LSM and Digital Education Transformation

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Abstract. The article describes the research carried by the authors in the global improvement framework of electronic tools in distance education. The text discusses digital transformation problems associated with using pedagogical concepts by universities in distance learning utilising learning management systems. In researching the problems, investigated the leading pedagogical technologies of behaviourism, cognitivism and constructivism, and aspects of personality-oriented and project-based learning. It was revealed a main regular concepts methods that can be applied in distance learning. The authors analysed a sample of the most popular LMSs for the sufficiency of functions to implement these pedagogical methods. As a result of research, the studied LMS has a fairly wide range of functions. However, these functions are not sufficient enough to allow all indicated pedagogical methods using. To compensate for the lack of LMS functionality, the authors recommend practising external electronic resources could be integrated into the learning management systems used by universities.

1. Introduction
Digital transformation and the transition to a new technological order bring humanity to a new level of development, requiring digital technologies to be active in almost all areas of everyday life [1]. Similar changes have affected higher education, expecting an adequate response to the ongoing changes. The dynamics of these changes indicate a significant alteration in the universities educational process emphasis on online education, using an environment where each student can study and share educational materials without attending traditional face-to-face lectures in the classroom.

Recall that the history of distance learning, as we understand it today, dates back to the middle of the 19th century, when Isaac Pitman began to teach the stenography system, sending postcards with transcribed texts by mail, and receiving transcriptions from students in replacement for fixes. The first television broadcasting as an element of distance education was first used by the University of Houston back in 1953, and software - by the University of Alberta in 1968. In 1985, US Southeastern University offered accredited degrees obtained online, and in 1993, Jones International University founded, the first university to operate entirely in a distance learning format. The subsequent evolution of the Internet provided the accelerated spread of distance learning in the educational process. The speed of distribution depends on environmental conditions, including the demand for such training and its legislative support. As an example, we note that before the COVID-19 pandemic, the volume of distance learning courses in the United States, within the higher and additional education framework, exceeded 30% of the educational services total volume. Simultaneously, the volume of similar educational services in Russia was about 1.1% [2]. The rapid transition to compulsory or advisory distance learning in various countries has changed the prevalence of distance education and narrowed the gap between them, at least at this stage. It can be assumed that after the end of administrative
restrictions, the number of distance learners will decrease. However, one should not expect a complete return to the previous indicators.

It is necessary to mention those who receive education in modern universities. The vast majority are students of the digital age. They were born after the technological revolution and have never seen a world without digital tools. This type of students spends time in virtual space up to 9 hours a day [3]. Constant contact with technology has developed many common mental and thinking properties: improved multitasking ability, attention selectivity, and shorter periods of concentration, as well as the ability to independently find, scan and process large amounts of information, the desire for autonomy and individuality, as well as hyper-awareness of the world around them [3]. It is essential to understand that digital technology is a tool skillfully using by such students. Therefore, digital technologies in the educational process are also an opportunity to form students' knowledge in the digital environment familiar to them.

A practical solution is learning management systems (LMS), used by universities as independent tools or integrated elements into the university's electronic information system [4]. Implementing various LMS has simplified creating an appropriate digital learning environment and facilitated the educational programs virtual implementation. Physical presence in classrooms has become less important as information sources shift from teachers and printed textbooks to digital media. Another rationale for using LMS is to ensure that education is accessible to a large number of students. According to Sidra Noreen, most universities worldwide are trying to incorporate LMS as a primary and indispensable tool for transforming teaching and learning [5]. However, learning management systems are only a learning tool. Replacing teachers with technologies is impossible, but the latter is becoming an everyday element in modern educational institutions. It means that the teaching methods implementation boundaries within the framework of specific concepts and theories limited by the capabilities of the tools used in each particular case.

At the moment, the most common educational technologies are behaviourism, cognitivism and constructivism [6]. Followers of behaviourism in pedagogy think that human behaviour is a controlled process, which nature determined by stimuli and requires positive reinforcement [7, 8]. In practice, this manifested in the same type of practical tasks multiple repetitions, supported by rewards and reviews; using hints when studying the material; forming a standard solving problems procedure, including a sequential steps chain; focusing on achieving visible and measurable, concrete results, etc. Even though behaviourism is one of the most ancient of the three pedagogical theories under consideration, it still applied in universities' educational process.

Cognitive psychology emerged in the 1950s as a response to behaviourism and emerged at the intersection of several disciplines - linguistics, philosophy and artificial intelligence, in addition to psychology itself. The concept of cognitivism considers a person as a system of receiving and processing information [9-11]. In distance learning, the tools of cognitivism demonstrated through feedback (not for reinforcement, as in behaviourists, but for clarifying and explaining the results obtained); focusing on active student participation in the learning process, including greater student control, as well as goal setting, planning and self-criticism; using analysis to reconcile necessary knowledge with new information; organizing information using diagrams, other graphical methods for organizing information and describing processes.

Constructivism is a pedagogical technology underlying the progressive ideas of modern education [12]. According to such constructivists as Lev Vygotsky and Jean-Jacques Piaget, pedagogy tasks are to reveal each student's capabilities, teach him constructive thinking and problem solving while maintaining the process of continuous improvement [13]. This pedagogical technology denies the knowledge transfer effectiveness in a completed form. It focuses on creating a supportive environment for students, who, in turn, must create knowledge for themselves, forming their meaning of learning. In the universities educational process, it is shown in solving problems posed in the actual external environment context; gaining different points of view on the same subject through collaborative learning aimed at developing alternative approaches to solving the same problem; debates,
discussions; search for solutions to tasks outside the initial information framework; evaluation of results, focused on the utilisation or transformation knowledge and skills.

The learning paradigm, reinforced by modern pedagogical technologies, shifts the emphasis of the educational process and changes the idea of how it should be implemented [14]. One of the paradigm key features is the student's academic freedom, meaning, among other things, the student-centred learning prevalence, determined by the constructivism pedagogical technology. The pedagogy tasks formulated today - the need to uncover each student's capabilities and learn to solve problems while maintaining continuous improvement [15].

Remember that the Bologna Declaration was signed more than 20 years ago, marking the beginning of the deepest and largest-scale European higher education reformation [16]. Today, the participants in the process, named after the place of signing Bologna, are 48 countries, including Russia. Along with the education quality control, academic mobility expansion, and employment provision for graduates, an essential value in the Bologna process has the "student-centred" education paradigm [17], which can be completed subject to the transition paradigm of learning. It means the use of modern pedagogical methodologies, student-centred and project-based teaching in the everyday educational process of universities [18-19], regardless of the education type.

The distance education task does not consist of the full-time education format exact modelling but the implementation of pedagogical concepts and methods in other conditions. LMS and their constituent elements are only pedagogical tools [20], very productive. However, they cannot replace teachers but must have the necessary tools to teach effectively. To realise, it is necessary to objectively assess the content and capabilities of the LMS and the electronic tools correspondence of these systems to the pedagogical methods needs. Such an assessment will give an idea of the problem areas of learning management systems. In turn, understanding such problem areas will allow local improvements and additions to the LMS used by universities. The limited tools should lead to their improvement and not decrease the online learning quality.

Investigations in applying learning management systems in secondary education institutions have shown that the platforms used for distance education of schoolchildren restrict teachers in using specific pedagogical methods [21]. Considering that educational processes in universities and secondary schools have significant differences, the authors conducted similar studies of the LMS application in higher education institutions. The socio-emotional segment of education not considered since it belongs to the competence of school teachers and not realised in universities.

2. Materials and methods

The investigation aims to verify the hypothesis that distance learning platforms insufficient filling with electronic tools can be used to provide distance teaching using the pedagogical concepts of behaviourism, cognitivism, constructivism, as well a student-centred and project-based learning.

The main pedagogical theories and methods of their practical implementation using distance education platforms were considered in the research process. Then, from the specified pedagogical components, the methods identified can be applied in the distance learning form [21]. Table 1 shows the groups of selected methods.

After that, were analysed a sample of popular LMS to compare the available functions with pedagogical methods. The comparison purpose is to establish the full, partial presence or absence of the necessary electronic LMS tools corresponding to the specified methods. During the research, the functions of each LMS compared with the methods from table 1.

For analysis, selected the four most popular commercial learning management systems - Moodle, Google Classroom, Canvas, Blackboard Learn. The chosen distance learning platforms characterized by high popularity and accessibility for educational institutions. As of June 2020, Moodle had over 213 million users, making it the most widely used learning platform globally [22]. Google Classroom had over 100 million active users at the beginning of April 2020 [23]. The number of Canvas users even before the pandemic exceeded 30 million [24], and more than 100 million people used Blackboard products in 2017 [25].
Table 1. Pedagogical conceptions and methods.

| Conception          | Distance Learning Applicable Methods                                                                 |
|---------------------|--------------------------------------------------------------------------------------------------------|
| Behaviorism         | Rewarding and feedback as a reinforcement                                                             |
|                     | Assessment of knowledge before and after the course                                                  |
|                     | Alerts, hints and remindersComparative analysis of the reinforcement methods effectiveness             |
|                     | Feedback for support and learning management                                                          |
| Cognitivism         | Activation of the necessary knowledge gained earlier                                                  |
|                     | Metacognitive skills formation                                                                       |
|                     | Case study tools                                                                                     |
|                     | Discussions                                                                                          |
| Constructivism      | Student self-discovery investigation tools                                                              |
|                     | Efficiency mark                                                                                      |
|                     | Performance assessment                                                                              |
|                     | Surveys and assessments to identify individual interests and student skills                            |
|                     | Individual student profile creation, taking into account the collected information, providing teacher's access to the profile |
| Personalized Learning | Learning tools for student abilities self-realisation                                                  |
|                     | Tools for adjusting the individual student's curriculum, taking into account individual cognitive characteristics |
|                     | Learning progress based on competencies                                                               |
|                     | Group education                                                                                      |
| Project-Based Learning | Student collaboration and communication                                                              |
|                     | Project management                                                                                   |
|                     | Authentic assessment and production evaluations                                                       |

3. Results

The research identified several gaps in the four LMSs reviewed: Moodle, Google Classroom, Canvas, Blackboard Learn. The examined LMS have some functions for implementing different pedagogical strategies. However, developing these strategies and explaining them to students have to be done by teachers. Without the teacher's ingenuity, there are fewer ways to implement the pedagogical methods described in the table within the framework of the courses. For example, reactivating previous knowledge is vital for cognitivism.

Nonetheless, there is no way to organize and find all relevant content in modules and courses such as knowledge management and tagging platforms. This trend continues for student-centred and project-based learning. In particular, creating a student profile displaying interests, strengths, and weaknesses required for personalized learning, LMS needed a more formal set of functions, collecting data from other sources and summarising them. Having a set of project management functions to organize a unit of study based on projects may also require more efficient electronic tools.

Table 2 summarises the investigation results reflecting the availability, partial availability (indicated the percentage of functions corresponding to pedagogical technologies) or default of functions corresponding to the pedagogical methods indicated in table 1.

4. Discussion

The educational process creation using online learning technologies, the course formation, filling it with educational elements, and implementing the learning process is the teacher's task. The modern pedagogical methods practising is wholly linked with the learning paradigm. As mentioned above, instead of transmitting information to students, the teacher needs to create conditions for students to construct their knowledge. At the same time, a student-centred way of learning becomes the central element of most pedagogical technologies scenarios. Its main elements are activities comprehension,
personal goal setting, activity planning, plan realisation, reflection, assessment, adjustment or goals redefinition - the core around which the curriculum content built up.

Table 2. The results of evaluating the rate of LMS functions to the considered pedagogical concepts requirements.

| LMS          | Behaviorism | Cognitivism | Constructivism | Personalized Learning | Project-Based Learning |
|--------------|-------------|-------------|----------------|-----------------------|------------------------|
| Blackboard   | 100%        | 33%         | 80%            | 60%                   | 50%                    |
| Canvas       | 100%        | 33%         | 60%            | 40%                   | 50%                    |
| Google Classroom | 100%     | 33%         | 40%            | No                    | 25%                    |
| Moodle       | 100%        | 33%         | 60%            | No                    | 50%                    |

The modern teaching paradigm implies a student's high activity throughout the educational process, where the relationship between the student and the teacher raised as subject-subject. Higher education institutions mission following this paradigm is to create an educational environment where students would engage in discovering and constructing knowledge, forming a robust learning environment, and assisting students in succeeding.

In the case of distance education, a large load falls on the learning management systems used. One way or another, but LMS is becoming the main channel of interaction between students and teachers. The distance learning platforms limited functionality narrows teaching opportunities and, consequently, the quality of education. Some universities partly resolve the LMS limitations by embedding them as an add-on to an already existing e-learning environment. Nevertheless, for those higher education institutions that consider LMS as the distance education primary tool, it is necessary to carefully correlate the chosen system capabilities with the pedagogical methods and concepts used in the daily educational process, as well as the application of external resources embedded in the LMS to compensate for the standard tools lack.

5. Conclusion

The investigations have shown that popular modern learning management systems have a relatively wide range of functions allowing the educational process to organize in a distance form. At the same time, some of the LMS limit the teacher's ability to apply pedagogical theories and methods created based on these theories due to the reduction of appropriate resources - the LMS functionality. The student's short capabilities in terms of the educational process managing - time management, planning, as mentioned above-make mainly subject-object relationships in learning, i.e. the student is in the position of the influence object [26]. It contradicts modern pedagogical methods focused on subject-subject relations when students and teachers participate in the educational process on an equal footing.

We should also note that the researches' results are comparable with the Bhattacharyya investigations results for secondary education institutions. It may indicate that the learning management systems insufficient content has a more global nature and applies to educational institutions of various educational levels. We also remark that the fundamental difference between the carried research and its analogues (for example [27]) is that the LMS comparison is taken out mainly according to cost criteria, licensing policy. In our case, LMS compared according to the applied pedagogical technologies.

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