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PREPARATION

OF STUDENTS FOR PEDAGOGICAL DESIGN OF PROFILE TRAINING

LA PREPARACIÓN DE ESTUDIANTES PARA EL DISEÑO PEDAGÓGICO DE ENTRENAMIENTO DE PERFILES

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ABSTRACT

The authors propose to implement a model of a system for preparing future teachers of physics, technology, and computer science to teach electronics in schools at a specialized level on the basis of competency models of a graduate supplemented by special competencies and other auxiliary models. At the undergraduate level, training is built with an emphasis on the formation of a special subject competency - the ability to study design of electronic elements and systems. At the master's level, the emphasis is shifted to the formation of a special professional competence - readiness for pedagogical design of teaching and methodological complexes of disciplines (UMKD) and sections of electronics. The authors associate the effectiveness of the formation of special competencies among students: with the variability of using forms of continuous training in electronics with a focus on extracurricular and independent work, with participation in the pedagogical design of elements of teaching materials.

Keywords: Electronics, mathematical modeling, pedagogical design, linear system, electronic device.

RESUMEN

Los autores proponen implementar un modelo de un sistema para preparar futuros maestros de física, tecnología e informática para enseñar electrónica en las escuelas a un nivel especializado sobre la base de modelos de competencia de un graduado complementado con competencias especiales y otros modelos auxiliares. A nivel de pregrado, la capacitación se desarrolla con énfasis en la formación de una competencia temática especial: la capacidad de estudiar el diseño de elementos y sistemas electrónicos. A nivel de maestría, el énfasis se desplaza a la formación de una competencia profesional especial: preparación para el diseño pedagógico de la enseñanza y complejos metodológicos de disciplinas (UMKD) y secciones de electrónica. Los autores asocian la efectividad de la formación de competencias especiales entre los estudiantes: con la variabilidad del uso de formas de capacitación continua en electrónica con un enfoque en el trabajo extracurricular e independiente, con la participación en el diseño pedagógico de elementos de materiales didácticos.

Palabras clave: electrónica, modelación matemática, diseño pedagógico, sistema lineal, dispositivo electrónico.

INTRODUCTION

The process of transition to the 3rd generation FSES of HE is associated with an increase in the efficiency of the training system for future teachers, with new challenges and requirements for the professional activity of a university teacher in the direction of organizing professionally oriented subject training based on various forms of training (Wenslavsky, Kozlov & Ponomarev, 2013).

Pedagogical project activity is subordinate to pedagogical goals and is considered as a means of achieving them. The success of pedagogical projects of teachers and researchers allows school administrations to carry out their own search and research functions, to determine competitively stable niches in the market of educational services. The interest of high school students in the learning process lies in the plane of initial vocational training, the acquisition of knowledge and practical experience in those subjects that are in demand in the future profession.

The focus of the first stage of "continuing professional education" at present can be independently determined by the school's leadership, based on the professional competence of the research teacher, who is capable of creative activity and the organization of the conditions for specialized training. The process of transition to specialized education for schoolchildren is associated with the formation of readiness of graduates of pedagogical universities to work in the new conditions, which requires a number of constructive steps in the methodological preparation of students - future teachers - technologists of the educational process. These are new approaches to the content of specialized subjects as the main source of a personality-oriented, value-based attitude to knowledge and educational activities, to the technologies of the educational process in a developed information and educational environment (IOS) (Desnenko, 2007).

The formation of the readiness of students - future teachers of physics and technology to work in the conditions of profile training for schoolchildren in the field of "Electrical Engineering / Electronics" (hereinafter - the "Electronics") includes the development of a culture of pedagogical design and educational modeling of electronic devices (EI), and is the subject of discussion (Wenslavsky, 2010).

The preparation of future teachers of physics, technology and computer science for teaching electronics in schools at a specialized level is associated with the development of special subject and professional competencies. The competency model of a graduate prepared to carry out training in electronics in a comprehensive school at a profile level, it is advisable, in our opinion, to supplement the following special (subject and professional) competencies: 1) is able to carry out educational design of electronic elements and systems; 2) I am ready to carry out pedagogical design of educational and methodological complexes of disciplines of the sections of electronics and elective courses of a profile level (Wenslavsky, et al., 2013).

METHODOLOGY

The methodological basis for creating a system for preparing future teachers of physics, technology, and computer science to teach high school students electronics in schools at the relevant level was allocated to competency-based, activity-based and synergetic approaches based on a systematic approach. We use a systematic approach in designing a methodological system for preparing students and in the design technology "from bottom to top" and "top to bottom" of elements and systems of modern electronics (Ilyin, 2018). Secondary approaches in preparing the future teacher are highlighted - historical and hermeneutical. The historical approach allows introducing emotional coloring into the educational process, presenting knowledge-intensive educational material "through the fates" of discoverers, developers of electronic elements and systems. For students to master physics, technology and computer science of special terms and high-tech concepts, educational texts of modern electronics and data interpretation, the use of a hermeneutic approach is required.

These features of students mastering the basics of electronics are solved more successfully, as experience shows, if the study of the subject begins at the junior level of study at the university and due to interdisciplinary connections with the disciplines of the humanitarian cycle.

There are a large number of obstacles (in the form of errors and errors in the educational literature) on the path of theoretical and practical knowledge of electronics, overcoming of which is useful, but it is probabilistic in achieving an understanding of the essence. It is quite difficult to overcome this barrier on your own, since the development of critical thinking for educational texts is required. A social order for training personnel who are to participate in innovative projects for the development of the economy is implemented by the transition to specialized education, designed to ensure the harmonious development of students' creative abilities, to provide primary vocational education for high school students.

The tasks of the professional activity of a technology teacher and a physics teacher in the context of specialized training in electronics are related to the implementation of the initial professional training of schoolchildren. The

pedagogical design of the initial professional training of schoolchildren in the areas requires appropriate subject and on its basis professional training of teachers of physics and technology, assessed by professional competence as achieved personal quality. The professional competence of a teacher "is based on fundamental scientific education, an emotional-value attitude to pedagogical activity, knowledge of the technology of pedagogical work and determines the teacher's willingness to creatively solve cultural and educational problems and self-realization of his personality.

Formation of the goals of the article (statement of the task). The aim of the study is to develop and test the main and auxiliary models for preparing future teachers of physics, technology and computer science for teaching electronics in a comprehensive school at a profile level. The main objectives of the study are to complement the competency models of graduates of undergraduate and graduate programs (future teachers of electronics) and, on this basis, the construction and implementation of training models. Research methods and organization: theoretical analysis and generalization, systematization; analysis of scientific literature.

RESULTS

Based on the competency-based approach to professional training of future teachers of specialized classes in the field of "Electronics", a number of problems can be identified that allow us to assess the direction of pedagogical design. These are problems in the field of communications, the content of the subject (the presence of errors and errors in modeling elements and systems), the development of continuity, vertical and horizontal integration of physical and technological education, technology and technical knowledge. From the position of a competency-based approach, the goal of preparing students of pedagogical universities - future teachers of physics and technology for professional activities in the field of initial vocational training of high school students in the field of "Electronics" is to achieve graduates of the university with a qualification level of subject and professional pedagogical competence (PPC).

Subject competence should be considered as the main component of the professional competence of the teacher. The model of the methodological system for the formation of students - future teachers- of physics and technology of SPTAC in the field of electronics is structured from interconnected blocks focused on the development of competencies as components of professional competence: targeted, motivational, informative, active, reflective.

The motivation block of the model of the methodological system for the formation of the motivational-value component of the future teacher's educational program is based on the guarantee of the customer in the person of the state, which ensures the social status and prestige of the profession of technology teacher and physics teacher, the prestige of physical and technical education. The motivation of students to master electronics is related to understanding the significance of the acquired experience in pedagogical design of initial vocational training, the importance of technical, technological and psychological-pedagogical knowledge and competencies of the future technology teacher and physics teacher.

The methodological component of the model of the methodological system for the formation of the PPPK teacher of physics and technology predicts the development of general cultural competencies (OK), general educational competencies (DIC) and professional competencies (PC). The methodological unit focuses on the development of the theory and methods of teaching electronics as a general technical discipline, on the integration of approaches and pedagogical technologies, on the use of research technologies for educational design of circuits and pedagogical design of a profile in the direction.

The substantive block of the model of the methodological system is designed to contribute to the formation of the substantive component of subject competence in the field of electronics and is based on the integration of physical and technological education, on the assessment of vertical links of initial professional training in the field of "Electronics".

Currently, the addition and deepening of the content of the main subject (the names of the subjects differ in different profiles) can be carried out by focusing on the implementation of local and cross-cutting projects and research. Complementary and matching elective modules can be proposed based on a comparison of the normative model of the student with the actual measured subject model of the student (Atanov, 2001) based on the analysis of input and current control.

Based on the analysis of the subject model of the student, it is possible to identify failures in mastering specialized discipline and proceed to assess the level of educational material: highlight problem modules, establish structure and integrity, use the opportunity to expand and (or) deepen knowledge, skills and competencies through the introduction of elective courses.

The technological block of the model of the methodological system is integrated in the content block and contributes to the development of the activity and research

component of the SPT based on the application of traditional and new teaching methods and forms. The main engineering and pedagogical methods that are used in the formation of the SPT for teachers of physics and technology are related to the technologies of educational design: information modeling of elements and systems, research and design, explanatory and illustrative and to a lesser extent reproductive.

Specific pedagogical methods include: the method of modeling errors, the method of critical analysis of study texts on a given topic, the method of modeling a study text (training module) and the study of a thesaurus on a given topic, the method of developing control questions and technical tasks, ICT methods using electronic CAD systems.

In the procedural component of the fundamental foundations of electronics, understanding and the ability of students to technologically apply the following methods is of great importance: the equivalent circuit method, the Kirchhoff method for constructing a mathematical model of a circuit in analytical form, the overturned characteristic method for constructing a mathematical model of a circuit in graphical form, the equivalent generator method, methods dual transitions from the "circuit" to the "nodal pair", the method of simulation of the mode, experimental methods of the laboratory layout Scheme setup and adjustment. The main forms of training: lectures, laboratory work, independent work, training conferences and colloquiums, research work (scientific seminars, participation in research projects, preparation of reports and publications, participation in scientific conferences). The main means of integration and the subject of teaching students of pedagogical universities, we consider an end-to-end educational project on the development of the teaching materials of the discipline and its individual components for setting up the educational environment:

- Copyright models of the educational process based on "exemplary";
- educational texts, tasks and articles of explanatory dictionaries;
- copyrighted educational software;
- copyright technical equipment for educational purposes, including demonstration modules and laboratory stands.

The communicative component of PPPK is determined by the thesaurus of modern electronics. In this area, work continues on the development and critical discussion of articles presented in explanatory dictionaries in physics, engineering, and technology. The urgent task, in our opinion, remains the release of an explanatory dictionary of a schoolchild and student of a pedagogical university in electronics.

The control and correction unit of the methodological system for the formation of the PPPK is aimed at the development of the reflective component and is intended to master the technology of building the learner's model — diagnosing the level and changes that occur in the process of teaching students - future technology and physics teachers the basics of electronics. Control methods provide feedback, which allows you to enter the correction of the learning process, exercise self-control, strengthen the modules to increase efficiency and approximation to the normative model.

During the entrance testing of physics students and technologists on the modeling of elements and simplest circuits, a number of minima and gaps are associated with the lack of initial training in electronics: low level of knowledge and lack of experience in applying the methodological foundations of the theory of knowledge (understanding of the system approach, technology of educational design and modeling); low level of knowledge and skills to apply the rules of signs; a gap in the representation of the variability and dualism of resistive element models, including sources; erroneous idea of mathematical modeling of sources and simplest circuits of the source-receiver type; misconception about Ohm's law for the complete chain.

Introduction to electronics is beyond the reach of the basic level of the school curriculum (as in the past) and, as a rule, is not fully studied at a pedagogical university. In modern pedagogical studies of the integration of physical and technological education, it has been shown that *"it is possible to build an integrative educational process that focuses on the holistic development of the content of education and the formation of the readiness of future teachers for integrative pedagogical activities at school"*. (Babin, 2003).

These conclusions allow us to focus on the integrative training of future teachers of physics and technology in the formation of subject competence in the field of "Electronics". The development of continuity of school and university education is currently being decided by the transition to specialized education (Filatova, 2005).

Preparation of students - future teachers- for the organization of initial professional training for schoolchildren in the field of "Electronics" can be carried out due to the variable part of the program - the elective matching course "Introduction to Electronics" as an introduction to the main course "Electronics". A similar model of training in electronics in a pedagogical university at the present stage

is necessary, from our point of view, for several reasons such as:

- Allows you to compensate for the lack of initial professional training of students in the field of "Electronics";
- allows you to compensate for the lack of a course "Fundamentals of Circuit Theory" (and a full-fledged course "Electrical Engineering") at a teacher training university;
- allows you to eliminate gaps and errors, bring it closer to understanding and using theory in practice;
- allows you to activate horizontal inter subject communications through discussion and practical application of elements of the theory of knowledge (a systematic approach, design, modeling as the main design procedure, including design procedures - analysis, synthesis and optimization);
- allows you to master the fundamental principles of designing and modeling the simplest circuits and bias circuits in devices;
- allows you to activate the motivation to engage in technical creativity at an early stage of undergraduate studies;
- allows you to gain experience in participating in the development of the educational information environment for initial training in the field of "Electronics", which will be useful in the development of pedagogical design.

At the "introduction" level, it becomes possible to study the fundamental principles of electronics in more detail and clearly, to carry out educational research in detail, from which the understanding is formed, leading to the motivation for independent study and the acquisition of practical experience. Within the elective framework, it is possible to eliminate gaps and misconceptions regarding: source modeling, circuit simulation, dual circuit simulation, design and simulation of electronic devices.

For a future teacher, it is important to understand that modeling involves the stage of formalizing a task, the creative process of selecting or creating a variant of a model, its simplification or complication. For simplicity and visualization of training, it is most convenient to use linear mathematical models or choose conditions when linear approximations are appropriate.

In a specialized school, the model range for dual linear resistive elements should, in our opinion, be called: R- or G-element (receiver), r- or g-element (source), E-element ($r = 0$) or I-element ($r = \infty$). When applying ideal models, the principle of unity of the abstract and the real should be strictly observed, which often leads to errors when the model is presented as a CVC or the components of the system are overlooked: the authors write the analytical equations without the system, the source model graph in the first quadrant is shown without load models.

CONCLUSIONS

For profile education of schoolchildren in electronics, for purposes of clarity, it is advisable, in our opinion, to use the receipt of mathematical models of circuit systems in graphical form. The approximate structural-logical model of the elective course "Introduction to Electronics" is built taking into account the formation of the SPT and is the basis for setting the design task for students to develop the teaching materials for primary training of students in the direction of "Electronics". The search for visual and accessible for the profile level methodological solutions for teaching schoolchildren to model the simplest source-receiver circuits resulted in the use of the overturned characteristic method for constructing a linear mathematical model of a holistic system. To use the overturn characteristic method for the educational design of linear models was, in our opinion, the implementation of the TRIZ hanging idea in the teaching of electronics. Application of the method makes it possible to construct a mathematical model of the circuit in graphical form, clearly demonstrate the modeling of the regime, and show the invariance of the graphic and analytical models (Wenslavsky, 2009).

At the magistracy stage, the center of gravity of the future teacher of technology and the physics teacher is shifting to the field of mastering pedagogical design, modeling the structure and content of initial vocational training for high school students for the implementation of the Electronics field. A significant place in the structure of training at this stage, as we believe, should be occupied by the design developments of the author's teaching materials of specialized and elective subjects, which can be further used in the school, developing the project together with students of the profile class. The composition of sample models of the CMD should include original simulation programs and hardware developed in the process of educational design. On the basis of approximate models of teaching materials (or their variants), students should be invited to conduct a training examination and find their own design solutions with subsequent protection and implementation. It is advisable to carry out educational pedagogical design of the models of the CMD on the basis of the training manual "Electrical Engineering, taking into account the historical experience of industrial training in electrical engineering at the beginning sixties (Anvelt, Pukhlyakov & Ushakov, 1963).

Thus, the models proposed in the work of preparing a future teacher for teaching electronics in a comprehensive

school at a profile level make it possible to ensure the formation of special competencies and set the vector of self-guided pedagogical activity.

BIBLIOGRAPHIC REFERENCES

Anvelt, M. Y., Pukhlyakov, Y. K., & Ushakov, M. A. (1963). Electrical Engineering: Textbook. allowance for students of urban secondary schools with production.

Atanov, G. A. (2001). Simulation of the educational subject area, or subject model of the learner. Educational Technology and Society, 4 (1).

Babin, S. N. (2003). Preparing future teachers of physics and technology for the integration of technological and physical education of students.

Desnenko, S. I. (2007). The concept of vocational and methodological training of pedagogical students to solve the problem of developing the personality of students in teaching physics at school.

Filatova, L. O. (2005). The development of continuity of school and university education in the context of the introduction of specialized education in senior secondary school. Laboratory of basic knowledge, 148.

Ilyin, A. (2018). The system of professional training of future teachers: Functional Approach. ***Revista San Gregorio***, (23), 32-39.

Wenslavsky, V. B. (2009). Training modeling and design of electronic devices. Science and school, (3).

Wenslavsky, V. B. (2010). Pedagogical design of initial vocational training in electronics. Humanitarian vector. Series: Pedagogy, Psychology, 1.

Wenslavsky, V. B., Kozlov, M. A., & Ponomarev, A. V. (2013). The pedagogical design and implementation of teacher training for teaching electronics at school at a profile level. Scientific notes of the Transbaikal State University. Series: Vocational education, theory and teaching methods, 6 (53).