MODERN APPROACHES IN TEACHING INFORMATICS

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Abstract

Informatics as a science has a wide range of applications: from information theory to the methods of computational and applied mathematics and their application to fundamental and applied research in various fields of knowledge (programming, multimedia, network technologies, development of computer systems and software, social informatics, artificial intelligence and etc.). Each of these areas has its own complexities, its approach to studying, taking into account the intellectual and psychological characteristics of the trainees. Therefore, there is a necessity to monitor, systemize and automate the identification of individual abilities, capabilities and desires of future computer science teachers and to build an individual learning path according to the results obtained, thereby helping students to make an informed choice of in-depth study of their own subject.

The article describes modern approaches to training future computer science teachers, based on two pedagogical approaches: interdisciplinary integration and internal differentiation, using modern information technologies. The introduction of this methodology into the training of future computer science teachers positively affects not only the improvement of the quality of teaching, but also the research work of students.

Keywords:Methods of teaching computer science, individual training, individual learningpath, interdisciplinary integration, differentiation, information technology, automation of teaching.

1. INTRODUCTION

At present, the traditional education system does not fully provide the necessary conditions for the development of a person, his abilities, self-determination and self-improvement, etc., both professional and personal. The search for new ways and conditions that determine the success of development, self-determination and self-improvement of trainees is an important pedagogical task. The desire to implement the person-centered model of training to the full extent actualized the problem of organizing individual training in order to improve the quality of education.

The individual trainingis viewed as the organization of the learning activity of the trainees, suggesting the construction of their individual learningpath on the basis of the individual model of the trainee in accordance with personal psychological and pedagogical characteristics(Nikitin P.V., 2014).

The main objectives of individual training are: the preservation and further development of the trainee's individuality, his potential capabilities (abilities); assistance in the implementation of learning programs for each trainee by the means of individualization, prevention of the poor progress of trainees; the formation of general educational skills and competencies relying on the zone of proximal development of each trainee; improvement of educational motivation and development of cognitive interests; the formation of personal qualities: independence, diligence, creativity, etc.

The following principles should be taken into account when organizing individual training: integration of individual work with other forms of learning activity; teaching students at an individual pace, style; the use of individual learning in all subjects studied, etc.

Thus, the main advantages of individual training are: adaptation of the content, methods and tempo of the learning activity of trainees to their characteristics; tracking every action of trainees, of their progress from ignorance to knowledge; the introduction of the necessary correction in the activities of the trainee and the teacher, etc. All this allows the trainee to work economically, constantly monitor the input of his forces, to work at an optimal time for himself, which, naturally, allows achieving high results in training.

2. METHODOLOGICAL PECULIARITIES OF ORGANIZATION OF INDIVIDUAL TRAINING

When preparing future computer science teachers, it is necessary to pay attention to: first, the subject training, which includes a set of educational disciplines (more than 12 disciplines) aimed at forming ideas about the basics of computer science as a complex scientific discipline and basic skills in the application and creation of modern information technologies on the basis of computingtechniques in the future professional activity. Secondly, we must not forget the other two main areas in the preparation of future teachers: it is psychological - pedagogical and methodological ones. These areas(psychological-pedagogical, methodological and subject-matter) must necessarily be interrelated, their unity and integrity are necessary conditions for the professional pedagogical orientation of the education and upbringing of students.

At the moment, the basic concepts have been developed that provide training for educators in the field of informatics and information technology. However, the works are mainly devoted to the substantiation of the content and methodology of training of the computer science teacher in a particular area (programming, networking technologies, teaching methods, etc.). The disciplines of the subject area are largely considered in isolation, without interconnection and revealing their integrative significance for future professional activity. In addition, it should be noted that the content of most disciplines of the subject block is designed for "an average student", without taking into account the student's personal potential.

Proceeding from the above, we can state the presence of the following contradictions:

- Between the varieties of disciplines that provide subject training for future computer science teachers, on the one hand and the lack of mechanisms for interdisciplinary integration in subject training, on the other hand;

- Between the personal potential of the student (the total number of his abilities: intellectual, cognitive, creative, communicative, etc.) on the one hand, and the lack of scientific approaches to identifying the contribution of this potential to a particular area of informatics (programming, multimedia, network technologies, informatization of education, teaching methods, etc.) on the other hand.

These contradictions can be eliminated by using an individual learningpath in the training of future computer science teachers. Individual learning path is a result of realization of the student's personal potential in education through the implementation of relevant activities.

The development of this path will be implemented on the basis of two pedagogical approaches: internal differentiation and interdisciplinary integration in the professional training of future computer science teachers using modern information technologies.

Issues of interdisciplinary learning (interdisciplinary integration) have been studied by many scientists. Analyzing the works of these authors, such a conclusion can be made that the role of interdisciplinary integration is confirmed by the general didactic principle of interdisciplinary connections, which implies a coordinated study of the scholarly apparatus (concepts, laws, methods, etc.) common to related disciplines. For the organization of interdisciplinary integration in higher education, the following general didactic and psychological-pedagogical conditions are singled out:

- Coordinated study of individual academic subjects, in which each of the subjects uses the scholarly

apparatus of another discipline and prepares students for the successful learning of the concepts of the following (in time) subject;

- Continuity and succession in the development of the scholarly apparatus;

- Obligatory unity in the interpretation of the scholarly apparatus for "general" subjects;

- Elimination of duplication of concepts, laws, theories, etc. when studying different subjects;

- A unified approach to the content of identical classes of concepts, laws, theories, etc.

With the transition of higher pedagogical education to a two-level system of education (bachelor, master), the professional training of future computer science teachers is carried out on the basis of the state standard "Pedagogical Education" (standard), which provides the study of the following training cycles: humanitarian, social and economic, mathematical and natural sciences, professional and sections: physical culture, training and work practices, final state attestation.

Each training cycle has a basic (compulsory) part and a variative (profile) part which are established by the university. The variative (profile) part enables the expansion and / or deepening of knowledge, skills, and competences determined by the content of basic (compulsory) disciplines (modules) and allows students to gain in-depth knowledge and skills for successful professional activity and (or) continuing professional education in the magistracy. And each of the cycles contains the elective disciplines and the professional cycle also includes additional courses.

Thus, the standard allows to implement interdisciplinary integration of subject-based training of students, and thereby tobuild individual learning paths.

One of the examples of interdisciplinary integration in the training of future computer science teachers can be interdisciplinary integration in the field of information technology (IT). The purpose of this training will be the formation of competence in the field of information technology, which is viewed as the students' ability to apply subject knowledge, skills in the field of information technologies and personal qualities for successful activity as a computer science teacher capable of creating and using modern IT tools both in computer science lessons and in extra-curricular activities.

This learning path will include six disciplines: three disciplines from the basic part and variative part of the standard ("Computer networks, Internet and multimedia technologies", "Use of ICT in education", "Information systems") and three disciplines from a block of elective disciplines ("Computer graphics and publishing", "Modern programming languages", "Databases and management").

The second necessary approach in constructing an individual learning path is internal differentiation.

Differential training is the organization of the educational process, which takes into account the individual psychological features of an individual, groups of students are formedaccording to different educational content and methods of training (Nikitin P.V., 2017).

The key element in the organization of differentiated education is the diagnosis of individual characteristics of students, such as: memory, modality, hemispheric dominance, organizational, communicative, information, intellectual skills, the level of development of the motivational-volitional sphere, etc.

As a result of the diagnostic tests, we get a very large array of results that allow the teacher to implement the level differentiation in a particular discipline, namely, to allocate material for the general level, material for in-depth training, material for more in-depth training.

In our study, we propose to distinguish three groups: creative, productive and reproductive.

For a reproductive group, the following principles are typical: the awakening of interest in the subject through the use of reasonable tasks, educational software tools that enable the student to work in accordance with his individual abilities; the elimination of gaps in knowledge and skills; formation of skills to carry out independent activity according to the model.

For a productive group - maintenance of educational motivation of trainees (through success of students in tasks of average complexity); development of sustainable interest in the subject; consolidation and revision of existing knowledge and methods of action; actualization of existing knowledge for successful study of new material; the formation of the ability to work independently on a task or with a training software.

For a creative group: maintenance of educational motivation of students; development of a sustainable interest in the subject; the formation of new methods of action, the ability to solve tasks of advanced

complexity, non-standard tasks, and creative tasks.

It should be noted that according to the principle of differentiation of education it is necessary to search and select educational material in a creative way and to individualize the part of the learning process aimed at the formation of students' academic skills and in this or that area of informatics.

Thus, through interdisciplinary integration and internal differentiation, an individual learning path for future computer science teachers is being built.

We will implement the technology of building an individual learning path for future computer science teachers using modern information technologies.

3. AUTOMATED ENVIRONMENT FOR BUILDING INDIVIDUAL LEARNING PATHS OF STUDENTS

So we developed an automated environment for constructing individual learning paths of students' education (system), which allows organizing interdisciplinary integration and internal differentiation of training, with the involvement of teachers of different disciplines.

The system allows automating the processes of the material submission (lectures, laboratory works, testing questions, and questionnaires), monitoring the results of learning activities, training, testing, questioning, generating tasks depending on the intellectual level of the particular student, the level of his knowledge, skills, motivation features.

Students can determine themselves the level of their preparation and evaluate the resultsregularly, obtain quickly the necessary theoretical information, practical examples and explanations in accordance with the subject area they study, as well as eliminate gaps in the study of certain sections and consolidate the acquired knowledge. The system expands the educational environment, creates an educational interdisciplinary laboratory in which the student, applying knowledge repeatedly for each discipline in new conditions, outside the discipline itself, develops the ability to apply knowledge in professional activities.

The technical implementation of the system is aimed at:

1. Collection and storage of necessary information in various forms of its presentation, its updating.

2. Giving the information to users.

3. Authorization of access to information by users and implementation of a multi-level information security system.

4. Administration of the system.

5. Effective and rapid creation of information resources by users.

One user can have access to various data, and several users can extract the same data. Therefore, the database contains several tables that are linked together. The teacher has access only to "his" registered students and he has the right to manage the data of his students.

The main modules of the system are:

• The computer system for supporting the interdisciplinary methodical system of training future computer science teachers allows an authorized teacher to create a standard educational and methodical complex using editors of the hypertext data model (Nikitin P.V., Fominyh I.A., Gorokhova R.I., 2015).

• Testing - the module is responsible for creating, editing and deleting tests, setting basic parameters, such as: the number of questions to be issued, sorting, level of complexity, types of tests (with open or closed response forms).

• Questioning - a module that allows conducting questioning of both students themselves and computer science teachers during pedagogical practice.

• Internet simulator is a test shell, based on the original methodology for assessing the knowledge and skills of learners and purposeful training of students in the process of repeatedly re-solving test tasks.

• Results of testing and questioning - this module displays data about the test results, exports them to the XLS format, or passes it to the "Presentation of results" module for plotting diagrams.

• Discipline,students, teachers, sections, chapters, etc.management units.

This system also includes an artificial intelligence platform. The application of this platform will allow teachers to build a system that is able not only to perform a once programmed sequence of actions on predetermined data, but also to analyze newly incoming information, to find consistent patterns in it, to make predictions, that is, to create neural networks - self-learning systems that imitate human brain activity. Thus, the teacher constructs a neural network with a given structure, determines its parameters and trains with one of the available learning algorithms in the system. As a result, he gets the neural network emulator, which helps him to organize level differentiation in a certain discipline and thereby helps the student to find his "own" learning path.

The neural network trained in this way can be used to generate control actions. This can be done by applying the "what-if" analysis. To enable it, you need to select the "what-if" visualizer. For example, designing an individual learning path for computer science, taking into account the individual characteristics of students (Nikitin P.V.,Fominykh I.A., Mel'nikova A.I., 2015).

4. RESULTS

The developed methodology was introduced into the training of future computer science teachers. The results of the experiment prove the positive effect of the developed methodology not only on the quality of training of future computer science teachers, but also on the research work of students.

Thus, the developed method of individual learning, based on the construction of an individual learning path of future computer science teachers which is realized through interdisciplinary integration and internal differentiation taking into account the student's personal potential and application developed by the information system:

1) Allows implementing a person centered approach to training of each student in the field of computer science, to monitor the process of his development, and to monitor the dynamics of this process;

2) Represents a complete, holistic system for monitoring the quality of training of future computer science teachers, allowing to evaluate not only the work of the teacher and the student, but also purposefully plan it;

3) Provides the opportunity to create a flexible, multi-level and branched structure of management of educational, cognitive and research activities of students in the process of training at the university.

The reported study was partially supported by RFBR, research project no.25.1095.2017/4.6.

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