International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-2, July 2019

Functional Monitoring and Control in Electronic Information and Educational Environment

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Abstract*: *The paper deals with the monitoring of the functioning and control of the effectiveness of the use of electronic information and educational environment of higher education. Particular attention is paid to the registration of events and their analysis in the Moodle learning management system from the perspective of the organization of educational interaction and analytical activities of the management. It is noted that the learning management system Moodle can not without additional plugins to provide information about site visitors, traffic sources, load indicators on the system. External tools, such as «Yandex.Metrics». By integrating this information system into the electronic information and educational environment of the University, it is possible to analyze additional statistical data (number and age of visitors, devices used to enter the environment). The obtained information allows not only to optimize the educational process from the position of control over the study of educational material, but also to significantly improve the efficiency, convenience and quality of work of students in the electronic information and educational environment of higher education.

Index Terms*: *electronic information and educational environment, e-learning, control, monitoring the functioning of information systems

I. INTRODUCTION

With the emergence and development of the electronic information and educational environment in higher education institutions, the issues of monitoring its functioning and monitoring the effectiveness of its use have come to a special place [1]. Monitored after A.N. Mayorov will understand the set of elements that ensure the functioning of monitoring procedures [2]. The elements of a monitoring system usually include the subjects of monitoring, monitoring indicators, tools and tools for monitoring activities and directly activities aimed at monitoring and controlling the operation of an electronic information and educational environment [3, 4, 5].

Revised Manuscript Received on 30 July 2019.
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In our case, the subjects of monitoring will include students, teachers, administrative staff, employers, partners and founders of an educational organization. To the complex of monitoring indicators we will assign a number of major and minor indicators capable of providing a holistic view of the state of the electronic informational and educational environment, of qualitative and quantitative changes in it taking place.

The monitoring toolkit is a set of statistical reporting forms, monitoring indicators, questionnaires and questionnaires. From a technical point of view, for the purposes of monitoring and control, as a rule, they use either the built-in functionality of the basic information system of the electronic information and educational environment, or external tools and software and hardware solutions [6, 7].

The collection and analysis of statistical data accumulating in the depths of the electronic information-educational environment can and should be used both as part of the management of the educational process and in the work on attracting applicants to an educational institution. In addition, an extended set of statistical data allows the developers of this environment to analyze them and use them in the process of improving it.

II. METHODOLOGY

The initial and main task of monitoring in information systems is to ensure information security. This problem was discussed in various scientific works. So A.P. Aleksanyan, I.E. Pestov considered a system for monitoring the status of information security in key information infrastructure systems [8], M.I. Ozhiganov, M.A. Maslov - information security monitoring system in information systems [9]. They note that the recording of all information system events directly or indirectly related to the security of the system is the essence of the information security audit. Registration of all actions performed by all participants in the educational process allows identifying and exposing intruders, as well as helping to identify vulnerabilities of the protected system. In this regard, the more parameters are recorded in the information system, the easier it is to formulate certain conclusions in the process of analyzing threats to its information security. Unfortunately, it is impossible to record all actions and keep journals describing them constantly in actual practice. This is primarily due to the volume of stored data, and secondly, with the load on the computing power of the information environment.

Not in vain in the generally accepted practice, this interaction was called “big data” [10]. As a rule, many organizations store the events of information systems included in the electronic information and educational environment for no more than six months. An equally important problem impeding the possibility of permanent storage of recorded data is the problem of labor costs in their analysis [11]. The fact is that the more extensively recorded data, the more. The more logged data, the more difficult it is to analyze them. In modern practice, it is almost impossible to analyze even operating system events without using additional software solutions, since analyzing, for example, a text file containing several hundred megabytes of statistics, manually searching for one record is equivalent to searching for a “needle in a haystack”. Modern software and hardware solutions of the electronic information and educational environment contain hundreds of various event recording systems, and accordingly hundreds of log files. Without the use of specialized monitoring systems to carry out their analysis is almost impossible. The maximum efficiency of automated monitoring systems is achieved in analytical management activities, the analysis of which is devoted to the publications of A.A. Korostelev, D.A. Poltoretsky, A.V. Bogdanov [12, 13].

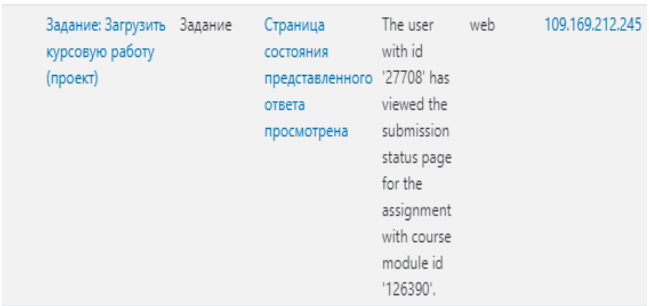
A number of papers examine the capabilities of the basic modules of a typical system for monitoring an electronic information and educational environment of an educational institution. The main subsystem of the monitoring system is most often the data acquisition subsystem. This subsystem is designed to carry out a survey of the main objects of the information environment to be monitored, and to obtain information about the recorded events. This survey is carried out in constant mode with a certain frequency [14, 15]. The monitoring system not only copies a part of the records from the system logs, which makes their primary analysis with the aim of at least their qualifications. If the analyzed events affect either the performance of the system or its information security, they are assigned a critical level, which generates automatic alerts to the administrator of the electronic information and educational environment. The next most important subsystem is the storage subsystem. It is intended for accumulation, storage and archiving of data on monitoring results. This subsystem works directly with database management systems, data repositories and external content analysis tools designed to reduce the amount of stored data with the possibility of their automated analysis. In addition to the above-mentioned subsystems, the monitoring system, as a rule, uses the data analysis subsystem necessary for the implementation of various kinds of studies with data, the notification subsystem, as well as the subsystem for the output of statistical information. The above subsystem is designed to generate statistical reports of various types, the analysis of which allows an educational institution to improve the capabilities of the electronic information and educational environment.

Thus, research and development is dominated by organizational and technological aspects of monitoring the functioning of the electronic information and educational environment of the university, but without proper attention, the implementation of learning management systems to control the effectiveness of the use of the electronic information educational environment of the university remains.

The basis of any electronic information and educational environment is one or another learning management system. Almost all modern systems of this orientation have built-in mechanisms for registering events and analyzing them. The main purpose of this article is to analyze the functional capabilities of the Moodle learning management system for monitoring the functioning and monitoring the effectiveness of the use of the electronic information and educational environment of the university. This paper discusses the capabilities of the embedded monitoring system for administrators of the electronic information and educational environment, as well as for teachers and school administrators.

III. RESULTS

The Moodle learning management system has a fairly powerful built-in mechanism for registering events and analyzing and monitoring them [16, 17, 18, 19]. The system automatically takes into account such information as the time spent on learning the course for participants in the educational process, the current and maximum size of the course data, a list of major and minor events, the analysis of real-time events. In addition, the system collects generalized statistics on its users. Consider the main reports generated by the system. One of the functional reports of the system is the report "Time spent on studying the course." This report allows you to analyze the time spent by students on the passage of a module. In addition, the report displays the number of attempts to pass the module and the final assessment. The maximum of primary information in the Moodle learning management system is stored in the relevant activity logs. Activity log can be obtained as a teacher within a specific course, and the administrator throughout the system. Activity log can be filtered by participants of the educational process, the time over which the analysis is carried out, actions taken by users, event sources and other parameters. The log itself stores information such as: the time of the event registration, the full name of the user, the user on whom certain actions were performed, the context of the event, the component, the name of the event, its description, source and IP address from which it was recorded (figure one). All log events, among other things, can be uploaded to delimited text files or Microsoft Excel spreadsheet.



Задание: Загрузить курсовую работу (проект)	Задание	Страница состояния представленного ответа просмотрена	The user with id '27708' has viewed the submission status page for the assignment with course module id '126390'.	web	109.169.212.245

Fig. 1 - Example of Moodle learning management event log entry

Based on the event log, Moodle's learning management system can construct a number of graphs, for example, a graph of user activity in an electronic information and educational environment.

On the graph (Figure 2), formed according to the data from our electronic information and educational environment, we see how the activity of students falls during the weekend, especially noticeable on public holidays that fall on May 9-11.

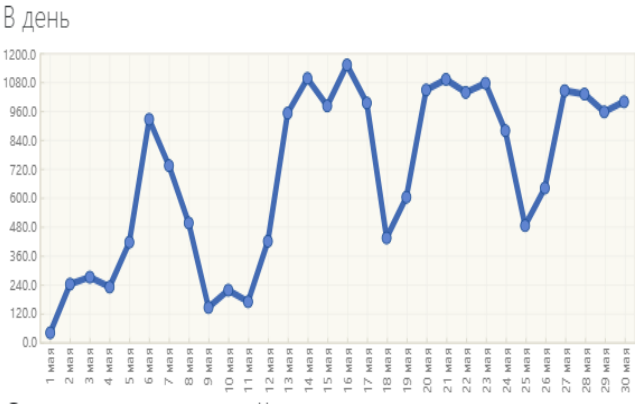


Figure 2 - Graph of user activity in the electronic information and educational environment

Of course, you should not forget about the main statistical measures that the system generates - these are user reports (Figure 3). This report focuses the attention of the teacher on the specific achievements of students.

Элемент оценивания	Рассчитанный вес	Оценка	Диапазон	Проценты	Отзыв	Вклад в итог курса
Информационные технологии в юридической деятельности						
Итоговая оценка за курс Среднее оценок. Включая незаполненные оценки.	-	Отлично	Не допущен-Отлично	100,00 %		-
Отчет по лабораторной работе №1	8,33 %	5,00	0–5	100,00 %		8,33 %
Отчет по лабораторной работе №2	8,33 %	5,00	0–5	100,00 %		8,33 %
Отчет по лабораторной работе №3	8,33 %	5,00	0–5	100,00 %		8,33 %
Отчет по лабораторной работе №4	8,33 %	5,00	0–5	100,00 %		8,33 %
Отчет по лабораторной работе №5	8,33 %	5,00	0–5	100,00 %		8,33 %

Figure 3 - User report in the electronic course

With it, you can find out the final marks for each student's activity, the grading range, the teacher's feedback, and the contribution of the achievement to the overall result of the course. Together with the above-mentioned reports, this report allows the teacher to almost fully consider the stages and achievements of each student at any time, which undoubtedly gives additional levers of control to the teaching staff.

Note that the built-in tools for registering events and monitoring the Moodle training management system are primarily aimed at supporting the educational process, solving technical problems of the system itself and a number of information security issues. Unfortunately, Moodle without additional plug-ins can not provide information about site visitors, traffic sources, and there is no web-visor and other marketing reports, for example, about traffic sources and load indicators for the system. External tools can solve this problem, for example, Yandex.Metrica. Integrating this information system into our electronic information and educational environment, we were able to analyze additional statistical data [20].

Figure 4 - Analysis of visitors of the information and educational environment for 2018

For example, with the help of Yandex.Metrika, we can see that over the past year more than 85 thousand visitors have visited the resources of our electronic information and educational environment (Figure 4). Analyzing the sources of traffic, we can conclude that the main source of traffic in our environment is internal referrals (33.9%), in second place are referrals from search engines (23%), then follow links on sites (21, 4%), direct visits (15.6%) and transitions from social networks (6.23%).

Very useful is the analysis of the types of devices used. In our environment, more than 75% of users use personal computers as the main tool for accessing informational and educational environment materials, 24% of users use smartphones, less than 1% tablets, several people have used the TV over the last year to access electronic course materials. Analyzing this statistical information, it is worth noting that the share of smartphones and tablets as devices used in the information-educational environment is constantly growing. Unfortunately, the pace of this growth leaves much to be desired. Taking into account the fact that the authors of the Moodle platform have developed specialized clients for mobile devices for the main operating systems, taking into account the adapted design of the platform and statistics on the use of mobile devices of other training services, we can conclude that the low increase in users of mobile devices is primarily queue, with low adaptation of e-course content teachers to use on mobile devices.

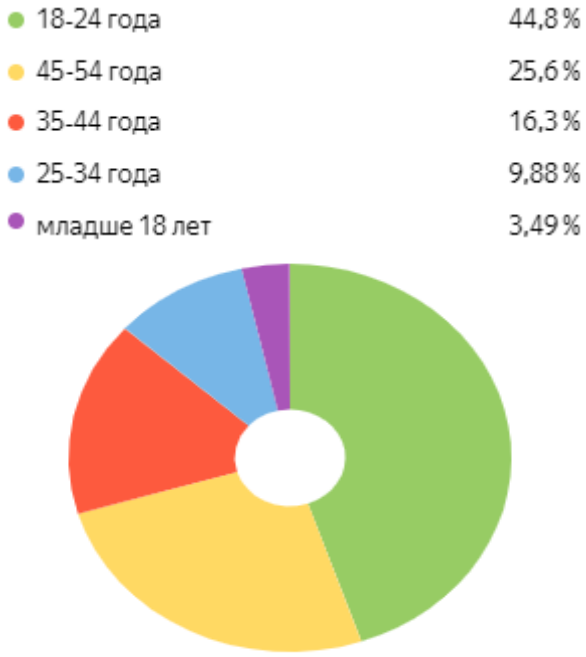


Figure 5 - Analysis of the age of visitors to the information environment for 2018

Another important statistical indicator is the analysis of the age composition of visitors. On the graph (Figure 5), it can be noted that a significant proportion of visitors to the information and educational environment are students aged 18–24 years and persons under 18 slightly less than 4%, which indicates a low activity of applicants in using the resources of the information educational environment. Increasing the activity of schoolchildren can be achieved by conducting competitions at various levels using the services of the information environment and the development of mass open online courses aimed at attracting applicants.

Another important Yandex.Metrica tool is a web-visor, an analytics tool designed to record user actions on the pages of the electronic information and educational environment [21, 22]. This tool (Figure 6) automatically records a series of user actions. As a result of the web-visor operation, a video is created that displays what actions the users performed on the site, what links they took, etc. Web visor videos are stored on Yandex servers for two weeks [23, 24]. It is possible to use the information obtained for obtaining additional analytics, analyzing the activity of users, their search queries, the time spent on the site, etc.

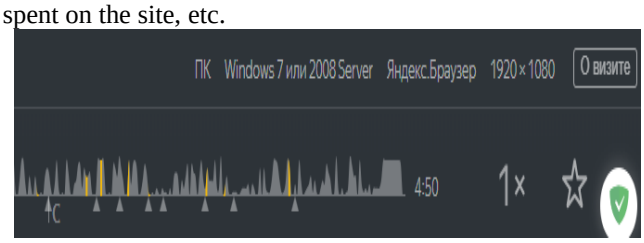


Figure 6 - The Yandex.Metrica web visor player

This system can help developers of information-educational environment to optimize their solutions, as well as identify errors made in the process of developing the site. There are six main user actions that can be recorded by the web-visor - moving the mouse cursor, scrolling pages, clicking the mouse, filling out forms, navigating through pages, selecting and copying text.

IV. CONCLUSION

Monitoring of the functioning and control of the effectiveness of using the electronic information and educational environment is one of the most important tasks from the point of view of its maintenance and development. The monitoring and control tools described in the work allow participants in the educational process, as well as system developers, to receive a large number of adapted for understanding statistical information. This information allows not only to optimize the educational process from the standpoint of control over the study of educational material, but also allows you to significantly improve the efficiency, convenience and quality of work of students in the electronic information and educational environment of the educational institution. The capabilities of the Moodle management system and the Yandex.Metrica information system described by us will help streamline the process of preparing students in higher education institutions.

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