1.8 COMPONENTS OF PROJECTING AND CONSTRUCTIONAL COMPETENCE FORMATION IN THE PROCESS OF GENERAL ENGINEERING TRAINING

Introduction: Social changes and processes taking place in modern society are linked with Ukraine's accession to the European Educational and Scientific space, the key strategy of which is the establishment of a competence paradigm. Thus, Bakum (2014) emphasizes that the need for specialists is actualized, who are able to solve both professional tasks and practically oriented task in the informational and production environments.

The competence of such specialist is determined by means of deep and strong general engineering training that promotes the scientific outlook development, systemic projecting vision, constructional skills, and developed personal and professional qualities. This requires the identification of structural components that will provide a more comprehensive assessment of the development levels of projecting and constructional competence in the learning process.

Materials and methods: Scientists who study various aspects of the projecting and constructional competence of future engineers (viz. Nasirova, Osaul'chyk, Puzanka, Sikora, Ternopil'ska, Torubara et al) emphasize that properly selected diagnostic tools will give possibility to see students' achievements, to estimate and to correct them objectively, and to work independently on mistakes. At the same time, a teacher will be able to identify possible problems in time by using such diagnostic tools and to find effective ways to overcome them in order to promote successfully learning of studied components.

Analysis of temporary State Standards of Higher Education of Ukraine (hereinafter SSHE), educational and professional programs of bachelor's training, and working programs made it possible to separate the structural components of projecting and constructional competence of future engineers in the process of general engineering training, viz. (1) motivational and incentive components (both motivationally targeted and emotionally volitional blocks);(2) cognitive and content components (engineering, graphical, informational and analytical blocks); (3) operationally-acting component (both projecting and constructional block); (4) professional and communicative components (both personally-individual and communicative block); (5) resultative and reflective components (both reflection and self-development). All abovementioned blocks are presented in *Table 1*.

Results: In order to identify the level of the projecting and constructional competence formation in the of diagnostic process, students got several tasks, the results of which were evaluated by appropriate scores. In turn, the score of the general exam mock was evaluated by the sum of score for each task. Therefore, the evaluation for the diagnostic exam mock is written by *formula (1)*, where X_i is the score for the completion concrete task i, and n is the common number of tasks in the diagnostic exam mock.

$$X = \sum_{i=1}^{n} X_i \quad (1)$$

It should be noted that X_i are random variables, therefore, we use mathematical statistics to analyze the obtained results (*Table 2*).

Table 1

Projecting and constructional competence of the future engineer in the general engineering training process

The structure of projecting and constructional competence of the future engineer in the general engineering training process		
Components	Blocks	Characteristics
motivational and incentive components	motivationally targeted	Interest in mastering practical problem-solving skills by means of using traditional and innovative technologies
	emotionally volitional	Current development of strong-willed qualities (purposefulness, initiative), emotional expressiveness (verbal and non-verbal means)
cognitive and content components	engineering, graphical	Ability to read and make drawings correctly according to the standards
	informational and analytical	Ability to solve problems, viz. to explain, to check, to analyze, and to predict the results
operationally-acting component	constructional	Professional skills in performing constructional works with the help of graphic programs
	projecting	Special skills that ensure effective project activity
professional and communicative components	personally-individual	The set of professional and personal qualities (intellectual mobility, activity, and creativity) that are necessary for the engineer in the professional activity
	communicative	Ability to work in a team, to use communication skills and independent experience
resultative and reflective components	reflection	Thinking about actions to evaluate and justify one's own beliefs (motives, aspirations, achievements)
	self-development	Consciously managed process that results in the enrichment of the acquired skills

Source: created by authors based on Bakum (2014) and Gorodys'ka (2015)

Table 2

Statistical analysis of projecting and constructional competence level as components formation in the process of general engineering training

Competence Level	Sample	Proportion of the students, %	Mean	Standard deviation	Critic Value (Student's Criteria *a = 0.05*)	Confidence interval
Low	27	8,4	64,07	2,85	2,05	(62,95;65,20
Average	187	58,6	73,50	2,17	1,96	(73,18;73,82)
Sufficient	95	29,8	82,72	2,20	1,96	(82,27;83,16)
High	10	3,2	92,00	1,25	2,228	(91,12;92,88)
Total	319	100,0	76,07	6,53	1,96	(75,34;76,79)

Source: calculated by authors

The calculations of sample means and standard deviations was performed according to the *formulas (2-4)*:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{m} n_i x_i \quad (2)$$

$$s = \sqrt{\overline{x^2} - (\overline{x})^2} \quad (3)$$

where $\overline{x^2} = \frac{1}{n}\sum_{i=1}^{m} n_i x_i^2$, n is the number of students who create the sample

x_i are scores received by the *i-th* student during the process of tasks fulfillment in this sample; m is the number of students' groups that are in this sample.

$$\left(\overline{X} - t_{n,\alpha} \frac{s}{\sqrt{n}}; \overline{X} + t_{n,\alpha} \frac{s}{\sqrt{n}} \right) \quad (4)$$

where $\dot{X}$ is the sample mean; s is standard deviation; n is a sample volume; $t_{n,a}$ is a random variable that has a Student's distribution, and a is a significance level. The $t_{n,a}$ magnitude that corresponds to the sample size n and a significance level a, or confidence level $p = 1 - a$, is found in the Student's Distribution Table.

In our research, when selecting a significance level, $a = 0.05$ for a two-tailed critical region from the Student's Distribution Table for the different samples, we find the critical values that are presented in *Table 2*.

The summarized results are shown in *Figure 1*.

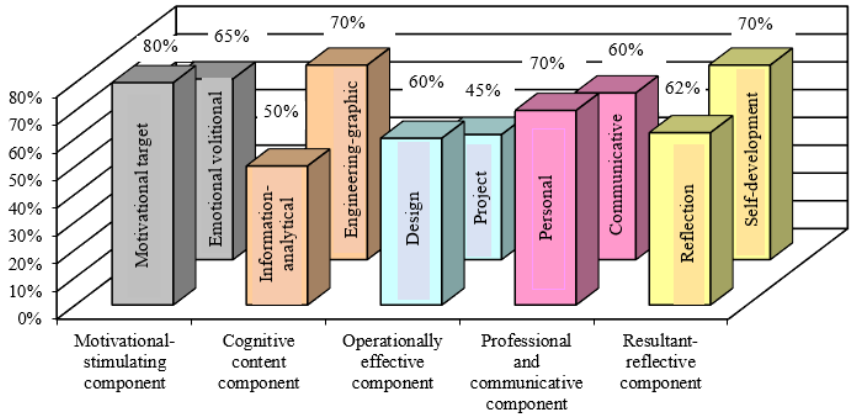

Figure 1: Compositional formation of students' projecting and constructional competences

Source: calculated by authors

The obtained results indicate that the most "problem area" is observed in the process of formation of the cognitive and content component (informational and analytical blocks) and operationally-acting component (projecting block). It is hard for students to carry out active cognitive search while solving problems, and to express their own thoughts in teamwork. It leads to their passivity in practical classes. This requires the use of interactive teaching methods in the process of general engineering training, which will ensure the qualitative formation of cognitive and content, as well as the operationally-acting components of study.

Conclusion: Based on abovementioned results of our research, we can conclude that the use of the partial search method helped to find rational ways to solve engineering learners' problems; the use of problematic method of teaching provided incentives to study general engineering disciplines; the discussion method enabled the activation of professionally-oriented students' communications during the teamwork decision making and the study project completion. Outlined methods helped to solve problematic situations, knowledge exchange, organization of students' brainstorm activity, which ensured the personal qualities development and ability to work in a team, using communication skills and gained experience.

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