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# Teaching Package Development for Engineering Training Programs

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**Abstract.** Nowadays society has a great need for efficient engineers. The article deals with relevant problems of engineering training programs productivity. The programs differ both in content and in the nature of educational process organization. Therefore, there is a need for appropriate teaching package development which provides educational and methodological support. Educational and methodological support is aimed at improving the quality of vocational education providing a specific combination of training tools and technologies. This process is designed by the teacher. The article focuses not only on teaching package development of the educational process but also on the content, monitoring and evaluation tools. Effectiveness research of vocational training program and their teaching package is carried out. The practical value of the research lies in the fact that the ways of teaching package development provide more efficient organization of the educational process. It leads to efficiency and high quality of education. We have conducted a study that resulted in a unified system concerning organizational and pedagogical conditions of academic and methodological support. We identified relevant requirements for teaching package development for students whose major is “Construction”.

## 1 Introduction

The reform and modernization of education in Russia is aimed at improving its quality, preserving fundamentality, increasing variability and strengthening humanistic orientation with the view to make the whole teaching process technological. As practice shows, there is a constant need for competent engineers. Thus, the demand for such specialists is increasing. It entails the demand for highly qualified specialists who train engineering students at universities.

At the same time, the level of graduates' qualifications and skills differ both in content and in the way the educational process is organized. It requires the need for appropriate academic and methodological support presented in a teaching package[1].

Once again we define the importance of the engineering sector for society as engineers are required in many spheres of life. Therefore, training specialists in this field is extremely important and necessary. At the same time, we will focus on the quality of education received by students. Paying attention to improving the quality of education in this area, we pay attention to the development of the country's economy.

Problems of organizing professional training of future engineers were highlighted in the works of A.V. Brushlinsky, S.D. Smirnova, V.A. Bigeeva. They devoted their work to a methodology of vocational education, the development of the concept of the vocational education system, oral communication teaching of future engineers. Besides, some research works are devoted to the institutional structure of engineering field.

In this regard, teaching package development for the vocational training system will be effective if modern requirements are observed. It is necessary:



- to have data for analysis and comparison;
- to summarize pedagogical experience, taking into account new achievements of modern pedagogical science;
- to ensure communication of the studied material with production and future field of activity;
- to be specific and brief; meeting the requirements of the Federal State Educational Standards [24].

It is significant to intensify scientific-pedagogical search and development of teaching effectiveness as well as methodological support while training specialists [9]. It is vital to increase education knowledge-intensiveness and culture-intensiveness, taking into account the ongoing reassessment of human values, professional opportunities, expansion of specialists' field of activity, the emergence of integrative educational institutions [8].

Thus, the study of the relevant problem allows determining main aspects in educational activities - teaching package development for engineering specialists training - in pedagogical theory and practice.

It is important to develop appropriate teaching package for engineering training programs as there is an increasing need for high-quality competitive specialists and improving the level of professional and personal competencies of engineering graduates. However, it is associated with insufficient quality of academic and methodological support presented in a teaching package [14].

## 2 Methodology

At the first stage, we carried out analysis of future graduates training programs, identifying features and problems in their organization. We also studied the research topic and its development in pedagogical and psychological literature. The bibliography and research project [18] completed the stage.

At the second stage, ways and possible solutions to the problem were selected, management process of the training system of future specialists was analyzed, effectiveness of teaching package development as well as its organizational and pedagogical conditions was proved [19]. At this stage, an experiment was conducted where the motive of choosing a field of study, students' satisfaction with the educational process was analyzed. There was also another experiment, where the development, analysis and verification of organizational and pedagogical conditions of the teaching package development system took place [7].

The third stage is marked by the analysis and generalization of the obtained data, identifying the prospects for further research in the framework of our problems. Conditions for the creation of educational programs, curricula and other types of teaching package for engineering education were tested [13].

The key point is the opportunity for students to be engaged in their own education at any time, at any place and at any time in their lives [10].

The greatest effect is achieved in improvement of educational process teaching package through the acquisition of computer equipment and programs [4].

In this regard, introduction of teaching support is the provision of a system for engineers training as a process and result of management structures at various levels in the field of education. Its aim is to provide methodological support in operating and developing the educational process [5]. Its main purpose is to improve the quality of educational process by providing faculty and students with materials that are necessary for the development of educational programs, taking into account the observance of the following principles: fundamentality, universality, integrity, integrity, professionalism, variability, multi-level preparation. [11].

Innovative pedagogical technologies contribute to a successful solution of professionally significant tasks. They should be based on a solid scientific foundation that guarantees the optimal combination of fundamental and practical knowledge, the use of interactive learning technologies, the development of strategies and technologies for applying knowledge, the relationship of the studied material with everyday life problems [3].

To confirm the effectiveness of the teaching package development for vocational training programs an experimental study was conducted.

The quality of future specialists training reflects: the quality of the educational process; the level of academic performance and level of training; quality of methodical work; quality of curricula and programs; quality of educational work; quality of material support; quality of teaching staff (teacher qualifications, certification results, involvement in innovative activities) [12]; quality of learning outcomes - the level of graduates skills, their level of demand, admission to higher professional educational institutions, the level of satisfaction of personal inquiries, teachers achievements [6].

The manual within the vocational teaching package should contain the following essential elements: annotation, table of contents, introduction, main part, conclusion and bibliography.

Additional elements in the textbook include preface, illustrations, glossary, a list of conditional abbreviations.

### 3 Results and discussions

The research results contribute to the systematic updating of the content of the main educational engineering program. Organizational and pedagogical conditions of teaching and methodological support, substantiated in work theoretically and verified in practice are aimed at improving example programs of the professional courses.

In pedagogical practice preparation of a competent specialist, the use of input, current, boundary, final testing is used.

Testing tools are both paper (test questions, jobs, tests, crossword puzzles, test tasks and coursework tasks, examination questions) and technical ones (computer monitoring programs should be highlighted) [22].

Developing methodological content to check students' knowledge we should pay attention to:

- variety of forms, teaching methods and methods of testing;
- variability of test tasks, both in the classroom and for homework (taking into account the level of preparedness of students), options for distant learning [21];
- educational and methodological support of testing procedures, focusing on the need and desirability of using specific visual (illustrative) materials including those made by students;
- evaluation criteria for all kinds of independent work.

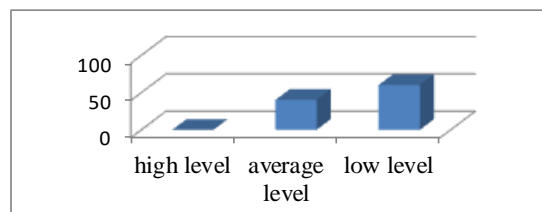
Studies show that the coefficient of mastering the material in the course "Engineering and computer graphics" must be at least 0.7. Only in this case we can talk about students' achievements.

During the test, we calculated the coefficient within three intervals in the range from 0.7 to 1.0, and their ratio at a 5-point scale (table 1).

**Table 1.** Criteria for assessing students' knowledge at a 5-point scale.

| Coefficient | Evaluation     |
|-------------|----------------|
| 0.7-0.8     | Satisfactorily |
| 0.8-0.9     | Good           |
| 0.9-1       | Fine           |

Students had to do a certain number of tasks that corresponded to a specific assessment.



**Figure 1.** The results of the ascertaining phase of the experiment.

Thus, the results of the test indicate a low level of effectiveness of the used teaching package development in the course "Engineering and Computer Graphics."

In the process of didactic data creation insufficiently developed educational and methodological support was revealed. Thus, it was necessary to implement computer graphics during the study of the course "Engineering and Computer Graphics."

To develop this project, a thorough analysis of the content of the course program should be carried out.

The experiment was attended by students of Nizhny Novgorod State Pedagogical University named after Kozma Minin whose major is "Vocational education (by industry)" training profile "Construction" (7 people) and "Service in housing and communal services" (9 people), In total, 16 students took part in the experiment.

The procedure of monitoring the training course "Engineering and Computer Graphics" can consist of several stages:

- 1) monitoring the development of theoretical material on each topic of the course;
- 2) an interview on the implementation of any tasks on each topic of the course, writing essays, listening practice [16].

The first stage is recommended to be carried out at the end of the course study since students are not allowed preparation time to pass them - testing reveals general knowledge of the course (concepts, classification of concepts, laws, patterns, principles, methods, etc.) and basic mental skills [20].

Students who do not have positive assessment cannot be admitted to the main stage of the final test, approved by the department.

The overall assessment is the subject of intermediate tests at each stage.

The content of the testing stages:

1. The results of the assessment of theoretical knowledge are evaluated at a four-point scale ("excellent", "good", "satisfactory", "unsatisfactory").
2. The interview is the main stage of the final test which is conducted on the proposed situations, containing several tasks (or one complex), the implementation of which confirms that the student has the skills defined by the objectives of studying the discipline [23].

Then comes the questions of self-control as well as a list of questions for the exam in the course "Engineering and Computer Graphics", which will be reflected in the annex to the final qualifying work.

The purpose of teaching package development was to test the effectiveness of its use in a vocational training course (using the example of testing students in the "Engineering and Computer Graphics" discipline) for the "Construction" training profile in Nizhny Novgorod State Pedagogical University named after Kozma Minin.

The use of teaching package development for the course "Engineering and Computer Graphics" showed that the use of this tool allows you to improve the effectiveness of students' vocational training to the standards of required professional skills.

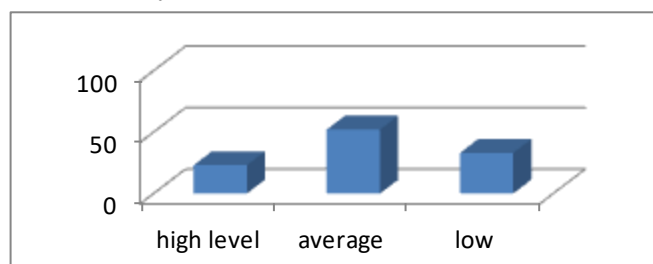
The study of educational material through the use of methodological support allows the teacher to pay more attention to the consolidation of knowledge and the implementation of exercises by students, which guarantees the acquisition by students more durable skills [15].

Conducting the ascertaining stage at the university shows that the development of educational information without the use of properly developed educational and methodological documentation can be difficult.

The need to learn a large amount of information distracts from its reflection. This negatively affects the future specialists' training, prevents the transition of motivation of their professional activities to a higher level [2]. The use of educational and methodological documentation in the process of mastering the discipline is intended to eliminate this drawback.

In the course of the study, as part of a pedagogical experiment, two groups of students whose major is "Construction" and "Service in the Housing and Public Utilities" were involved. As well as at the ascertaining stage, the verification of the effectiveness of the implemented educational-methodical

documentation was carried out by conducting testing in the topics of the course "Engineering and Computer Graphics" at the university.



**Figure 2.** Results of the final stage

Evaluation of students' knowledge was carried out with the use of test control and reflected the learning of knowledge on the topics of the discipline in accordance with educational and methodical instructions.

The success of the teaching package development for the "Engineering and Computer Graphics" course is seen in the improvement of the list of recommended literature.

Thus, the results of testing in the discipline "Engineering and Computer Graphics" showed a higher level of material learning by students, the results confirmed the effectiveness of the implemented educational and methodological support.

#### 4 Conclusions

We have identified specific features of modern requirements for teaching which affected students whose major is "Construction". Developing a teaching package we attracted employers, an expert assessment.

We have established the importance and the need to improve education in the engineering field since in modern society the services of engineers are extremely in demand. The better the training of future graduates in this area, the more these needs are met, which generally affects the country's economy. Engineering is one of the most promising areas, so higher schools should develop it further using the latest teaching tools, including technological ones which have become an integral element in both training and professional and everyday life.

Summing up the research, it must be said that for effective vocational training of students in modern conditions, teachers need to develop and use new teaching methods.

In the process of research the theoretical and methodological aspects of vocational course teaching package development are considered.

Teaching package development is aimed at improving the quality of vocational education using a combination of training tools and technologies for their use. This process is designed by the teacher [17].

The principles of the formation of a teaching package are: the principles of compliance of the content of education with its goals, which are determined by the needs of the development of society, science, culture and personality; target orientation, integrated mastering of knowledge and skills; feedback; functionality; integrity of the formation of competence and a number of others.

The intermediate stage reflected the low quality of students' knowledge obtained in the course of the educational process using the current teaching package.

This factor contributed to the need for a new educational program documentation development in accordance with modern trends in educational process and civil law relations. Introduction of methodological documentation developed in the study and verification of its success by conducting testing revealed the increase in the quality of knowledge gained by students.

As a result, the interdependence of the teaching package efficiency and the quality of the learning process is revealed. The restructuring of the content of methodological activity requires a turn from

normative regulation of teaching activity to stimulating their creative activity, active introduction of innovative approaches in the system of education.

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