

INTRODUCTION

The development trends in higher education in Ukraine are characterized by the search for various approaches to build the educational process of future engineers and to improve educational concepts. Paraschenko (2004) points out the need for accumulation of normatively defined knowledge, skills and abilities to form the ability to act in practice, willingness to apply modern techniques and experience in the professional activity. The purpose of training acquires purposeful guidelines, i.e. the formation of individualities capable of self-development and ready for further enrichment and growth of their educational potential.

MATERIALS AND METHODS

Researchers who study various aspects of general engineering training (Bakum, Gaidaenko, Goroshkina et al, 2005) emphasize that the dynamic development of pedagogical science and widespread use of informational technologies encourages changes in the content of disciplines of the engineering cycle, improving methods, techniques, teaching means and methods of the projecting and constructing competence formation of future engineers.

In the context of the outlined problem, it should be noted when solving graphic problems, students use active teaching methods that involve them into an active search. It contributes their active thinking; arouse interest into the scientific knowledge (inversion method, analogy method, heuristic questions method, and brainstorming).

Solving tasks also contribute to the development of mental activity and the application of principles, methods, and techniques of a mental nature, i.e. analysis, forecasting, generalization, and concretization.

It is expedient to offer students to perform basic tasks for finding natural size and traces of a straight line in practical classes similar, but not the same as the model. For example, not find the natural value of the segment AB, but to build a second projection of the segment AB, if the actual length is 35 mm; not to find traces of a straight line, but to construct projections of a straight line on the set traces. This will contribute to the analysis of known information and the ability to apply the obtained knowledge in the process of changing the conditions of the graphic problem.

When solving graphical problems, future engineers must find themselves in a problematic learning situation, which they try to solve in the team that has a positive effect not only on the development of the ability to analyze and predict, but also on the ability to listen and develop the hypotheses of other team-members. Therefore, the method of forming projecting and constructing competence of future engineers involves the use of problem-based presentation of the material in combination with the partial search, and to consider discussion as a means of team solution of educational and cognitive tasks to enhance professional communication of future engineers.

The proposed method provides the use of a set of approaches (systemic, competence, personality-oriented, active); general didactic and specific principles of learning, which should be implemented in an organic relations, complementing and conditioning each other; methods (problem statement, partial search, research, discussions); techniques (analysis, cognitive search, hypotheses generating, planning, forecasting); forms of training organization (lectures, practical and laboratory classes, self-study and individual work); means (graphic programs).

RESULTS

The results of statistical processing of experimental studies of the projecting and constructing competence formation of future engineers in the control group (hereinafter CG), the statistical significance of differences between the initial and final level of formation in the process of traditional learning was analyzed using Pearson's test. The results are considered and characterized in *Tables 1-2*.

Table 1

Comparative distribution of students by levels of the projecting and constructing competences in CG

Competence level	The beginning of the study		The end of the study	
	Students	%	Students	%
Low	10	6,4	2	1,2
Average	98	63,3	113	72,9
Satisfactory	41	26,5	30	19,4
High	6	3,8	10	6,5
Common	155	100	155	100

Source: estimated by authors

Table 2

Comparative distribution of students by levels of the projecting and constructing competences in CG (χ^2-Pearson's test)

Competence level	The beginning of the study	The end of the study	
i	n_{1i}	n_{2i}	S_i
Low	10	3	90639,25
Average	98	101	1084,22
Satisfactory	41	40	298,52
High	6	11	35285,31
Common	155	155	127307,30
Pearson's test (χ^2)			5,68

Source: estimated by authors

As it is seen, Pearson's test χ^2=5,68 is between the critical values χ^2_{cr} (0,05; 1) = 3,841 < χ^2 = 5,68 < χ^2_{cr} (0,01; 1) = 6,635. Accordingly, it can be argued that the traditional teaching of students has almost no effect on their level of formation of the projecting and constructing competence. It is confirmed by the value of Pearson's test, which is in an uncertainty interval.

The results of statistical processing of experimental studies in the experimental group (hereinafter EG), the statistical significance of the differences between the initial and final level of formation of the projecting

and constructing competence on the basis of the proposed method was analyzed using Pearson's test.

The results are given in *Tables 3-4*.

Table 3

Comparative distribution of students by levels of the projecting and constructing competences in EG

Competence level	The beginning of the study		The end of the study	
	Students	%	Students	%
Low	11	6,7	0	0
Average	90	54,9	76	46,4
Satisfactory	55	33,5	75	45,7
High	8	4,9	13	7,9
Common	164	100	164	100

Source: estimated by authors

Table 4

Comparative distribution of students by levels of the projecting and constructing competences in EG (χ^2-Pearson's test)

Competence level	The beginning of the study	The end of the study	
i	n_{1i}	n_{2i}	S_i
Low	11	0	295692,0
Average	90	76	53773,78
Satisfactory	55	75	75291,26
High	8	13	103509,2
Common	164	164	528266,3
Pearson's test (χ^2)			20,02

Source: estimated by authors

As it is seen, Pearson's test χ^2=20,02 is over the critical value $\chi^2_{cr}(0,01; 1)$ = 6,635 < χ^2 = 20,02. It is in the significance interval that indicates the effectiveness of the formation of the projecting and constructive competence of future engineers in the process of general engineering training based on the proposed methodology.

The results are given in *Table 5*, and *Figure 1*.

As it can be seen from *Table 5*, there is an increase in the number of students in EG with the high and satisfactory levels of the projecting and constructing competence (high level from 6,5% to 7,9%, and satisfactory level from 19,4% to 45,7%); the number of students with intermediate and low levels has been decreased (average level from 72,9% to 46,4%, and low level from 1,2% to 0%).

CONCLUSION

Based on abovementioned results, it can be argued that the proposed methodics of forming the projecting and constructing competence of future engineers in the process of general engineering training in experimental groups has given positive results compared to the traditional methods.

Table 5

Formation of the projecting and constructing competence in the process of general engineering training

Group	Competence level	Number of students	%	Group	Number of students	%
CG	Low	2	1,2	EG	0	0
	Average	113	72,9		76	46,4
	Satisfactory	30	19,4		75	45,7
	High	10	6,5		13	7,9
	Common	155	100		164	100

Source: estimated by authors

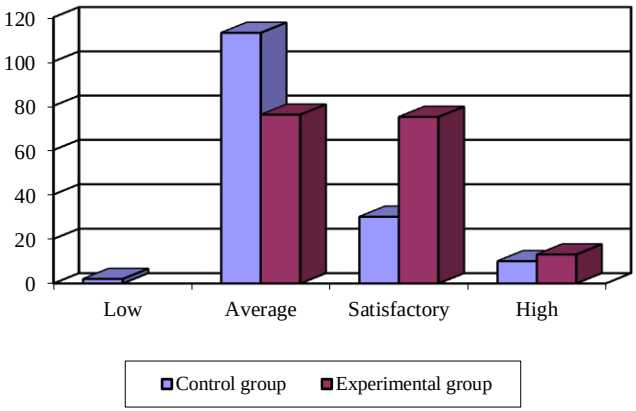

Figure 1: Comparison of the formation levels of the projecting and constructing competence in CG and EG

Source: estimated by authors

Comparison of the obtained results in CG and EG proves the changes in the levels of formation of the projecting and constructing competence during the study of general engineering disciplines. The reduction of low and average levels and an increasing of satisfactory level is an evidence of the effective formation of the projecting and constructing skills of students. The results of the pedagogical experiment were statistically calculated and verified using Pearson's test.

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