

SCIENTIFIC AND METHODOLOGICAL PROVISION OF PROFILE TECHNOLOGIES TRAINING IN HIGH SCHOOL

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The article emphasizes the importance of profile training of engineering technologies and development of appropriate educational and methodological support in the form of special courses (elective courses) in technology. Systematization and generalization of the scientific research results of a number of topics (senior profile school) have been carried out in the department of technological education of the Institute of Pedagogy of the National Academy of Pedagogical Sciences of Ukraine with the purpose of systematic use of theoretical developments (conceptual and theoretical and methodological foundations, models; formulated hypotheses, innovations, ideas; developed methods, approaches, etc.) in the process of designing effective content of special courses for profile technology training. The results obtained formed the scientific and theoretical basis for the design of the textbook content for the special course of engineering and technical orientation «Designing and construction of engineering objects».

The importance of the special course content for the formation of project-technological competence, creative technical potential, providing pupils with a conscious choice of their future professional activity of engineering and technical orientation has been substantiated.

The role of the wide-ranging methodological apparatus of the manual has been highlighted for the effective realization of the special course content «Designing and construction of engineering objects» in the educational process of the high school and the tasks fulfillment of profile technologies training according to its content.

Keywords: profile technology training; design and technological competence; special courses; content; scientific basis; theoretical and methodological principles; engineering and technical orientation; experiment.

Formulation of the problem. In the process of integration of Ukraine into the educational, economic and cultural European space, the profile technological education, its content is one of the most pressing problems of the theory and practice of modern school education in Ukraine.

Particularly urgent is the problem of profile training of engineering technologies. Ukrainian society develops in the period of scientific and technological progress, development and introduction in all branches of industrial production of the most modern machinery and technologies. The successes of Ukrainian scientists, designers, technologists and manufacturers are significant in the most science-intensive industries — aviation, space and military. Therefore, profile training of pupils in the basics of design and development activities is promising and extremely important in terms of ensuring the engineering and technical future of Ukraine and one of the priority tasks of national importance (preparation of a new generation of scientific and technical specialists).

Achievement of didactic goal of profile training, effective formation of project-technological competence of high school pupils will be implemented effectively if the teacher has the latest, scientifically substantiated content of engineering and technical orientation. For a positive solution to this problem, a special role should be given to special courses of engineering and technical orientation, the content of which will contribute to the acquisition of pupils' knowledge and skills on the basics of designing and construction of engineering objects, the formation of their design and technological competence, which involves the creation of training manuals of special courses with relevant modern content.

It should also be considered that in the current conditions of society, the independent creative activity of pupils in the field of technology is of great importance. Therefore, the role of textbooks of engineering and technical orientation, which would fulfill the teacher's functions appropriately, is significantly increasing. From the passive media, the manual has to be transformed into an active didactic system that would provide pupils with independent creative tasks, self-control, self-examination, the formation of their creative personality, subject design and technological competences and key competences. Since it is a profile technology training, the content of such a guide should provide a conscious choice for pupils in their future engineering profession.

The above requires a major reformation of the profile technological education, as it must ensure the technological competence of the modern specialist in engineering and technical orientation, the ability to design and manufacture products, analyze the

process and results of their activities, make responsible decisions taking into account their interests, interests of other employees and society as a whole.

Thus, nowadays the problem of educational and methodological provision of profile technologies training of engineering and technical orientation is quite urgent. the creation of a scientific and theoretical framework for designing the effective special courses content of engineering and technical orientation is equally important.

Analysis of recent research and publications. Analysis of the current state of profile technology training in high school shows that there is a profound rethinking of national and world experience in the formation of the purpose, objectives and content of the profile technological education, the construction of methodological systems for the implementation of technology training, the development of innovative scientific and methodological support for profile technology training.

A considerable number of scientific works of scientists of the Institute of Pedagogy of the National Academy of Pedagogical Sciences of Ukraine [1] — [8] is devoted to creating textbooks as a basis for a methodological system of competently oriented teaching, exploring the competency potential of textbooks and their importance for the tasks of the New Ukrainian School, considering the textbook as a means of developing the communicative competence of high school pupils etc. The features of structure formation and textbooks' content and special courses for profile training have been considered [1]; [2]. Theoretical and methodological foundations and methodological peculiarities of designing the content of specialized subjects of technological profile of teaching of high school pupils have been developed [9] — [11]. The stages of creation of modern textbooks and manuals have been determined [12].

Different aspects of didactic modeling of qualitatively new content structures of curricula, textbooks and manuals for profile technologies training in high school on the basis of competency approach were investigated by T. Bozhko, V. Vdovchenko, M. Golovko, T. Machacha, M. Korets, A. Tarara, A. Tereshchuk, V. Tutashynskiy and others. These researchers have identified, substantiated and put into practice the wide variability of theoretical and practical developments in technological education at the profile level.

In recent years, a number of monographs, curricula, textbooks, educational and methodological manuals for profile technologies training in high school have been developed and published [9] — [11]; [13]; [14].

The analysis of literary sources allows us to draw the following conclusion. There is a considerable number of research that addresses a wide range of problematic issues in the creation of textbooks and manuals, including for profile training. However, there are no scientific works that solve the problem of creation of training manuals of special courses of engineering and technical orientation for profile technologies training on the basis of systematic use of scientific and theoretical developments (resulting from long scientific researches).

Formulating the goals of the article. *The purpose of the article is to reveal the innovative nature and practical application of a set of concepts and theoretical and methodological foundations, innovations, methods, approaches, etc. in the process of scientific research for designing training programs and effective content of special courses for profile technologies training of engineering and technical orientation.*

Main part. «The Problem Statement» section identifies systematic problems that need to be solved in the process of profile technologies training in the content of engineering courses.

In general, special courses are an important component of the content of the profile technologies training in high school. They reflect the specifics of a particular training profile. Special courses should provide an in-depth and expanded study of the content sections of profile subjects, may contain additional related sections that orient pupils to a complex of possible professions in the line of the chosen profile of study and so on. The authors have defined the conceptual approaches of selection of special courses for profile technologies training, features of interconnection and complementarity of profile subject and special course, strategic and tactical tasks of profile technologies training of engineering and technical orientation [13]. It has been emphasized on the peculiarities and importance of independent use (regardless of the profile subject) of special courses of engineering and technical orientation in the educational process of high school [13]; [15].

Specificity of profile technologies training of engineering and technical orientation places special requirements for designing the content of special courses. The process of designing their content should take place on a sound scientific-theoretical basis, which is the result of long, thorough research. The results of the research should be summarized and systematized with the purpose of their complex use in the process of designing the effective content of special courses of engineering and technical orientation.

Given the above, we formulate, first of all, a new approach to designing the special course content, the essence of which is that its structure and content should ensure the multipurpose use of the special course in the educational process of high school: in combination with a profile subject in schools that have chosen technological profile, and as an independent subject in schools that do not have a technological profile. In order to accomplish this task, we have developed a curriculum of the special course «Designing and construction of engineering objects», which fully meets the requirements for the content of the technological profile of teaching high school pupils. The program received the stamp of the Ministry of Education and Science of Ukraine, it is posted on the website of the Ministry of Education and Science of Ukraine (<https://mon.gov.ua/en/osvita/zagalna-serednya-osvita/navchalni-programi/navchalni-programi-kursiv-za-viborom-fakultativiv>).

We have already considered the peculiarities of using the special course in combination with the profile subject [13]. Consider the second variant of using a special course.

Profile training of technology in high school in the content of the special course of engineering and technical orientation «Design and construction of engineering objects» (as an independent subject, chosen by the school) should provide a number of important tasks. These include:

1. A thorough mastering of high school pupils by the basics of designing and constructing of engineering objects in the process of profile technology training.
2. Formation of project-technological competence of pupils. The transition to the competency model of teaching in high school necessitates the development of educational and methodological support for the profile technology training based on the competence approach. The purpose of training in the content of a special course of engineering and technical orientation should be the formation of project-technological competence of pupils, which should be considered as an integrated pupils' ability to apply the new knowledge, skills, methods of activity, experience and personal values in the future professional activity of engineering and technical orientation.
3. Formation of creative technical potential and creative personality of pupils.
4. Providing pupils with a conscious choice in their future profession of engineering and technical orientation.

In the context of solving these problems, we will consider the features of designing the textbook content for the special course of engineering and technical orientation, provided the systematic (in the complex) use of the results of scientific research in the department of technological education of the Institute of Pedagogy of the National Academy of Pedagogical Sciences of Ukraine of the following topics: «Pedagogical conditions for realization of content of technological teaching profile of high school pupils» (2009-2011), «Designing the content of profile technology training in high school» (2015-2017) (innovativeness of the theoretical researches in the process of implementation of these 2 topics and the obtained results on their basis is the development of scientific-theoretical foundations and methodology of projecting the content of profile technologies training engineering and technical topics) and the theme «Scientific and methodological support of the variant component of the content of the profile technologies training in the professional lyceum», which is currently being performed (2018-2020).

In general, the effectiveness of the manuals' content for the profile teaching of technology of high school pupils depends largely on those hypotheses, ideas, innovations, methods, approaches used in the process of its creation, application of modeling processes, etc., which is scientific and theoretical the basis for creating the content of the guide. Particularly important in this regard are expediently defined

conceptual and theoretical and methodological principles for designing the manuals' content for special courses of engineering and technical orientation.

Consider the features and the end result of the systematic use of scientific and theoretical development in the process of designing the manual's content for the special course «Design and construction of engineering objects».

Taking into account the specificity of profile technologies training of engineering and technical orientation, the authors formulated a number of innovations.

1. The primary task of the profile subject — the development of the creative personality of high school pupils (human-centered), rather than mastering technological skills (technosphere).

Creating a new technical object involves creative activity in the production of designers, designers, technologists, inventors, innovators, technicians. Likewise, the structure of a creative project development of a technical object by the pupils involves the intellectual, project-search and heuristic activities of the pupils. However, successful and effective execution of project-search actions and operations that correspond to these professions, is possible only if the sufficiently high development of such personality traits as: creative technical thinking, ingenuity, ingenuity, intuition, associative thinking, ability to find the right solution in complex or controversial technical situations, etc., which are components of the general creative potential of the specialist. Therefore, the primary task of the special course «Design and construction of engineering objects» is the formation of the creative personality of high school pupils with a sufficiently high level of development of these qualities.

2. In the manual of the special course «Design and construction of engineering objects» creative technical activity of high school pupils is considered and presented in the form of basic types of technical creativity of specialists, differentiated to the pupil level, but not in the form of traditional group (extracurricular) work.

It is known that the main types of specialists' technical creativity are: designing, designing, rationalization and invention. The special design course «Design and construction of engineering objects» in a form that is accessible to pupils of high school must present all these varieties of creativity in the field of engineering, which will ensure the design and technological competence of high school pupils.

3. Synthesis of technical characteristics of the product and its aesthetic qualities in the process of development of creative projects (integration of technical, technological and artistic-aesthetic knowledge and skills, ensuring their practical orientation).

The acquisition of technical and technological knowledge, skills and competences of high school pupils is of great importance. Prominent among them should be the in-depth knowledge of the main requirements for the industrial manufacture of products (technical perfection, aesthetics, economy) and the ability to translate them into each product effectively. This will allow:

- be well aware of high school pupils that it is necessary to realize a harmonious combination of beauty and expediency in every product (technical aesthetics and technical perfection, manufacturability, functionality);
 - to form the ability in high school pupils to realize these requirements in the process of independent development and production of products, the importance of which is confirmed by experimental studies in secondary schools.
4. Ensuring effective preparation of high school pupils for conscious choice of future professional activity in the following areas:
 - Experimental research and development activities of specialists in the process of designing new technical objects (designers, structural engineers, engineer-technologist, etc.);
 - rationalization activities of specialists;
 - the inventors' activity in the process of designing new technical objects.
 5. Project-technological system in the content of profile technological education in grades 10-11.

The implementation of design, design and technological activities in the educational process will allow to integrate all types of technical creative activity of high school pupils — from the appearance of creative design of a technical object to its realization in the form of finished products (end of innovation 5).

With the purpose of designing the modern manual's content for the special course of engineering and technical direction, a conceptual idea is formulated, which corresponds to the innovation 2 stated above: «The teaching of the Lyceum's pupils on the basics of designing and constructing of engineering objects at the profile level should be carried out according to the content of the main types of specialists' technical creativity (designing, construction, rationalization, invention), differentiated to the level of pupils.» The idea is at the heart of the content of the program and guide for the special course «Design and construction of engineering objects» became the content line of structuring its educational material.

Formulated hypothesis, which is also the basis for the development of the manual: «Profile technology training in high school will facilitate the conscious choice of pupils of the future profession of engineering and technical orientation, subject to detailed consideration in the content of the special course of a wide range of types of specialists' technical creativity (and features of their respective professions), mastering by the pupils the basics of knowledge in the production design and engineering of objects and adequate assessment of their knowledge, skills, preferences, inclinations, etc. «.

The content of the special course on technologies should be designed so that it could ensure independently the formation of project-technological competence of pupils, creative technical potential, conscious choice of their future professional activity of engineering and technical orientation. Therefore, the basis of profile training in the content of the special course «Design and construction of engineering objects» (as an

independent subject) must be a comprehensive project and close to the production training activities of pupils in the structure of modern science-intensive high-tech production: technical designing and construction, designing technological processes production equipment (at school — training workshops), manufacturing technology, presentation of the manufactured product. *To do this, the content of the special course should include the pupils' activities* on the principle of production design bureau, department of technologist, experimentally dummy shop, presentation room. This will facilitate the creation (in an appropriate amount) of training environment close to the production, in which they will take the form of a business role-playing game. The essence of such creative activity lies in the fact that each pupil chooses a certain creative role in the game: designer, constructor, technologist, head of the game. The pupils change their roles at will. According to the results of the experiment, the presence in the business game of roles, imitating the creative technical activity of professionals at the professional level, is of great importance for the pupils' profile training in the content of the special course «Designing and construction of engineering objects». The scientist V.O. Moliako has developed a training role-playing game «Design Bureau» for senior pupils which is one of the important innovative forms of organizing the educational process for pupils to learn the basics of designing and constructing of engineering objects.

The development of educational and methodological support for the profile technologies training of engineering and technical orientation should be performed in accordance with modern scientific approaches, to which we include:

- competent;
- personality-oriented;
- active;
- cultural studies;
- axiological, which will form the basis for ensuring the value orientation of pupils' knowledge of lyceum;
- system-structural and functional approaches that will ensure the systematic knowledge, their integrity and functionality.

When designing the special course content «Design and Construction of Engineering Objects», the didactic principles of succession with the primary school and the prospect with the higher school should be adhered to in the formation of subject design and technological competence of pupils and industry professional competences of junior specialists and bachelors. It should also be based on the theoretical proposition that, in the content of the course guide, the system-forming function must fulfill the principle of pupils' creative, creative, productive learning activities.

The content of the special course should provide a basis for the innovative and inventive activities of high school pupils. For this purpose it is necessary to envisage (as mentioned above) in the content the pupils' activity in the created sections like:

design and design bureau, department of technologist, experimentally model shop, presentation hall. In addition, the special course must establish a connection between individual specialized courses of technological profile and with the basics of other sciences' knowledge (physics, biology, mathematics, economics, general technical disciplines of universities, etc.), provided that the optimal combination with such didactic principles as science, accessibility, integrity and consistency will ensure the fundamental content of the pupils' profile learning in the content of such a special course.

The special course «Designing and Construction of Engineering Objects» is intended for profile technologies training, so its content should maximize the professional self-determination and self-realization of pupils, conscious choice of their future professional activity of engineering and technical orientation. To do this, the content of the manual should: to maximize the professional activity of specialists and other training material of the production plan; to reveal the peculiarities of the specialists' professional activity, related to the design and construction of new technical objects, rationalization and invention in the process of their creation; to use educational information that discloses: the tasks and responsibilities of professionals, the qualification requirements for their profession; information on the life and work of eminent designers, scientific engineers, etc.

The essence of the conceptual provisions for the direct design of the manuals' content for special courses and further profile technology training, we define the following. At the first stage of designing the idea, the concept of the future structure of the special course content is created, which is reflected in the form of created innovative models of the content structure of the training programs and manuals. The theoretical and methodological substantiation, innovative ideas, conceptual approaches, principles and criteria necessary for designing of special courses' content for profile technologies training in professional lyceum are being developed. The result of designing must be the structure of programs and manuals' content of special courses of technological profile and the criteria for its selection.

The next stage is didactic-methodical, on which the content of special courses is selected based on the results of its design.

In the context of the above, it is important to consider the role of the methodological apparatus for the special course manual of engineering and technical orientation «Design and construction of engineering objects» for the effective implementation of its content in the educational process of high school.

The methodical apparatus of the guide «Design and construction of engineering objects» is multifaceted and wide-ranging. It provides a thorough, mastery of the manual contents by the pupils, the effective use of the acquired knowledge and, accordingly, the implementation of the tasks of profile training in its content, the formation of subject design and technological competence and key competences

of pupils. The methodical apparatus includes: questions on actualization of pupils' basic knowledge, practical work, creative tasks for fixing the educational material of the topic, control questions, recommended literature to the topic, columns «Key concepts», «World of professions», «Outstanding scientists in the field of science and technology», «Dictionary of New Terms». One of the components of the quality control mechanism for pupils' knowledge in the manual is a system of test tasks throughout the course «Design and construction of engineering objects».

Conclusions. The article deals with the systematization and generalization of the results of scientific research in the department of technological education of the Institute of Pedagogy of the National Academy of Pedagogical Sciences of Ukraine (senior high school) with the purpose of systematic use of theoretical developments (conceptual and theoretical and methodological foundations, models, formulated innovations and innovative ideas and sub-ideas etc.) in the process of designing of special courses' content of engineering and technical orientation for the profile technologies training of high school pupils, the definition of methodological especially of effective implementation of special courses' content in the educational process. The obtained theoretical results formed the scientific and theoretical basis for designing of the training manual's content of the special course of engineering and technical orientation «Design and construction of engineering objects».

The importance of the special course content for the formation by the pupils of project-technological competence, creative technical potential, ensuring the conscious choice of pupils of their future professional activity of engineering and technical orientation has been substantiated.

Taking into account the didactic orientation of the contents' functions of the manual «Design and construction of engineering objects», the basic principles of its creation are formulated: development of creative abilities and formation of creative personality of high school pupils; a competent approach to the formation of technical design knowledge and skills; thorough acquaintance with the peculiarities of professions that correspond to the main types of technical creativity of specialists; integration of knowledge and skills in different disciplines of industrial direction and relevant general subjects; logic, accessibility and perspective in the presentation of the manual's educational material; development of skills and habits of independent search for knowledge and self-control on the level of personal educational achievements in technical designing; connection with daily life and production of educational material and possibility of its practical application; application of the projects' method, organizational forms in the form of business training games; use of object-development environment close to real production environment, etc.

The importance of the multifaceted and wide-ranging methodological apparatus of the special course manual has been substantiated for substantive mastering of the special course content, formation of subject project-technological competence of pupils and key competences.

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НАУКОВО-МЕТОДИЧНЕ ЗАБЕЗПЕЧЕННЯ ПРОФІЛЬНОЇ ОСВІТИ ТЕХНОЛОГІЙ В СТАРШІЙ ШКОЛІ

У статті наголошено на важливості профільного навчання технологій інженерно-технічного спрямування й розроблення відповідного навчально-методичного забезпечення у вигляді спецкурсів (курсів за вибором) з технологій. Проведено систематизацію й узагальнення результатів наукового дослідження низки тем (старша профільна школа) у відділі технологічної освіти Інституту педагогіки НАПН України з метою системного використання теоретичних розробок (концептуальних і теоретико-методологічних засад, моделей; сформульованих гіпотез, інновацій, ідей; розроблених способів, підходів тощо) у процесі проектування ефективного змісту спецкурсів для профільного навчання технологій. Отримані результати утворили науково-теоретичну основу проектування змісту навчального посібника для спецкурсу інженерно-технічного спрямування «Проектування і конструювання об'єктів техніки». Обґрунтовано важливість змісту спецкурсу для формування в учнів проектно-технологічної компетентності, творчого технічного потенціалу, забезпечення свідомого вибору учнями своєї майбутньої професійної діяльності інженерно-технічного спрямування. Висвітлено роль широкопланового методичного апарату посібника для ефективної реалізації змісту спецкурсу «Проектування і конструювання об'єктів техніки» у навчальному процесі старшої школи й виконання завдань профільного навчання технологій за його змістом.

Ключові слова: профільне навчання технологій, проектно-технологічна компетентність, спецкурси, зміст, наукова основа, теоретико-методологічні засади, інженерно-технічне спрямування, експеримент.

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НАУЧНО-МЕТОДИЧЕСКОЕ ОБЕСПЕЧЕНИЕ ПРОФИЛЬНОГО ОБУЧЕНИЯ ТЕХНОЛОГИЙ В СТАРШЕЙ ШКОЛЕ

В статье отмечена важность профильного обучения технологий инженерно-технического направления и разработки учебно-методического обеспечения в виде спецкурсов (курсов по выбору) по технологиям. Проведены систематизация и обобщение результатов выполнения ряда тем научно-исследовательской работы (старшая профильная школа) в отделе технологического образования Института педагогики АПН Украины с целью системного использования теоретических разработок (концептуальных и теоретико-методологических основ, моделей, сформулированных гипотез, инноваций и инновационных идей, способов и подходов и т. д.) в процессе проектирования содержания спецкурсов инженерно-технического направления для профильного обучения технологиям учащихся старших классов, определение методических особенностей эффективной реализации содержания спецкурсов в учебном процессе. Полученные теоретические результаты составили научно-теоретическую основу проектирования содержания учебного пособия спецкурса инженерно-технического направления «Проектирование и конструирование объектов техники». Обоснована важность содержания спецкурсов для формирования у учащихся проектно-технологической компетентности, творческого технического потенциала, обеспечения сознательного выбора учащимися своей будущей профессиональной деятельности инженерно-технического направления. Определены методические особенности эффективной реализации содержания спецкурса «Проектирование и конструирование объектов техники» в учебном процессе старшей школы. Обоснована важность многогранного и широкопланового методического аппарата пособия спецкурса для основательного овладения учащимися содержанием спецкурса «Проектирование и конструирование объектов техники», эффективного выполнения задач профильного обучения технологий по его содержанию.

Ключевые слова: профильное обучение технологий, проектно-технологическая компетентность, спецкурсы, содержание, научная основа, теоретико-методологические основы, инженерно-техническое направление, эксперимент.