

# Project activity of students of construction specialties in universities

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**Abstract.** For the modern higher education of the construction area the problem of development of professional competence is one of the key issues. The subject of mathematics is the basic for the study of General and special disciplines, as using the mathematical apparatus students learn to solve applied problems. The mathematical competence of students of construction specialties is an important component of their professional competence. For the development of mathematical competence of students-builders in the process of teaching mathematics, we focus on the applied, professional orientation of training. We solve applied problems, related to construction and architecture, with students, but the emphasis is on the project approach in teaching. The examples of projects on the topic "Mathematics in construction and architecture": "Mathematics in my future profession", "Architecture of my city", "Without mathematics we are nowhere, and with mathematics we are everywhere", "Golden section in architecture", "Mathematics in architecture", "Draw – means to deceive" "Journey into the world of fractals", "Architecture, construction and mathematics", "World of geometry in construction", "Construction", "Anthropometry in the design of buildings".

## 1. Introduction.

For the modern higher education of the construction direction the problem of development of professional competence is one of the main. The subject of mathematics is the basic for the study of General and special disciplines, as using the mathematical apparatus, students learn to solve applied problems. Mathematical competence of students of construction specialties is an important component of their professional competence [1].

## 2. Urgency

For the development of mathematical competence of students-builders in the process of teaching mathematics, it is necessary to focus on the applied, professional orientation of training. We studied the experience of V. P. Boltyansky and L. M. Pashkov [2], B. V. Gnedenko [3], O. V. Petunin and L. I. Mamonova [4], M. V. Noskov and V. A. Shershneva [5], S. V. Plotnikova [6] in this direction. All of them focus on solving applied problems in the direction of training students. We also solve applied problems related to construction and architecture with students, but the emphasis is on the project approach in teaching. In modern scientific pedagogical literature there are studies on the problem of implementation of the project approach in the system of education in the University. We relied on research of J. Dewey [7], I. D. Chechel [8], D. Kilpatrick [9], E. S. Polat [10], L. B. Pereverzev [11], N. A. Kralja [12], V. I. Slobodchikov [13]. However, the application of the project approach to the



formation of mathematical competence of students of construction specialties of the University, as part of their professional competence, has not been studied enough and is still quite a new educational technology.

The aim of our research is to develop, implement into practice teaching in each section of mathematics for students of construction specialties practice and professionally oriented tasks and topics of projects (personal or group), and experimental verification of changes in the level of development of mathematical competence of students.

### 3. Theoretical part

The key concept of the project approach is "project". According to I. D. Chechel, who worked with research projects, the project is literally "thrown forward", that is, a prototype of the object under consideration, an activity.

According to his point of view, the project activates cognitive activity, develops creative thinking [8]. If students create a group project, they acquire skills of work and interaction in the team, get experience in analyzing the results of their activities. In pedagogy, a project is an image, an idea, a plan.

In Russia of the 20s of the 20th century the method of projects was actively developed, even too actively. Education in schools and universities was replaced by the implementation of projects in factories and plants, as a result of knowledge of the subjects was not, from the method of projects was decided to refuse. In modern education, the method of projects is again relevant. One of the leading specialists in the development and implementation of this method in modern Russia is E. S. Polat [14]. The method of projects has become popular due to the fact that it meets the needs of society, which are expressed in the form of social order of employers, in competent professionals who understand the meaning of their work who are able to set professional goals and objectives, to find ways to solve them, to defend their opinion, to realize the responsibility of the decisions taken, their consequences [15]. As a result, there is a need to develop students' design skills for project development.

We mean the project, on the one hand, the creative work of students, performed on a given topic (problem) independently, but under the supervision of the teacher; and on the other hand – the form of organization of joint activities of students. In the first sense-it is any student projects (individual and group); and in the second project – it is the process of development of mathematical competence of students [1].

Thus, the concept of "design" in our study means the process of developing a given topic (problem) and its design in the form of a multimedia presentation, book, booklet, album, volume layout, tables, drawings, and training maps.

The project approach in mathematics higher education involves the use of integrated knowledge from various fields of science, technology, art, everyday life. With the project approach in education, the student is forced to get answers to the questions, to come up with ways and means to achieve their goals; he acquires the experience of design activities. The student begins to better understand the topic under study, shows his creativity, and mathematics does not seem abstract, detached from life science.

We have carried out experimental work on mathematics classes with students. As the subject basis of our research were the students of the "Magnitogorsk state technical University. G. I. Nosov", the students in the construction professions. A total of 104 students who made up the experimental group, they participated in the ascertaining, and in the formative experiment. Three groups of students of construction specialties were selected. In two of them (EG-1, EG-2), students in the classroom of mathematics for each major study topic solved professionally oriented tasks, projects. Implementation of projects showed the applied, professional value of mathematics, its connection with other disciplines. And in the third experimental group (KG) students studied mathematics as standard, without tasks of applied value.

Let us consider the examples of student projects related to the solution of professional problems in which mathematics performs an applied function. Thus, in the study of the topic "Curves of the second order and spatial bodies" students of experimental groups EG-1, EG-2 carried out a project on

"Unusual figures in our world", the development of which required the production of models of figures, geometric bodies, preparation of multimedia presentations or abstracts. The most interesting topics for student projects: "The Mobius Strip", "The Impossible triangle of Reutersvard", "Impossible figure", "The Penrose Triangle", these projects were completed creatively, with great imagination and a close connection with their substantive focus [1].

The great interest of the students was caused by the implementation of cross-subject projects showing the relationship of mathematics with other subjects studied at the University, for example, with physics, or disciplines of the construction profile. For example, students of group EG-1 and EG-2 was given the theme "Mathematics in construction and architecture" related to special disciplines. The concretization of the content, as well as the choice of tools and forms of projects was the area of creativity of students, so that the completed projects were diverse and original: these are models of architectural structures and abstracts to them, multimedia presentations on the topics: "Mathematics in my future profession", "Architecture of my city", "Without mathematics we are nowhere, and with mathematics we everywhere", "The Golden section in architecture", "Mathematics in architecture", "Draw – means to deceive", "Journey to the world of fractals", "Architecture, construction and mathematics", "The world of geometry in construction", "Building structures", "Anthropometry in the design of buildings". Students are very interested in projects that reflect the relationship of mathematics with everyday life. For example, during the study of mathematical statistics and probability theory, students performed group projects on the topic "Sports and mathematics". According to the results of their work, a seminar was held, where students defended their projects. In the process of working on a project on this topic, students discovered the use of mathematical statistics and probability theory in tennis, football, volleyball, and chess. Very diverse in content and design were works on "Mathematics in my life", which presents interesting projects to create their future street cafe, own home, own garden, shows the relationship of mathematics and the laws of nature, the relationship of mathematics and beekeeping [1].

The quality of the completed project was evaluated by the following criteria: completeness and logic of the theme, the complexity of the project, the aesthetics of the project design, and the protection of the project product took into account literacy and evidence of the speech, completeness of answers to questions, the share of personal participation in the development of the project (if it is a group), the presence of personal attitude to the project, the volume of research work. The activity of the student as a listener was also noted: the ability to listen to the performance of classmates, ask them questions on the merits, express their opinions on the submitted projects.

Defending their own project at the seminar, students enter into a discussion dialogue with their fellow students, defend and defend their point of view, analyze their own activities. It develops students' reflexive and communicative skills.

Among the tools to assess the level of development of mathematical competence of students we use and portfolio. Portfolio is a presentation of student learning achievements. In the system of modern mathematical education portfolio is one of the active methods of learning used in the project approach, the student independently captures personal achievements in mathematics. The work of a student to create their portfolio contributes to the development of his reflection and motivates to improve their results in the study of the subject.

Portfolio can be made in the form of paper version, electronic version of the portfolio, presentation on the website (web portfolio). Such portfolios contain basic information about the author and student, the annotations of the results of its project activities, the results of all types of works and their protections, expressed in points, the results (in points) of tests, exams, and in addition the results of the performance of the student on conferences in mathematics, participation in competitions, competitions, reflected in diplomas, articles in collections.

#### **4. Results of experimental work.**

In the course of the experimental work were developed criteria and indicators of the level of development of mathematical competence of students [16-20]. When processing the data of the

experiment, we evaluated each indicator of the level of development of mathematical competence of students on a three-point scale.

At the preparatory stage of the experiment, the primary data were determined to determine the further stages of the experimental work. The primary diagnosis was defined as a fairly low level of development of mathematical competence of students (low level of mathematical knowledge, skills of students, lack of interest in mathematics, creativity, project activities, insufficient level of need for self-realization of students, etc.). The preparatory stage of the experiment allowed to determine the tasks of the discipline "mathematical training", contributing to the development of mathematical competence of University students.

Taking into account these conclusions, the main stage of the experiment was developed and conducted.

As a result of this experiment in all groups there is a positive dynamics of increasing the number of students with medium and high levels of development of mathematical competence in comparison with the initial data

**Table 1.** Results of development of mathematical competence of students in the process of experimental work.

Group	Number of persons	Stage	Levels						$\chi^2$ obser.
			low Number	%	medium Number	%	high Number	%	
EG-1	38	Initial	23	60,5	11	29	4	10,5	0,13
		Final	3	8	24	63	11	29	10,52
EG-2	32	Initial	19	59,5	11	34,5	2	6	0,17
		Final	4	12,5	21	65,5	7	22	7,20
KG	34	Initial	20	58,8	11	32,4	3	8,8	-
		Final	13	38	17	50	4	12	-

In the course of experimental work, we used Pearson's statistical  $\chi^2$  test to determine the causes of changes in the results. According to the zero statistical hypothesis, the levels of mathematical competence of students of experimental and control groups as a result of the experiment will be the same.

According to the results of the table, we see that at the level of significance  $\alpha=0.05$  in the experimental groups EG-1 and EG-2  $\chi^2$  observed  $> \chi^2$  critical ( $\chi^2$  critical = 5,99), that is, the condition of the application of professionally oriented tasks and projects in the process of teaching mathematics is statistically significant for the development of mathematical competence of students, as  $\chi^2$  observed  $> \chi^2$  critical. According to Pearson's criterion, an alternative hypothesis is accepted. It means that the more successful development of mathematical competence of students-builders of the first and second experimental groups is not accidental, but is a consequence of the introduction into practice of teaching in each section of mathematics of practice and professionally oriented tasks and projects.

## 5. Summary.

The best results in the experimental groups compared to the control show that due to the applied, professional orientation of mathematical training of students of construction specialties, the process of development of their mathematical competence is more successful. The problem of our research is solved. Graduates of universities of construction specialties with experience of creative, project activities, easier to adapt to modern economic conditions, they have a higher level of professional competence, they are more competitive in the labor market, as they are able to effectively use their knowledge, skills and experience, can independently make decisions in unusual situations, anticipate the result.

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