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DIGITAL TECHNOLOGIES IN ONLINE EDUCATION

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Abstract

Currently online education is widely in demand in society. It is actively promoted by educational institutions and it is an object of interest of the state, contributing to the development of educational services market and increasing the level of accessibility of education for all society members. Modern digital technologies play an important role in the transformation of education in digital economy. The article deals with modern standards of online learning used for creating personalized adaptive online courses. It is noted that to meet the requirements of adaptability and develop an individual learning trajectory, it is necessary that all educational objects are located in a special repository, which is an online library for storing, managing and sharing educational resources. The system makes a decision on the choice and sequence of inclusion of educational objects in the online course based on the collection of information about the educational activity of students. The use of an object approach to knowledge structuring makes it possible to effectively organize the educational process: creating flexible, personalized learning technologies, changing the content and scenarios of pedagogical work of the teachers. The introduction of modern information technologies in online education will allow to respond ahead of time to the needs of society for qualified staff in the context of the formation of digital economy, the development of breakthrough and promising technologies and their impact on business.

Keywords: Online course, educational standard, repository of educational objects, electronic portfolio, individual trajectory.

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1. Introduction

The processes taking place in the economy clearly demonstrate that sustainable development of modern society is achieved through the widespread use of digital technologies. The intensive development of digital technologies poses new challenges for the education system to create a flexible digital educational environment and actively use online courses hosted on various platforms (Boutell & Fisher, 2017; Rao-Nicholson et al., 2017). Advances in information technology and a deeper understanding of the pedagogical principles underlying successful distance learning have led to the creation of innovative methodological approaches in online education.

One of these innovative approaches is to develop a training course based on educational objects that represent small parts of electronic training materials intended for the purpose of training (Komleva & Dneprovskaya, 2018). Thus, the platform for creating e-courses should provide an opportunity to exchange and share educational content and other data between different educational systems via the Internet. To implement this requirement, open protocols and standards must be used when creating educational facilities. Some of the standards are outdated, some are updated, but their application will always be relevant and in demand. Today, it is difficult to imagine the sphere of online education without using international standards ensuring its accessibility and mobility. With the development of the IT sphere, new technologies and new ways of presenting information have been used in online education, which leads to changes in standards and approaches for implementing online learning.

2. Problem Statement

The need for constant updating of content, as well as the high priority of the problem of creating competitive training courses, emphasizes the relevance and need to study modern educational standards and their application in the educational process and research, in particular, to solve the following issues:

- Transition from training based on a set of pre-prepared training courses to the training based on personally selected programs that are automatically generated from the repository's training objects in accordance with the results of monitoring the learner's competencies and the desired output results;
- Organization of distributed storage for placement of educational objects and implementation of requirements for the repository of educational objects: compliance with modern standards, ease of maintenance, portability, availability and efficiency;
- The possibility of using systems to collect information about the actions of students in online training.

3. Research Questions

The study raised the following questions.

What is the successful global experience of developing online education standards?

What opportunities does the repository of learning objects provide for constructing the personalized adaptive online courses?

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What tools can be used to obtain information about a particular student's abilities and learning outcomes to achieve learning goals?

4. Purpose of the Study

Research of digital technologies of online education that contribute to the training of highly qualified personnel for the digital economy. The implementation of the goal set in the work is achieved by consistent answers to the questions posed.

5. Research Methods

5.1. Analysis of the development of online education standards

Almost all existing Learning Management Systems (LMS) implement online education standards in one way or another. Many courses are static, i.e. there is no adaptability, which consists in adjusting the educational content to a certain level of knowledge of the student (Uthayakumar & Sarukesi, 2011). This adaptability can be implemented using modern online education standards: xAPI and mi5, the repository of educational objects and the Learning Record Store (LRS) system.

The development of online education standards has led to the emergence of xAPI and cmi5, which allow creating dynamic courses, where information about the actions of student during the course is collected and then saved to the LRS system for further processing and analysis (website xAPI).

The “reference standard” for online education is SCORM, which was developed in 1999 on the initiative of Advanced Distributed Learning (website Advanced Distributed Learning). This standard allows you to upload an online course to any existing LMS system that supports this standard. One of the main drawbacks of the SCORM standard is the lack of in-depth analysis of student activity.

Tin Can (or xAPI) (website xAPI) has become an improved standard compared to SCORM. This standard significantly expanded the capabilities of the SCORM standard, which led to the ability to track and record the student's learning activity. The problem with the standard, if it could be called a problem, is that it is supported only by modern LMS systems.

The cmi5 standard corrects the shortcomings of both SCORM and xAPI. In 2016, the standard became available to the general public. The old LMS systems are not supported by the xAPI, so cmi5 was able not only to solve this problem, but also allowed students to take courses even without an Internet connection.

Online education standards make it easier to use and transfer courses to different LMS. Thus, the universality of the developed course is achieved.

5.2. Research of the principles of developing a repository of educational objects for creating personalized adaptive online courses

Modern standards of online learning support the ability to adapt the course content to the level of training of the student by using only the educational materials that are embedded in it. This approach has its drawbacks:

- The relevance of training materials may become outdated over time.

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- Incomplete disclosure of certain topics or activities.

Each training object can include one or more components (information objects), such as text, presentations, video materials, various tables, graphs, or any other type of document or file.

The training object must be built so that the user does not have problems integrating it into the e-course due to its internal structure. In other words, a reusable learning object should be a “black box” in the sense of object-oriented programming theory (Merzon & Ibatullin, 2017).

The main advantage of working with educational objects is that they can be reused by teachers and students to develop e-courses containing materials that directly correspond to their individual learning goals (Brusilovsky et al., 2016).

A course is a set of educational objects that are combined according to a certain sequence. In order for an educational object to be included in an online course, it must correspond to the content of the course and form the student's competencies that the student must have after completing the course. The course itself can also be considered as a training object.

All educational objects are located in a special repository, which is an online library for storing, managing and sharing educational resources. Access to repository components is controlled by special built-in security services.

The repository of educational objects consists of two parts: public and private.

To automate content processing, each material in the information environment needs to be associated with a certain set of parameters, based on which a decision is made to process it (to delete it, move it between sections, or copy it to a closed section of the portal). For example, in the information and educational environment of an educational institution, as noted (Komleva et al., 2018), parameters can be: category, metadata, dates of changes, popularity, moderator rating. Metadata is required for the purpose of identifying and searching content.

When a training object is published in an open part of the repository, it needs to match a certain set of parameters, based on which a decision is made to process it (delete it, move it between sections, copy it to a closed section of the portal). Based on this data, the object will be automatically described with metadata, which is used to classify, organize training objects and facilitate their search. To move a training object to a closed part of the repository, it must pass a check: how accurate, relevant, and useful the information contained in the material is for users, to what extent it meets the specified standards, and how much you can trust the author of this content (Komleva et al., 2018).

Of course, metadata is an important element in making learning objects reusable. They allow to interact effectively with objects by accurately defining interfaces and formats. Cataloging educational objects using metadata allows to distribute them individually or in combination with others to increase their frequency of use.

However, reuse of training objects is also affected by the level of content detail. It corresponds to the level of specification of components and can range from a simple image or graph to a complete curriculum or course in its entirety. The more detailed the training object is, the more likely it is to be reused.

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The main organizations involved in developing specifications and tools for summarizing learning objects are the WorldWideWeb Consortium (W3C), the International Organization for Standardization (ISO), the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), the Dublin Core Metadata Initiative (DCMI), and the Global Learning Consortium for learning management systems (IMS / GLC), which have created the working groups to establish protocols and standards for defining and managing metadata.

Courses that consist of repository training objects are packaged in the SCORM and xAPI standard. This makes it possible to use the created courses and training facilities in any existing LMS, but to collect information about the actions of students, an LRS system is needed.

5.3. Overview of LRS systems' capabilities in online learning

To get information about the abilities and learning outcomes of a particular student, it is necessary to monitor their educational activity. This process is necessary for implementing adaptability in the system. This will allow to respond to the actions of the trainee in a timely manner and offer him those educational objects that are most suitable for him to achieve the goal of training (Liguori et al., 2019). Collecting student learning activity is supported by the xAPI and cmi5 standards. This data is stored in the Learning Record Store (LRS) system, which can be either embedded in the LMS or exist as a separate service.

LRS is a database that contains information about educational activity (website with LRS description). These systems accept requests from the LMS to save, receive, and correct information.

Developing an LRS is a complex process that involves meeting certain requirements for the operation of such a system. However, some companies are developing such systems using a variety of technologies.

With the blockchain technology the financial sector has changed a lot, which has led to the emergence and reinterpretation of old business processes and the creation of new ones. The use of blockchain is not limited only to the banking sector, but is actively beginning to be used in such areas as healthcare, logistics, energy, education, and others.

Blockchain technology is a continuous chain of blocks. The use of encryption algorithms allows to protect records belonging to a particular person from being edited by other network users.

One of the possible ways to use this technology is to develop a new type of LRS systems. Such systems are called Learning Record Blockchain (LRB) systems (Walther, 2018) and, compared to conventional implementations, have a number of advantages:

- Privacy of personal information using cryptography.
- Decentralized data storage system.
- Invariability of the added blocks (the block cannot be removed).

In online learning, the xAPI standard sends data about each student's academic activity to the LRB system, which is stored in blocks using encryption algorithms. Thus, to get information about a particular student, you must pass verification (Sharples & Domingue, 2016).

Each student will be able to pass the verification procedure in order to create an appropriate account in the LRB, where the results of training and online courses will be saved. However, the LRB can not only store information about the actions of the student, but also store certificates, diplomas and information

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about the organization where the user was trained and what results in the educational process, he was able to achieve, in fact, forming his electronic portfolio.

Access to the student's data will be carried out solely on their consent, which will allow to control the issuance of certain data, so that they do not affect confidential information.

The blockchain is known for its high level of trust in stored data, which is achieved using cryptography, decentralization, and consensus algorithms. This level of security guarantees the correctness of stored information, but does not guarantee its reliability. An educational organization may still issue a fake certificate or other methods of providing false information that are currently very difficult to verify.

Storing information about the student's actions, certificates, diplomas and other educational activities in a single cryptographically protected system will not only accumulate information about the abilities and learning results of a particular student, but also make recommendations on the content and sequence of including educational objects from the repository in accordance with monitoring the individual level of student competence.

6. Findings

Individual trajectory / personalization is an educational route that is tailored to a specific person, taking into account their characteristics and needs (Chaw & Tang, 2018). Developing a personal trajectory is carried out by implementing the following components:

1. A database containing information about the student (LRB).
2. Module for analyzing hierarchies of materials in the closed part of the repository.
3. Module for exporting analysis results to generate a course.
4. Module for evaluating the quality of the built learning trajectory.

Learning objects are extracted from the closed part of the repository for later use in an online course. Since each training object contains a specific set of metadata, the search for the desired objects is much easier.

Getting training results from the LRB system for related courses allows you to select training objects from the repository with higher accuracy.

Today a lot of attention is paid to the transformation of the learning process and the formation of an individual learning trajectory (Afanasev et al., 2018; Nikulchev et al., 2019). Some LMS try to implement this approach, but it does not always show excellent results. Developing an individual trajectory is possible only if there is enough quantity and variability of educational materials in the repository to fully implement the creation of an adaptive online course aimed at a specific student.

7. Conclusion

The evolution of the modern information society and education system clearly demonstrates that knowledge is becoming the dominant means of achieving high socio-economic results and the main source of competitive advantage (Kılıc et al., 2015; Liventsova et al., 2016). The defining concepts of these processes are knowledge management and intellectual capital. Today, online education is widely in demand in society, is actively promoted by educational institutions and is an object of state interest (Ilieva-Koleva

& Dobreva, 2015). Personalization of the training course is a new direction in the educational environment, it is characterized by taking into account the requirements and needs of the student and helps to educate them to be independent in addition to fulfilling their target task. In an environment with an ever-growing popularity and demand for online courses, the development of software that implements a personal trajectory is one of the most important tasks of modern education. An important role in the transformation of education in the digital economy, ensuring its accessibility and mobility is assigned to modern standards of online learning used to build personalized adaptive online courses. Developing a repository of educational objects designed in accordance with modern standards for their storage, management and sharing meets the modern requirements of online education and contributes to the training of highly qualified personnel for the digital economy.

References

Afanasev, M., Dneprovskaya, N., Kliachin M., & Demidko, D. (2018). Proc. of the 19th Eur. Conf. on Knowledge Management – ECKM 2018 (Padova), vol. 1. Academic Conferences and Publishing International Limited.

Boutell, M. R., & Fisher, D. S. (2017). Entrepreneurial minded learning in app development courses. *Paper presented at the Proceedings - Frontiers in Education Conference, October 1-8*. https://doiorg/10.1109/FIE.2017.8190436

Brusilovsky, P., Somyürek, S., Guerra, J, Hosseini, R., Zadorozhny, V., & Durlach, P. (2016). Open Social Student Modeling for Personalized Learning. *IEEE Transactions on Emerging Topics in Computing, 4*(3), 450-461.

Chaw, L., & Tang, C. (2018). Proc. of the 17th Eur. Conf. on e-Learning - ECEL 2018 Co-Hosted by the University of West Attica. Hellenic Air Force Academy.

Ilieva-Koleva, D., & Dobreva, J. (2015). Social Entrepreneurship as a Form of Social Responsibility in Bulgaria. *Megatrend Revija, 12*(2), 123-136.

Kılıc, K., Ulusoy, G., Gunday, L., & Alpkan, L. (2015). Innovativeness, operations priorities and corporate performance: An analysis based on a taxonomy of innovativeness. *Journal of Engineering and Technology Management, 35*, 115-133.

Komleva, N., & Dneprovskaya, N. (2018). Proc. of the 17th Eur. Conf. on e-Learning - ECEL 2018 Co-Hosted by the University of West Attica. Hellenic Air Force Academy.

Komleva, N., Dneprovskaya, N., & Vnukova, T. (2018). Proc. of the 19th Eur. Conf. on Knowledge Management – ECKM 2018 (Padova) vol 1 ed E Bolisani, E Di Maria and E Scarso. Academic Conferences and Publishing International Limited.

Liguori, E., Bendickson, J., Solomon, S., & McDowell, W. C. (2019). Development of a multi-dimensional measure for assessing entrepreneurial ecosystems. *Entrepreneurship and Regional Development, 31*(1-2), 7-21. https://doi:10.1080/08985626.2018.1537144

Liventsova, E., Rumyantseva, T., & Syriamkina, E. (2016). Development of social and entrepreneurial skills of students of engineering and technical specialties in the modern university. *Paper presented at the MATEC Web of Conferences*, 79. https://doi:10.1051/matecconf/20167901018

Merzon, E. E., & Ibatullin, R. R. (2017). Architecture of smart learning courses in higher education. *Paper presented at the Application of Information and Communication Technologies, AICT 2016 - Conference Proceedings*. https://doi:10.1109/ICAICT.2016.7991809

Nikulchev, E., Ilin, D., Belov, B., Kolyasnikov, P., & Kosenkov, A. (2019). *Int. J. of Adv. Comp. Science and Appl, 10(*4), 29-34.

Rao-Nicholson, R., Vorley, T., & Khan, Z. (2017). Social Innovation in Emerging Economies: A National Systems of Innovation Based Approach. *Technological Forecasting and Social Change*, *121*, 228-237.

Sharples, M., & Domingue, J. (2016). *The Blockchain and Kudos: A Distributed System for Educational Record, Reputation and Reward.* https://link.springer.com/chapter/10.1007/978-3-319-45153-4_48

Uthayakumar, C., & Sarukesi, K. (2011). An adaptive e-Learning system using knowledge management. In *3rd International Conference on Trends in Information Sciences & Computing (TISC2011), Chennai* (pp. 70-74). https://doi: 10.1109/TISC.2011.6169087

Walther, P. (2018). *Learning Record Blockchain.* https://elearningindustry.com/learning-record-blockchain