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Pedagogical Design of E-courses as a Means of Motivating Students to Cognitive Activity

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***Abstract*—At present, especially in the light of ongoing pandemic, the problem of using remote forms of activity has become noticeably actual. This article presents experience of developing guidelines for the pedagogical design of electronic courses based on the Moodle distance learning system. Methodological recommendations on the pedagogical design of electronic courses are aimed at providing the necessary meaningful information, forming a certain sequence of presentation and introduction of modern digital ways to convey educational content. The main task of the research is to develop methods of distance learning by introducing modern information technologies. John Keller's motivation model formed the basis for the concept of distance learning methodology. The purpose of the study is to develop rational and effective guidelines for the pedagogical design of distance courses based on the Moodle educational environment. The eigenvalues and accumulated variances of the experimental data formed the basis for the factor analysis procedure.**

Keywords—distance learning system, e-course, distance educational technologies, e-learning, pedagogical design

I. INTRODUCTION

Modern society is characterized by the informatization of education. It is defined as a purposeful and organized process of providing the education sector with the theory, methodology and practice of creating and using scientific, pedagogical, educational and methodological developments focused on the organization of educational process which employ information and communication technologies [1]. The development of education informatization involves active use of distance educational technologies, which are understood as educational technologies, implemented mainly with the application of information and telecommunication networks with indirect (at a distance) interaction between students and teachers (paragraph 1, article 16, Federal Law "On education in the Russian Federation "dated December 29, 2012 No. 273-FZ). In this regard, it is becoming relevant to use distance learning systems, on the basis of which controlled independent work of students is carried out in the remote access mode.

Distance learning systems (WebTutor, Moodle, Associate Professor, Prometheus, etc.) as educational ones include various components that provide conditions for organizing and managing the educational process using distance educational technologies, and also allow training and knowledge testing in corporate networks and the Internet. At a university the key figure that directly affects the efficiency and quality of education based on distance learning technologies is a distance learning teacher. University teachers who develop their own electronic educational resources and at the same time accompany the organization and supervision of distance learning should not only be well versed in the subject of their teaching, but also have the necessary knowledge and skills to carry out educational activities of information interaction in conditions of distributed access based on the distance learning system [2]. Professional qualities of modern teachers depend on their readiness and ability to independently master, use information and communication technologies in professional activities to solve a range of educational problems, integrate them with professional experience in order to increase the efficiency of educational process [3].

Most authors [4], [5], [6], [7] emphasize that when conducting distance learning, the main means based on the

distance learning system, are electronic educational resources. Modern studies [8], [9], [10] also admit, that there is a lack of well-developed electronic resources for educational processes based on distance learning technologies. Teachers do not use the full range of didactic capabilities of ICT: immediate feedback between the user and the electronic educational resource; computer visualization of educational information; archival storage, transmission and processing of information; automation of information activities and processing of learning outcomes; automation of the processes of educational activities organizational management and control of the mastering educational material results [11].

The effectiveness of the creation and use of electronic courses in solving professional problems of a teacher depends on his/her competence in this field. A decisive role is played by the ability of a university teacher to apply knowledge in the field of pedagogical design of electronic courses based on a distance learning system [12].

II. Materials and Methods

The methodological basis of this study is the theory and practice of e-learning. The practice of organizing and functioning of informational communication systems of leading universities shows that when planning and conducting educational processes in a distributed access environment, there are used technological platforms, which are usually represented by learning management systems (LMS)1 and/or learning content management systems (LCMS)2 [13].

In modern conditions of a university, LMS/LCMS are key links in the implementation of distance learning network technology. Foreign and domestic authors call them differently. In foreign sources [14], [15] these systems are called e-learning (short for electronic learning). In the Russian scientific literature [16], [4]; [17] there are such options as an automated training system, an educational process control system, an environment for developing network courses, a distance learning system, etc.

Modern distance learning systems fall into two broad categories: closed source (commercial) and open source (free) ones. As a rule, closed-source systems are commercial developments focused on teaching using distance technologies, or for organizing e-learning within an educational institution. Each of the presented systems is focused on e-learning.

III. Results and Discussions

In modern conditions of informatization of education, specialists who implement educational programs through e-learning should not only be organizers of educational processes, but also be able to arrange the content of training sessions, to control the educational activities of students, taking into account individual approaches to them, to use modern methods and forms of education with the involvement of electronic educational resource [18]. Training using imitation of a professional process is one of the ways that have such advantages as: minimizing risks, reducing costs in relation to time, financial and human resources; and most importantly, the opportunity to speed up the process of gaining professional experience [19].

In the process of studying the role of a teacher in the use of e-learning in an educational process at a university, O.E. Egadzai found that his/her "functions are expanded and updated" [20]. A university teacher, who is at the same time the author-compiler of the content of educational and methodological materials in electronic form, developer of the technical component of his/her own course and the organizer-coordinator of the educational process carried out in a distributed access environment based on a distance learning system, constantly improves the taught courses, increases creativity and his/her qualifications in accordance with the requirements of the standard.

Pedagogical design of e-courses is a fairly new concept in the modern education system. It has entered our practice along with the use of e-learning, organizing an educational process with an "open architecture" and creating a real learning environment. The founder of pedagogical design in Russia A. Yu. Uvarov prefers to view pedagogical design “as a systematic use of knowledge (principles) about effective educational work (teaching and learning) in the course of designing, development, evaluation and application of teaching materials” [21].

The technology of pedagogical design is determined primarily by the needs of students and the goals of learning, and secondly, by the possibility of the fastest possible transfer of knowledge and information on a certain discipline in a fairly short period of time. Methodological recommendations on the pedagogical design of electronic courses are primarily aimed at providing the course with necessary meaningful information, forming a sequence of presentation and introducing modern digital methods to represent educational content.

When designing an e-course, it is important to take into account the needs of the target audience, its competencies and expected learning outcomes, for which the following actions are necessary:

- determination of the goal and objectives of the educational material;
- analysis and structuring of materials in accordance with learning objectives;
- choice of means and methods of educational work;
- creation of elements, style and visual design of the course;
- development of tests and tasks, means of control and collection of information on the discipline;
- creation of an e-course using appropriate tools;

[1] A platform for deploying distance learning, in some cases, can also be used to administer the traditional educational process.
[2] A platform designed to solve curriculum content management tasks and aimed at content developers, course layout specialists and training project managers.

- loading the course into the learning management system;
- development of methods for assessing the results and effectiveness of training materials;
- decision making for further improvement of educational content.

The main task of a pedagogical design is a high-quality and systematic development of the course, i.e. the most complete transfer of information in an accessible and understandable form for the application of the acquired knowledge by students in practice. To that end, an educational design is based on 8 principles of the American psychologist Robert Mills Gagne [22], one of its founders and an author of books on learning theory:

1. Attracting the attention of students, motivation for learning, awakening interest in the topic and the chosen methods.

2. Explanation of the purpose and objectives of training. Here is formed the level of expectations from the training course and motivation.

3. Presentation of new material. Development of materials that help maintain interest and focus on the most important points in the learning process.

4. Accompanying training. Learning guidance that allows students to retain what they have learned.

5. Consolidation of the knowledge in practice.

6. Feedback to assess the level of training effectiveness.

7. Assessment of progress and general assessment of the effectiveness of the training course.

8. Transformation into a practical plane, helping students to retain knowledge and apply it correctly. In contrast to the fifth principle, it is important here to transfer practical skills in accordance with new conditions not specified by the original framework of the course. This will allow to assess the depth of the knowledge assimilation.

In accordance with these directions, the following research steps were identified: development of methods for assessing courses; analysis of the students' assessment of the courses taken by them; analysis of the students' needs and motives; development of guidelines for university teachers on the pedagogical design of separate elements of the Moodle learning environment; search for ways to improve the developed courses; creation of style, design for each element of the distance course.

In many respects, the process of designing e-learning materials is similar to disciplines such as programming, logistics, design, and applied psychology. After analyzing popular pedagogical design models, we settled on a model with classical design stages called the ADDIE model. The abbreviation consists of the concepts: Analysis – Design – Development – Implementation – Evaluation [23].

1. Analysis. Within this stage, there are identified key elements, are studied the needs of students and the task of the teacher, are formulated the goal and objectives of training, is assessed the target audience and the forms of working with it, and is drawn up a list of expected results laid down by the standard of competencies.

2. Design. This stage is characterized by its vastness and unpredictability. Here it is necessary to take into account all the conclusions of the analysis stage and develop a general plan and structure of the material, draw up a scheme of exercises and assessments, visual series, interface and general design. When creating a script for the entire project, this stage can be divided into several steps:

a) Choice of teaching aids, specification of educational tasks and refinement of the tools, as well as identification of the necessary knowledge, skills and abilities to complete all the objectives of the course.

b) Creation of a script for future training materials, design and approval of the appearance of typical screens, development of working layouts of fragments of the presentation of training material and their expert assessment.

c) Preparation of a trial version of training materials, selection or creation of illustrations, animation effects and interactive elements, audio or video.

d) Assessment and revision of materials, taking into account the presented objectives of the course.

e) Maintenance and elaboration of training materials. Creating a new version of the course.

3. Development. At this stage, all created materials occupy their place in the general structure, there are developed forms of feedback and verification of mastering the material (tasks and methods of control), there is determined the interface and transitions between the individual components of the course.

4. Implementation. During this stage, the training course is loaded into the distance learning system, on the basis of which students are provided with access to the materials.

5. Assessment. At this stage there are evaluated the e-course teaching materials, the achievement of the set learning goal, the feasibility of the specified types of tasks and their compliance with the general task.

When considering the advanced capabilities of Moodle, it can be noted that this programming environment allows to create both separate e-courses and independent educational portals. Below we'll introduce practical experience results of using the instrumental capabilities of the distance learning system at the Federal State Budgetary Educational Institution of Higher Education (FSBEI of HE) "Naberezhnye Chelny State Pedagogical University".

In the first term of the 2019-2020 academic year at the Faculty of Mathematics and Informatics of Naberezhnye Chelny State Pedagogical University by the faculty's teachers there were developed electronic courses based on the Moodle distance learning system. They were used to organize independent work of students in all the disciplines.

At the final stage of each of the conducted courses, there was organized a survey of students on the basis of a distance

learning system. In the course of the survey, students were asked 10 questions with a request to assess the quality and satisfaction with the course within a framework of a 10-point scale:

1. The level of your motivation to study the course materials.

2. The level of your interest in theoretical materials.

3. The quality of the controlling materials.

4. The level of feedback.

5. The level of importance for you of the approval from the course curator.

6. The frequency of return to course materials.

7. The level of interest in the success of the fellow students of the same year.

8. A variety of ways and techniques to keep your interest in the course.

9. Your interest in the intermediate and final results.

10. The compliance with modern methods of material presentation.

One of the indicators that caused concern during the analysis of the survey results for all the completed courses was the low level of motivation noted by the students. The low scores given by trainees on 1, 2, and 8 indicators motivated the development team to turn to John Keller's motivation model. Motivation in the course of learning has become one of the levers of the developed courses change management. Keller's model includes 4 stages: attention, relevance, confidence and satisfaction [24].

The peculiarity of the Keller's model is that the first stage should be observed throughout the entire course of training. Attracting the student's attention to the course takes place under the influence of the teacher at the stage of "attaching" the entire group to that e-course in the Moodle learning environment. However, in the course of training, as the results of our work showed, the developers-teachers of the faculty failed to maintain the attention of users.

The second stage of the Keller's model is relevance. This indicator of the importance of this process itself and its learning outcome for students themselves was also not taken into account and was not designated as paramount for course developers. Undoubtedly, relevance is a force that pushes a student to independently strive to learn new things, even in spite of emerging obstacles, including psychological ones [12]. In this regard, in the process of developing an electronic course it is necessary to provide an opportunity for students to see the connection between the course and a student's expectations, the practical value of it for him/her personally.

The third stage in the motivation model is confidence. Confidence is a belief of a student that he/she has sufficient abilities to independently master new things. The content of the course should be designed taking into account the capabilities of the trainees.

As the modules progress, at the end of the course the role of satisfaction should increase. By the end of the course, trainees feel tired, have doubts about the applicability of new knowledge and positive results of final tests, etc. To overcome the decline in satisfaction with their results, it is necessary to increase the practical relevance of educational materials and tasks of the electronic course. It is essential to include into the assessment process positive motivators in the form of bonuses, rewards, praise, etc. John Keller's motivation model formed the basis of guidelines for teachers.

A distance learning course is an open didactic system based on the author's concept of studying a specific discipline. The structure and content of a lecture is a feature of the teaching methodology of a particular teacher. Presentation of educational information in the form of a "lecture" requires special efforts: it is necessary to process all the available theoretical material on the particular topic in order to obtain structured material. It is also necessary to think over in advance the sequence of text presentation. The largest list of supported multimedia file formats is provided by the PDF format [25].

A survey of students showed that long lectures (more than 5 pages), where several questions are considered, the answers to which are scattered throughout the text and the core of information is not clearly highlighted, cause a negative attitude towards the studied section, formal review of the material and the desire to answer control questions from the students' own experience. More popular are short videos (5-10 minutes) and presentations (up to 7-8 slides), in which the material is clearly structured and the main ideas are explicitly indicated.

The main negative aspect of video materials is their large size. It is not recommended to place video materials on the main page of the course and the main pages of lectures. One should try to place them on additional pages whenever possible. In this case, the transition to them by reference can be provided at the request of a student. When creating a link, it is advisable to indicate the page size, which will allow students to understand the time costs. It is advisable to arrange video materials in the form of resources (files), rather than insert them into the documents of the training course, while taking into account the fact that decoders for displaying video materials must be installed on the users' local computers. As one of the optimization options, we can recommend placing them in a separate folder, indicating their location when linking to video materials.

When working with text information in a presentation, one should take into account the following design guidelines: use no more than 3 fonts and bullets of the same type; place text information against a white background; do not abuse dies and text strokes with markers; use contrasting combinations of text and background colors; do not change the font color within one sentence; observe the correspondence of the line thickness of tables, arrows to the thickness of the font line, use animation on the objects of the presentation slide only in order to attract attention of students to highlight the author's intention.

When making a test, a course developer should take into account that test items can contain different types of questions added from the question base. Each attempt should be automatically recorded; the other option is to set up "manual" grading by a teacher. After passing a test task, students should be able to familiarize themselves with the correct answers to the test questions. The question base should contain questions drawn up in accordance with the structure of the discipline or in accordance with certain topics of the course. Questions should be of different types. The questions should also have notes explaining to learners the correct answers to the questions. Tests should be used as part of a course exam, as mini-tests to complete assignments or at the end of a specific topic, and in the final exam to provide immediate feedback and self-assessment.

The “Poll” element should be useful as a quick poll. For example, when voting to reveal the opinion of the majority, in the distribution of groups for a certain joint work, or when choosing the date and time of seminars / tests / consultations. The effectiveness of this element is determined by its ability to set restrictions. Thus, in the choice of a topic - when the limit set by the teacher is reached, the users who take the survey afterwards will no longer be able to select the same topic. In terms of guidelines, polls can be used as a quick vote to select a topic, to promptly check understanding, and to assist learners in decision making.

The analysis of the survey of students also showed that the database catalog allowed participants in the educational process to create, maintain and search for records from a set of previously laid down data. The "database" element is recommended to be used by students of electronic courses within the framework of joint accumulation of text information (articles, books, etc.), demonstration of graphic information created by distance learning students (photographs, posters, etc.), providing distance learning students with storage space files of various formats.

When developing a pedagogical design of an electronic course, it is necessary to provide materials for communication and interaction within the framework of the forum and chat. Thus, according to the students, an organization and holding of a forum is effective only if students experience difficulties when working with a practical assignment within the framework of the electronic course and they need advice from the teacher or the students themselves. To organize a chat, a course developer should pre-define this event as one-time or multiple, which can be organized within a certain time frame daily or weekly.

The presented methodological recommendations suggest the need to take account of the originality and characteristics of a particular academic discipline, to take into account its specificity, features of its conceptual apparatus and methods for studying its laws, the implementation of modern methods of information processing.

IV. Conclusion

The developed electronic courses on the basis of the presented recommendations for pedagogical design made it possible to optimally organize distance learning due to analyzing the need for training, motivating students and the goals set for the course. The approbation of new courses and revised versions, which took into account the recommendations, during the second term of the 2019-2020 academic year confirmed their effectiveness. Statistical processing of the results was carried out using methods of factor analysis. Factor analysis is understood as a method of transition to generalized indicators, the number of which is much fewer than the number of initial indicators. Mathematical methods are most suitable as descriptive methods in educational research. The eigenvalues and accumulated variances of the experimental data, made it possible to carry out the procedure of factor analysis. The obtained static indicators of this study show that the second component of D. Keller's model “relevance” is represented by the respondents' internal motivations. The second latent variable (hidden, unknown, generalizing factors) includes actual variables (actually measured), expressing, mainly, the motives of the students' current educational activity, aimed at the formation of professional competencies depending on the internal motivation of activity. For the studied group of respondents there was admitted prevalence of internal motivation. The methodologically competent pedagogical design of electronic courses made it possible to take into account many psychological and technical features of the implementation of modern information technologies into education. The results of the study made it possible to significantly increase the effectiveness of distance learning, as well as reduce the time spent on their creation.

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