Developing SMART educational cloud environment on the basis of adaptive massive open online courses

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Abstract. The use of adaptive massive open online courses (MOOCs) in the educational process of students contributes to the expansion of ways to implement personalized learning. The development of new approaches and intellectual methods for this area is a priority. Based on the developed approaches, it is possible to build individual educational paths in MOOCs. The analysis showed that the development of new intellectual methods for providing complex personalization in the SMART educational cloud environment requires further research and scientific justification. The development of this direction will ensure the implementation of the most important didactic principles: individualization, differentiation and adaptability. In this paper we summarize the approaches and methods used to provide personalization in the MOOC. In our research model of the adaptive MOOC architecture is presented. It includes describing of the following main components: «Database Student», «Database Course», «Database Learning Process», «MOOC Intelligent System», «Personal Learning Path». The interconnection of the processes of these components is based on Big Data processing and analysis, using the methods Data Analysis, Learning Analytics, Education Data Mining.

Keywords: Massive open online courses, MOOC, Adaptive Learning, Cloud Computing.

1 Introduction

In recent years, a number of changes have taken place in the educational environment, which have had a serious impact on the methodology of mastering and the practice of teaching the academic disciplines at the university. Nowadays the concepts of the personal educational environment of students and individual educational path are actively developing. Introduction in the educational process of massive open online courses has allowed expanding the boundaries for learning by students of different disciplines or separate modules of disciplines [3,12]. Students have an advantage to choose the order of the study material according to their interests and needs. But, one of the completely unsolved problems, despite the opportunities that have been opened, remains the task of optimal planning, construction and correction of individual educational path. Modern learning management systems contain a considerable amount of information, allow forming the profile of the student, based on his preferences, aca-

demic performance and other significant criteria. Because online courses involve massive work with students, the traditional planning personalized training routes to become very difficult for tutors accompanying rates. In our research we proposed the solution for solve this problem. We developed approach which include automated accompaniment of personalized work with listeners in the SMART educational cloud environment, based on the principles of intellectual self-organization.

2 Problem overview

An important condition for the adoption of effective solutions in the field of e-learning is an analysis of data from the participants of the educational process at various stages. Nowadays, the volume of data circulating in the educational environment, providing work with online courses, grows exponentially. This is facilitated by the rapidly growing demand for open education. In this way, it is necessary to develop new approaches to the creation of SMART educational cloud environment. The basic component of such an environment is adaptive massive open online courses. We offer an approach based on the methods of Learning analytics and the methods of Education Data Mining.

Modern online learning systems are aimed at working with Big Data, which, first of all, is conditioned by the basic principles that are fundamental for an innovative educational environment. In our research we defined as the main following principles: spontaneity of learning (gaining knowledge regardless of control and scheduling), adaptability (use of data on previous experience of teaching each learning to plan the learning process and track educational progress), the «invisibility» of the evaluation (ensuring automatic collection of data on the behavior of the listener in the learning process).

The main problem with the existing systems of online learning management is the lack of integrated support for all listed elements. Basically, this is due to the high resource intensity and computational complexity of the analyzed parameters. For the same reason, the process of constructing individual educational trajectories is complicated. Accumulated data is not analyzed in real time. So, for example, each potential learner has his own learning goals, interests. Also each learner needs his own set of content components and ways of activities in a particular situation. Therefore, it is necessary to use such e-learning opportunities that will ensure the formation of socially-demanded competences in the most differentiated, fast, high-quality and effective manner. The solution to the problem can be the use of heuristic methods built on methods of machine learning. Thus, the task of forming a profile of the interests of the listener of an online course can be solved by using teaching methods with a teacher, without a teacher, with partial teacher involvement, with reinforcement or multi-level training. At the same time, existing innovative data processing technologies based on methods of data mining and neural networks. But such approaches for correct work require the use of preliminary expert evaluation on reliable samples for further training and verification. In order to effectively configure such a system, the stored, but

previously unused data becomes particularly important, which in turn also introduces additional overhead costs for the analysis and verification of this information.

3 Discussion

Let's generalize the various approaches, algorithms and methods that provide personalization of training in MOOC, proposed by different researchers. For example, in [1] the implementation of a system of personal recommendations to listeners of MOOC on the study of additional thematic video lectures and educational resources based on the behavior of participants of the course, their interests and preferences is presented. This system is implemented on the basis of the results of processing large sets of data obtained when watching video lectures by students and their active participation in forums.

Qiang Tang [2] proposed a different approach to providing personalization of training in the MOOC. The listener, who first registered on the MOOC platform, passes a test to determine the learning style and learning strategy. Based on the results, the user's personal dynamic Bayesian learning network. Using the information from the Bayesian learning network, the MOOCs platforms gets the learner's personalized features and pushes adaptive courses and learning companion to create learning communities.

A team of researchers from Armenia [5] outlined the approach to personalization of learning, based on «teaching scenarios» (sequence of teaching units), which constructed during the process of learning. These scenarios are being constructed via the quality and quantity characteristics of the teaching units and user's knowledge. As a result, a group of researchers using genetic algorithms solve such important tasks in e-learning systems as creating adaptive learning scenarios and constructing a corresponding course map reflecting the progress of each particular learner.

A group of scientists consisting of Xiao-hong Tan, Rui-min Shen and Yan Wang suggest using genetic algorithms to build online courses that take into account not only the level of complexity of the material and the time taken for its mastering, but also the changing results of training of individual students in time of the educational process [4].

Another method of personalization, according to a group of researchers from Greece and Spain, is to use the learning / prediction algorithms, which are the basis of the system of personal recommendations. Such a system can prepare intelligent recommend actions to the learner based on the actions of previous participants in the course, and make a dynamic correction of the content of the course based on the profile of the trainee's profile, its interests and needs.

Another approach to ensure the personalization of learning is based on the technique of evolution through computerized adaptive testing. Then the genetic algorithm and case-based reasoning are employed to construct an optimal learning path for each learner [6].

A team of researchers from China [7] proposes a personalized system of recommendations in the MOOC, based on Dynamic Bayesian Network.

In the next paper [8], led by Jill-Jênn Vie, it is proposed to use adaptive testing in MOOC, in which the test tasks are formed by predicting the student's academic performance. Such an approach, according to the authors, will prevent the students from dropping out of the course, and also provide feedback to the test subject at the end of the test, indicating which knowledge components need further study.

4 The architecture of adaptive massive open online courses

SMART educational cloud environment, which is personalized, is characterized by complexity, high dynamism, and huge data flows. Wherein:

1. When we use of intelligent information technologies in the construction of adaptive MOOC goals and the pace of training, electronic educational content, as well as methods and means of teaching can vary depending on the interests, needs, characteristics of individual students, the degree of their readiness for learning, the results of tracking progress in the learning material. For example, recommendations can be offered for mastering individual variable modules of discipline or related online courses that expand and deepen knowledge in a specific subject area.

2. The adaptive learning subsystem in MOOC offers everyone an optimal individual space-time educational route and can organize groups of listeners who are similar in terms of educational preferences and opportunities, for example, for the joint evaluation of completed assignments.

We developed an adaptive MOOC architecture (see Fig. 1), each components of this structures we describe in more detail.

Database Student-a set of different characteristics of students (variable and constant data), which can be used in the process of the adaptive MOOC. Such characteristics include such Big Data as learning goals, interests in the subject area, the results of the survey, diagnostic testing, personal profile data (age, gender), psychological profile data (learning style, perception and memorization) and others. From the data contained will be selected those that distinguish a particular student or most accurately characterize his personality.

Database Course-information about courses and sets of their various characteristics that can be used in the process of creating an adaptive MOOC. Those characteristics that are most suitable for the needs and capabilities of a particular student will be selected from the existing ones.

Database Learning Process-a set of different characteristics describing the learning process (progress of students) based on a specific MOOC. Those who most accurately describe or characterize a personal way of realization of personal potential of the concrete trained will be chosen from the keeping characteristics. The meaning of these characteristics is constantly changing in the learning process based on MOOC. Such characteristics include such as points for each educational object being evaluated (for example, 50-70% - low, 71-89% - medium, 90-100% - high); the level of complexity of the material on the student feedback (simple, normal, complex); time spent on tasks; other.

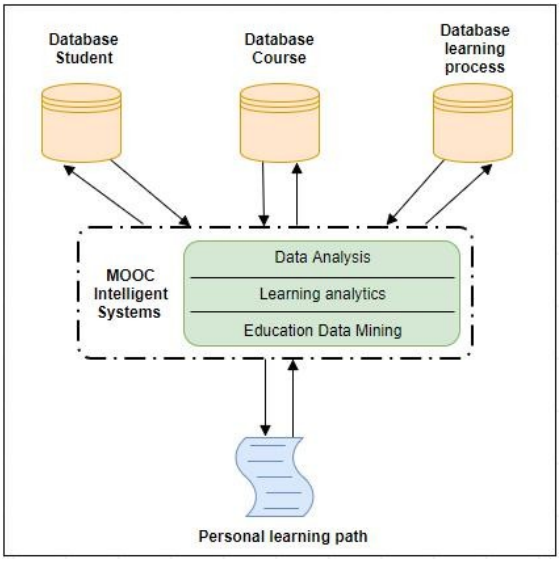

Fig. 1. Proposed architecture of adaptive massive open online courses.

MOOC Intelligent system is a module of hybrid intelligent system, responsible for the adaptability of the mooc to the needs, preferences and capabilities of a particular student. In this module, more than one method of human intellectual activity simulation is used to solve the mooc adaptability problem, for example, fuzzy logic, genetic algorithms, artificial neural networks, simulation statistical models and others. Neuro-fuzzy models allow, on the one hand, to bring the ability to learn and the computational power of neural networks into systems with fuzzy logic, and on the other hand – to strengthen the intellectual capabilities of neural networks inherent in the "human" way of thinking fuzzy rules of decision-making. optimization of the educational process by providing students with educational material in the most preferred form.
Personal learning path-a script that allows for each student to form an individual learning path for the development of a particular MOOC, which is later corrected in real time. For the purpose of correction of an individual trajectory of training the methods of data mining based on personal features and preferences of the trained are used.
The described architecture is a General representation of the implementation of adaptive MOOC and requires further detailed description of the functioning of all its components.

5 Conclusion

The article attempts to design a multifaceted, holistic, self-organizing cloud environment based on MOOCs, which creates the conditions for maximizing the personal potential of each learner by simultaneously creating the following components: adaptive content and training program, an optimal individual educational route, an intelligent selection system and course recommendations for interested students of the edu-

cational platform taking into account their personal interests, possible needs, personal characteristics for organizing collaborative work in the implementation of joint projects and other effective educational network interaction.

Thus, for today the task of searching for and creating effective methods for intellectual processing of large data sets for the complex personalization of the cloud educational environment remains completely unresolved and is in the stage of actualization.

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