Activating the Process of Educational Services Using Independent Computing Resources to Manage and Monitor the Quality of Learning

Nadiia Pasieka[1], Nelly Lysenko[1], Oleksandra Lysenko[1], Vasyl Sheketa[2], Mykola Pasieka[2] and Mariana Varvaruk[1]

[1] *Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, 76000, Ukraine,*
[2] *National Tech. University of Oil & Gas, Ivano-Frankivsk, 76068, Ukraine*

Abstract

The educational and methodological systems and methods aimed at enhancing the educational process are analyzed. These methods and techniques are designed to effectively solve problems, the quality and training of specialists on the basis of integrated methods, as well as improving the content, forms and methods of organizational educational process, implementing current trends. Based on these results, scientific research and practical research on the effectiveness of software application on independent computing structures showed many positive aspects, that is, this method has broad prospects for the construction of distributed information systems. The use of an independent computing structure allows the application software to be used around the clock without worrying about its working condition, since this task was outsourced to a third party when used. However, this way of organizing the management and monitoring of the educational process has its drawbacks, that is, the necessary level of protection of personal data on such independent platforms is not studied. Since the information database is located on an independent computing platform, the owner of the educational platform cannot guarantee the security of the process of external intervention. In addition, the use of information technology has been calculated and analyzed to prove and improve the model of enhancing the learning process, thereby improving the learning process and enhancing the quality of education.

Keywords 1

higher school, learning, quality of education, information technologies, management of higher education institution.

1. Introduction

With the rapid development of information and communication technologies, the expansion of free cloud services is becoming relevant to the application and introduction of the latest information services in industrial use on the basis of common use of competitive technologies. Taking this into account, there is an urgent need to outsource information and communication technologies – cloud services (IT-services) in the development. [2, 8, 17] The concept of "IT-outsourcing" provides the transfer of any IT process (program, function, work) or a certain part of a third party organization, which provides professional IT-services on an independent computer platform, it supports the functioning of information and reference, expert systems, information security databases and databases of enterprises, storage and processing of significant amounts of data, provision of hardware resources. Outsourcing

MoMLeT+DS 2021: 3rd International Workshop on Modern Machine Learning Technologies and Data Science, June 5, 2021, Lviv-Shatsk, Ukraine
EMAIL: pasyekanm@gmail.com (N. Pasieka); nelli.lysenko@gmail.com (N. Lysenko); lysenkowa@gmail.com (O. Lysenko); vasylsheketa@gmail.com (V. Sheketa); pms.mykola@gmail.com (M. Pasieka); varvaruk.mariana@gmail.com (M. Varvaruk)
ORCID: 000-0002-4824-2370 (N. Pasieka); 0000−0002−1029−7843 (N. Lysenko); 0000−0002−1029−7843 (O. Lysenko); 0000−0002−1318−4895 (V. Sheketa); 0000−0002−3058−6650 (M. Pasieka); 0000-0002-9606-9146 (M. Varvaruk)

solves the issue of reducing the financial and time costs of implementation, support and modernization of IT-infrastructure. It ensures the convergence of information and communication media, namely, the convergence of various electronic technologies to increase business requirements for stability and availability of IT- services. [11]

To develop a software system using cloud technologies, the development team must develop a structural scheme that defines the main functional properties of the software system, their interrelation and purpose. The functionality of a software system is understood as the components of the system elements, devices, functional groups, functional links. Building a structural scheme, which is designed to reflect the overall structure of the project (task in hand), is the development of its main blocks, nodes, parts and formation of the main links between them. From the structural scheme of software development of the system with the use of cloud technologies it should be clear how the system works in the main modes of operation and how its parts interact. The designations of the structural scheme elements can be chosen arbitrarily, though the generally accepted rules of scheme execution should be observed as much as possible. [13, 26]

Cloud computing is a free way to access external information and communication resources in the form of various Internet services. The term "cloud computing" was proposed by Ramnath K. Chellappa, who noted it as a computational paradigm in which the boundaries of computational elements will depend on the economic feasibility, not only on technical limitations [25]. The appearance of the first technology, which provided access to applications through the site, namely the software systems as a service (Software as a Service [SaaS]).

The urgency of development of distributed software systems on the basis of cloud technology lies in the fact that the need for modern high-performance systems is constantly growing and the methods of their correct development and algorithms of supporting computational work on independent computing platforms at the peak moments of the load are very few. [5, 6, 16] The study focuses on the most controversial modern challenges in the development of software systems based on cloud technology, faced by architects of such systems, namely, the algorithms of moving the load between the computing nodes and the architectures of software organization within the framework of business logic of enterprises. The use of the proposed technique on independent computing platforms for the development of fault-tolerant software systems based on cloud technology allows us to expand the worldview approaches to the construction of productive mechanisms of distribution of computational load between the nodes of the corresponding system. [1, 4, 9, 10, 12] Taking into account the insufficient research of this subject area we understand that the successful algorithm of the mechanism of transferring the computational load which promotes the effective modification of this resource within the framework of the task in hand is the main criterion in the choice of program technologies by the architect of program systems (Figure 1).

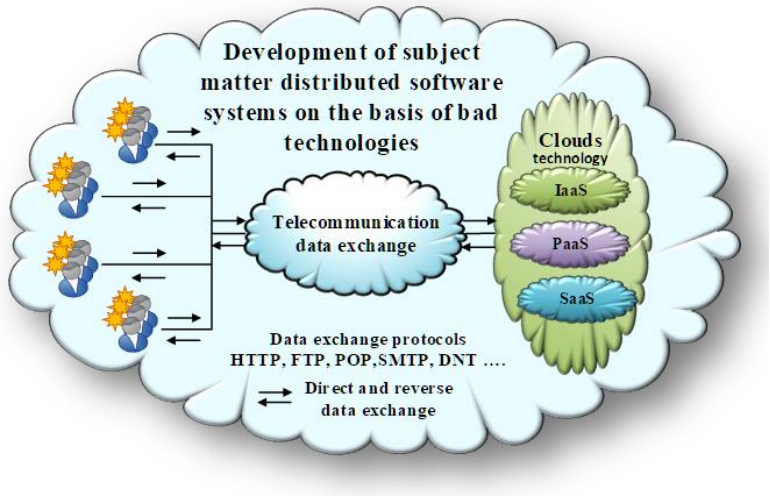

Figure 1: The model of fault-tolerant distributed software system based on cloud technologies

Methods: System analysis, logical mathematical approach to assessing the level of difficulty of test questions for an objective analysis of their complexity, analysis of publications on the topic,

comparison, generalization of cognitive and negative features of similar approaches and critical testing of the proposed development, cluster analysis of test questions, reasoning based on precedents.

2. Practical deploying educational services on a cloud platform to management and monitoring the quality of learning

With the rapid development of information technologies, other models of provision and use of cloud services on independent computing platforms were further developed (Figure 2) [31].

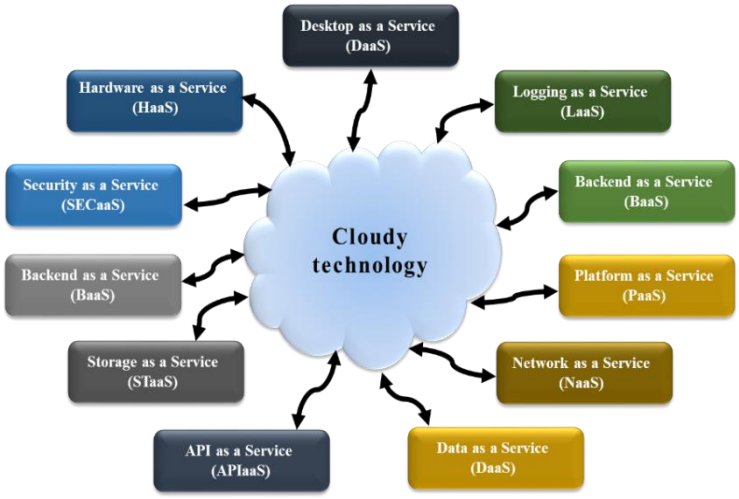

Figure 2: The model of cloud services on independent computing platforms

The evolutionary development of existing service models in particular:

- Hardware as a Service (HaaS) - hardware;
- Security as a Service (SECaaS) - providing security;
- Backend as a Service (BaaS) – "backend";
- Recovery as a Service (RaaS) - recovery of programs and data;
- Data as a Service (DaaS) - data acquisition and processing;
- Logging as a Service (LaaS) - authorization and identification;
- Network as a Service (NaaS) - network technologies;
- Platform as a Service (PaaS) - computing platform;
- Desktop as a Service (DaaS) - desktop;
- Storage as a Service (STaaS) - storages and databases;
- API as a Service (APIaaS) - API (application programming interface).

Some of the listed services provided by independent computing platforms are aimed at using a limited number of specialists as developers and administrators, while others are successfully used by consumers in a wide range of their activities. [23]

Development of software systems using cloud technologies refers not only to software modules, but also to ensuring their effective delivery of the developed software module as a component of the software system to interested users, and at the same time contains the stages of deployment and maintenance of software modules. However, the service-oriented architecture does not consider how the developed application should be delivered to the interested users or how independent providers of computing services will efficiently manage the software modules during their execution. Cloud computing on independent platforms can help SOSE deliver software modules efficiently by ensuring that they can be easily deployed and maintained by cloud service providers through virtualization, using a standardized interface for easy access by interested users and using software modules as part of a developed cloud-based software system.

Challenges for software development

Today's paradigms in software development using independent computing platforms require innovative approaches to providing efficient virtualization and interaction between the layers of SaaS, PaaS and IaaS. The essence of this approach calls for a rethinking of urgent issues in software engineering, but some of them are not new, and at the same time they require more serious attention in

the context of providing computing services on cloud platforms. We noted seven critical areas in the development that create serious obstacles to the development of software modules using SOSE.

Confidentiality and data integrity

By using independent cloud computing platforms, interested users have limited control over the processing and storage of data streams, i.e. on remote computing nodes owned and operated by various cloud service providers. Since these data streams are not encrypted, there is a significant risk that cloud service providers or malware may disclose or alter their content. While there are many methods to protect your privacy, all of them cannot fully guarantee it, but when applying a certain model of protection to cloud services and systems, you must remember that they are only designed to protect your data flows from malicious attacks outside the system [14]. Cloud services and software on independent platforms have different providers of these services within the virtual system.

Reliability and availability of cloud platforms as services

Stakeholders rely heavily on independent cloud service providers for business logic solutions. There are growing concerns in the information space about how these information threats can affect the reliability and availability of cloud platforms as a service - from the uncertain economic climate of society as a whole, and of the service provider in particular, to natural and man-made disasters and cyberattacks - can have a significant impact on the service, and therefore on the business, of the cloud user. To minimize these information threats, independent cloud service users must test their data backup plan, system reliability, disaster recovery and disaster recovery plans. To minimize these information threats, independent cloud service users must verify their data backup plan, overall system reliability, emergency exit and software system recovery plans, end-of-service support, and event history documentation before deciding to use certain services. [20, 21, 28] Today, a variety of cyberattacks are an extremely critical threat. Independent cloud computing services and systems provide fast and flexible computing resources to meet the business needs of interested users. For the business community, the computing capabilities and resources of independent cloud service providers often seem unlimited, as they are available at any time and in any volume. However, information-cyberattack software can also buy significant amounts of cloud computing resources that enable them to launch more powerful cyberattacks. Attackers have already used the Amazon EC2 and Google App Engine cloud computing platforms. To solve this problem, both for the services themselves and for independent cloud service providers, innovative and effective software tools are needed to monitor and detect harmful actions against users, as well as to strictly authenticate users and control their access.

Security in a multitasking cloud

In the developed software systems with the use of cloud technologies on independent computing platforms in a multifunctional device one copy of the software module runs on the server, which can have several users or tenants at the same time. In the multilayer architecture the software system is developed practically separates its information data and configuration, where each interested user works with an individual sample of the virtual software module.

Services and systems of cloud computing on independent computing platforms have a multi order, because many interested users repeatedly use the software module and a set of hardware for processing information flows. The main problem with cloud data flow protection platforms and developed software systems is the vulnerability to cyberattacks. To provide the necessary level of protection, service providers use a hypervisor that controls access between virtual machines and hardware and software. However, some hardware and software tools, such as processor caches and graphics processors, are not designed to provide strong insulation properties for multilayer architecture. Even virtual machine hypervisors, which are provided by an independent cloud service provider, may have some flaws that allow the virtual machine of one interested user to gain unauthorized control over other tasks and data flows. More recently, cybercriminals have exploited multiple hypervisor vulnerabilities to affect other users' computing operations or to gain unauthorized access to data sets. Therefore, addressing these vulnerabilities requires innovative methods of developing software systems to provide multilayer architectures for cloud-based services, such as virtual machine isolation and monitoring.

Cloud risk profile

Cloud-based software systems developed on independent computing platforms have limited access to services and cloud computing, as well as information on internal system architecture, software module versions, configuration, operations and related security practices of these service providers. This limited access for interested users can increase usability, but it also has serious limitations for operational risk management. Risk management in software engineering ensures that module developers initially identify and analyse threats to the software module business process and use appropriate strategies to minimize and control risks. Namely, how the failure to complete projects within the specified time schedules and

budget constraints, as well as not fully meet the requirements of interested users. Since software developers using cloud technology lack information about the internal organization of the system under the layer of virtual abstraction, they may not be able to conduct appropriate research on risk management. To solve this problem, software developers should turn to independent cloud service providers and consider three steps:

- partial or full disclosure of software design and infrastructure information;
- Disclosure of relevant logs and data such as network intrusion logs, anomaly logs and security logs;
- Disclosure of security policy details and enforcement mechanisms.

Taking a professional look at these steps will not completely eliminate the risk, but the information obtained will provide much more effective business risk management.

Monitoring the quality of cloud service delivery

Independent providers of cloud platforms as services and management of various QoS software requirements are extremely difficult to manage, as numerous software module developers dynamically create services in networks to form several computing workflows, and different cloud technology providers with different methods and policies manage services in different ways. As a result, the QoS functions of all cloud services are closely linked and there are trade-offs between them.

Thus, the functions responsible for the bandwidth and latency of a particular service rely on the distribution of information resources of the developed software system during the execution of the module. Often, a single server hosts multiple services that compete for CPU time, memory and server bandwidth. In addition, service compositions, the status of server resources, workflow priorities and QoS requirements usually change dynamically during cloud computing. So, meeting QoS requirements for multiple computing processes requires effective methods of adaptive allocation of system resources for each cloud service. Managing multiple QoS properties for such developed software, services and cloud computing systems requires situational awareness, context analysis and QoS assessment, as well as optimal hardware and software resource allocation. [18, 22]

Internet Things as Cloud Services Delivery Systems

When developing software systems using cloud technology, the main criterion is the network, because users or software systems are located on different hardware devices, namely: desktops, laptops, smartphones, tablets and personal computers, that is, they can access network services at any time and in any place with the help of standard protocols of information exchange. Since identity theft and service theft are major threats, mobile services and computing providers in independent cloud platforms require rigorous software development techniques to provide unrestricted access to computing data services. [3]

Cloud platform legislation

Users who use cloud computing services and systems on independent platforms do not know the exact physical and geographical location of their data because they have often processed and stored data in undefined locations, both domestic and foreign. However, legally, each territory has a different legislative jurisdiction, and independent cloud service providers in foreign countries cannot always guarantee compliance with regulatory and legal requirements. This can be, for example, protection of privacy, backup of information data or the provision of audits and the like. Thus, independent cloud service providers may not be prepared to take responsibility for security incidents, failure to comply with data backup requirements, and the provision of audits. They may also not be able to protect intellectual property according to compliance standards.

While computing services and cloud computing have great potential, there are some criticisms of meeting the increasing demands for dynamic development and use of software modules, and the full realization of this potential requires a change in the structure of software development.

3. Practical deploying educational services on a cloud platform to management and monitoring the quality of learning

3.1. Information support of the learning process and its management

The problem of effective or assured functioning of integrated systems of organizational and production direction is related to both technological components and the ability of personnel to make decisions. That is, the level of professional training of operators of different authority ranks is one of the decisive criteria

for the functioning of the integrated hierarchical information management system of a higher educational institution.

The professional level of pedagogical and production personnel is based on the knowledge base obtained in school, so it is developed on the basis of subject-oriented theoretical knowledge obtained in higher education and in the process of special training or mobile trainings. As practice of work of the personnel in various conditions (extreme, marginal) shows, not all cope with technological tasks for a number of reasons (physiological, mental, cognitive), that is such workers in extreme conditions cannot effectively use the acquired knowledge given some features of thinking or behavior [33, 36, 38].

The analysis showed that for an effective management strategy it is necessary to consider, in addition to technological requirements, the ability of administrative personnel to make decisions in different situations [32, 37]. This ability is closely related to intelligence, psychology, professional training, the level of mental and intellectual stability and way of thinking in making decisions with appropriate information support.

Types of thinking in terms of levels of cognition (sensory and rational) can be reflected in the following order:

- philosophical theoretical thinking at the verbal-logical level;
- generation of ideas and hypotheses regarding problem-solving schemes;
- visual (figurative) thinking - action thinking, in which the solution of problems is carried out by real transformation of the situation in the target with the observation of the motor act;
- visual-imaginative thinking - is associated with the representation of situations and their changes as a result of activity, taking into account the acting factors and completing the various characteristics of objects;
- analytical (logical) thinking, its dynamics and structuring are determined by the hierarchy of levels of goal orientation, a real assessment of the situation, effective purposeful search for a scheme of problem solving;
- heuristic as an egocentric disoriented inner thinking of a person.

Thus, information support for the learning and management process of the university is a process of determining the strategic content, search, collection, processing and presentation of necessary information in an informative form. The use of information technology ensures the intensification of the learning process and provides an opportunity to improve the effectiveness of the educational level of the specialist [29].

3.2. Software service of the learning management process

To prove the effectiveness of using computer services on independent computing platforms to monitor and manage the learning process we deploy a specialized software application whose work is shown in (Figure 3-6). This specialized computer application can be used both for students (trainees) and teachers [19, 30]. It allows you to interactively select from an information database only the information you need at the moment.

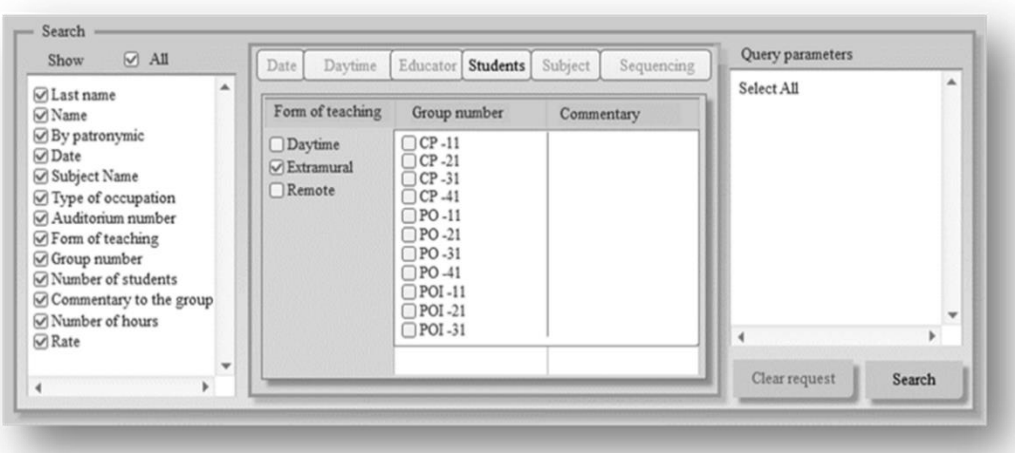

Figure 3: An example of a robot program: “Information about students”

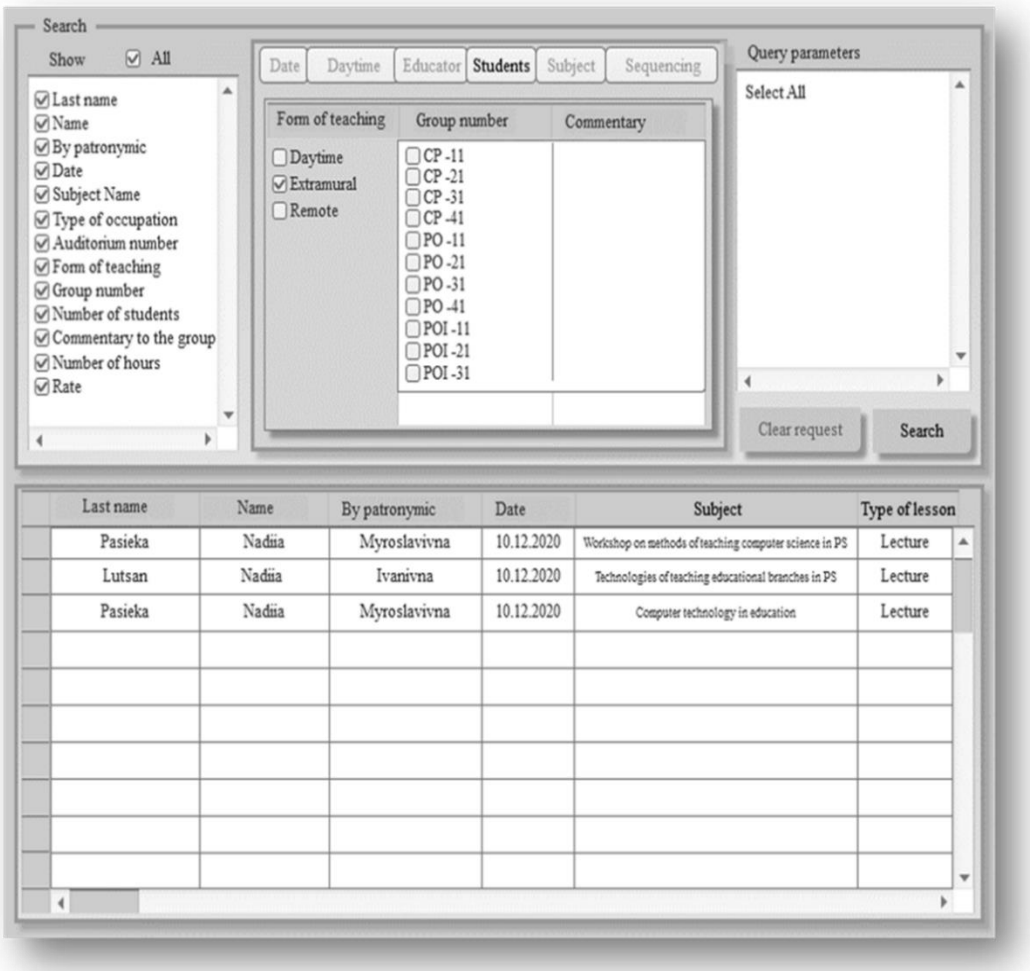

Figure 4: An example of a robot program: “Information about students”

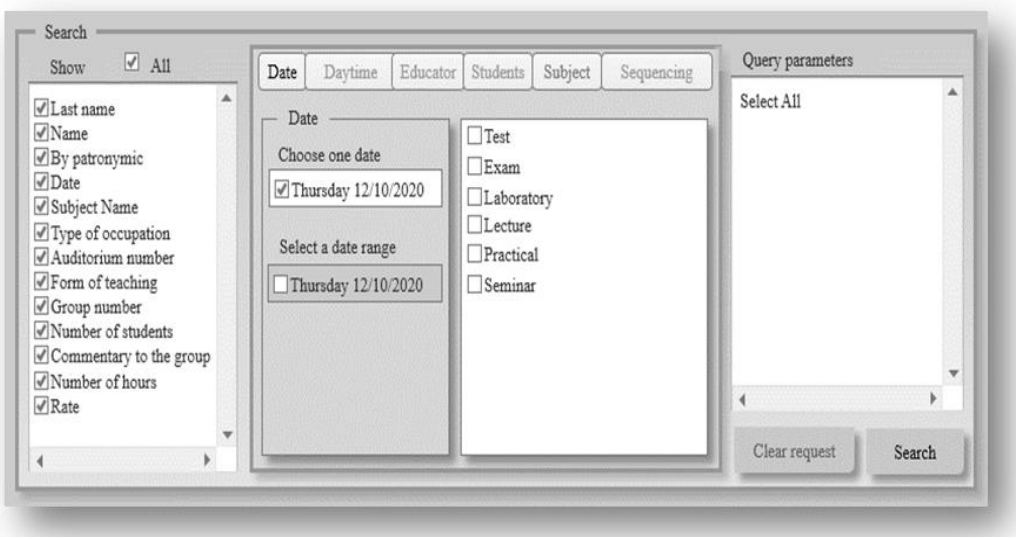

Figure 5: An example of a robot program: “By date interval”

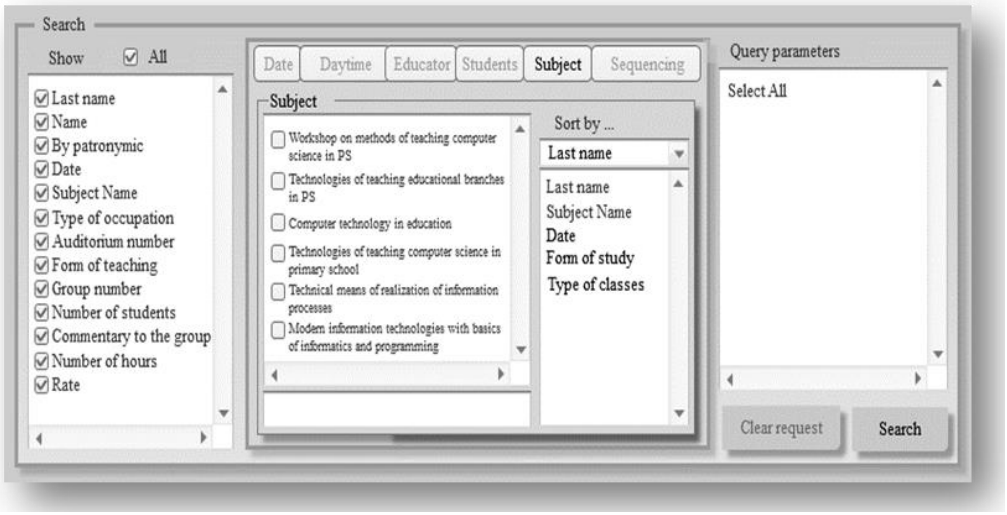

Figure 6: An example of a robot program: "In the context of the subjects studied"

Besides, at the further expansion of functionality of the given software application with use of storehouses of the data where the information on all listeners and teachers for the certain interval of time will be stored, there will be a possibility of analytical processing of these data for support of acceptance of administrative decisions for the purpose of improvement of ways of delivering the educational content and thereby to provide possibility to influence improvement of quality of rendering of educational services.

4. Logical and mathematical model for assessing the level of difficulty of test tasks to enhance the learning process

Let the test consist of *m* different tasks, and *n* students perform the test. Denote by $x_{i,j}$, *j* the numerical score of the success of the *j-th* task and the *i-th* student. If the *j-th* student performed *j-th* task, then $x_{i,j} = 1$ to *100* points for the task. Test results in the form of a matrix of results x, which has size *[n] [m]*, are shown in Table 1: where - $i = 1, n$ - number of students who participated in the test; $j = 1, m$ - number of questions posed to students.

Table 1

The result of the test of students in relation to question numbers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
St. 1	84	50	92	87	91	77	94	90	98	100	96	97	86	94	85	42	79	100	88	91	86
St. 2	80	48	80	77	88	74	78	92	69	98	77	80	84	88	83	64	69	98	84	88	80
St. 3	90	93	87	92	93	75	94	100	78	89	84	82	92	95	97	52	93	100	94	96	91
St. 4	77	65	58	75	72	84	81	66	71	67	83	98	74	85	88	79	83	100	77	86	78
St. 5	66	60	63	54	72	65	80	65	63	61	74	80	70	84	78	69	67	100	74	68	71
St. 6	55	51	64	67	72	68	83	55	39	64	67	64	69	85	77	57	65	90	65	57	69
St. 7	80	52	88	87	92	79	94	92	90	94	90	92	84	90	84	68	79	92	85	89	82
St. 8	77	76	84	75	82	74	83	90	74	90	80	77	86	84	85	76	82	89	83	86	82
St. 9	88	90	85	88	90	78	92	96	76	86	88	83	87	90	90	77	92	96	92	92	88
St. 10	82	74	66	82	76	88	84	69	78	87	83	80	86	88	84	85	81	74	68	82	78
St. 11	77	69	74	65	72	78	86	63	69	79	76	74	78	82	69	78	84	97	87	83	77
St. 12	69	71	72	74	74	70	81	65	77	84	82	68	72	64	61	76	70	95	71	67	76

Graphical representation of the results of the test in relation to the quality of the questions is shown in (Figure 7).

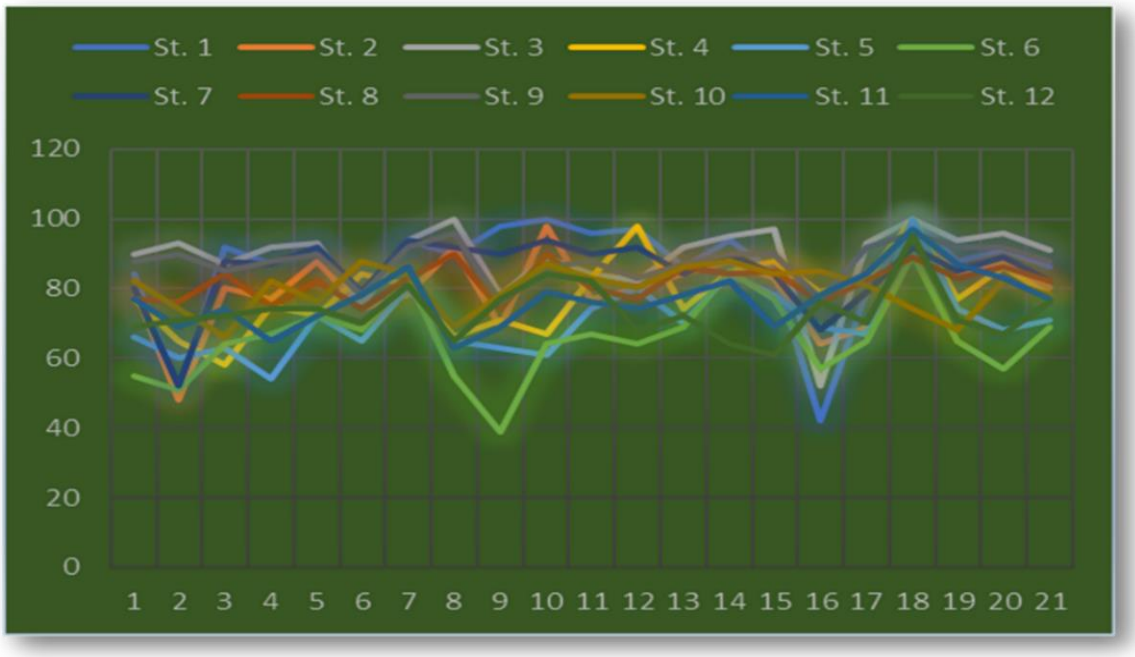

Figure 7: Visualization of the quality of the questions posed to determine the level of knowledge of students

By calculating $p_i = \frac{\sum_{j=1}^{m} X_{ij}}{m}$ (the proportion of correct answers of the *i-th* student for all test items and $q_i = 1 - p_i$ – the proportion of incorrect answers), you can determine the initial logit of each student's knowledge level (that is, the initial score of the knowledge level *i-th* student in the logit scale):

$$\theta_i^0 = \ln(p_i / q_i), \quad i = l, n. \tag{1}$$

By calculating $p_j = \frac{\sum_{j=1}^{m} X_{ij}}{m}$ (the proportion of correct answers of all students in the group to the *j*-th task and $q_j = 1 - p_j$ – the proportion of incorrect answers), we can determine the initial logit of task difficulty (that is, the initial estimate of the level of difficulty of the *j-th* task on the logit scale):

$$\delta_j^0 = \ln(p_j / q_j), \quad j = l, m. \tag{2}$$

This stage of parameter estimation is the initial one. After its completion each of the parameters will be expressed in an interval scale, but with different values of the mean and different standard deviations. At the next stage we translate the value of θ_i^0 and δ_j^0 into one interval scale, having previously calculated the average value of the initial logits of students' knowledge level:

$$\theta = \theta_i^0 + \cdots + \theta_n^0, \tag{3}$$

And the standard deviation *V* of the distribution of the initial values of the parameter:

$$V = \sqrt{\frac{\sum_{i=1}^{n} (\theta_i^0 - \theta)^2}{n-1}}, \tag{4}$$

We get the formula for calculating the logit complexity of the *j-th* problem:

$$\delta_j = \theta + Y * \delta_j^0, \qquad j = 1, m; \tag{5}$$

Where

$$Y = \left(1 + \frac{V^2}{2{,}89}\right)^{1/2}. \quad (6)$$

Similarly, calculating:

$$\delta = \frac{\delta_1^0 + \cdots + \delta_m^0}{m}, \ldots W = \frac{\sum_{j=1}^{m}\left(\delta_j^0 - \delta\right)^2}{m-1}, \quad X = \left(1 + \frac{W^2}{2{,}89}\right)^{1/2}. \quad (7)$$

We get a formula to calculate the logit level of knowledge *i-th* student:

$$\theta_i = \delta + X * \theta_i^0, \qquad i = 1, n. \quad (8)$$

This estimation of the parameter δ_j makes it possible to assess the level of difficulty of all tasks, regardless of the level of students' proficiency.

Given the values obtained, we can determine the level of students' knowledge by the difficulty level of the test tasks. If $\theta_i - \delta_j$ – is a negative value and large in modulo, then the task difficulty is too hard for a student with the level of knowledge δ_j and it will not be useful for assessing the level of knowledge θ_i of the *i-th* student. If this difference is positive and large modulo, then the problem is too easy, the student learned the question a long time ago. If $\theta_i - \delta_j$ so, then the probability that the student will complete the task correctly is 0.5.

After estimating the values of $\theta_i - \delta_j$ in the logit scale, calculate the probability $P(\theta)$ of different students completing the jth test item correctly:

$$P_j(\theta) = \frac{e^{1,7*(\theta-\delta_j)}}{1 + e^{1,7*(\theta-\delta_j)}} \quad (9)$$

Where

$$\theta = (\theta_1, \theta_2, \ldots, \theta_n). \quad (10)$$

The probability of P_j correctly completing *j-th* the test assignment is a rising function of the variable θ_i. Obviously, the higher a student's level of knowledge, the greater the probability that he or she will correctly complete *j-th* the test task.

By introducing the conditional probability P_j of different students correctly completing *j-th* the task, we can proceed to construct a curve: *j-th* test task (Figure 8).

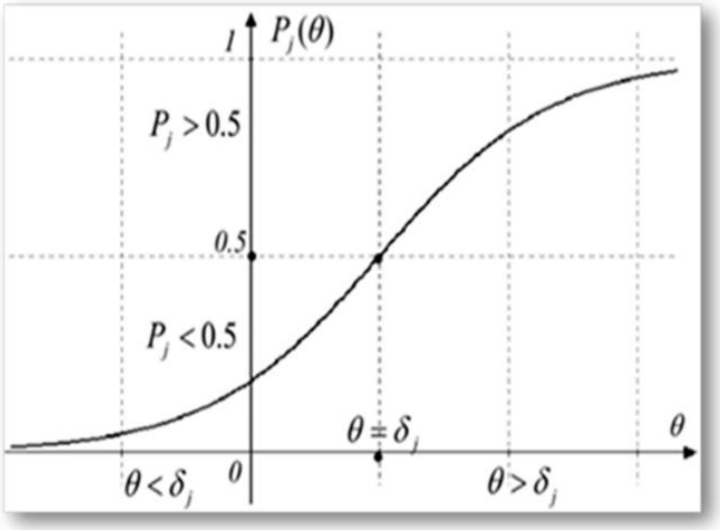

Figure 8: Characteristic curve of the *j-th* task

The characteristic curve j-th of the test task shows the relationship between the values of the independent variable θ and the values P_j. The inflection point of the curve: corresponds to the value $\theta = \delta_j$, and at

this $\theta = \delta_j$ point equals 0.5. Thus, a student with a level of knowledge corresponding to the difficulty of j-th test item will answer it correctly with probability 0.5.

For students with a level of knowledge much higher than δ_j, the probability of a correct answer to this task approaches unity. If, however, the value of θ is placed far enough away from the value $\theta = \delta_j$ and to the left of the inflection point, then the probability of correctly completing the j-th task will approach zero.

The characteristic curves corresponding to tasks of different difficulty levels do not overlap. An increase in the difficulty of the j-th test item by the constant C (C> 0) will cause the characteristic curve to shift to the right. With the previous probability, the student with proficiency level $\theta + C$ will answer this problem. Since $\theta - \delta = (\theta + C) - (\delta + C)$, the value of the function $P_j(\theta)$ does not change. So, if a difficult problem is taken, the student whose level of proficiency changes by the same constant as the level of difficulty of the problem will answer it with the same probability.

The fundamental difference of testing system based on adaptive tests is that the assessment of students' knowledge level does not depend on the difficulty of the test, that is, it is objective. Assessment of students' knowledge level can be effectively used to solve problems of optimization of the educational process - evaluation of the effectiveness of innovative technology, monitoring, intelligence of students and teachers.

Conclusion

The analysis of educational and methodological systems and methods to improve the educational process aimed at effective solution of the problems of competence, quality of training specialists was carried out. Based on the results obtained, a scientific and practical study of the effectiveness of software application on independent computing structures was conducted, which showed a number of positive points, namely: this approach to the construction of distributed information systems has significant prospects for the future. The use of independent computing structures makes it possible to use application software around the clock without worrying about its working condition, because this task is transferred to third parties during such use. However, this approach to organizing the management and monitoring of the educational process has its disadvantages, namely: the required level of personal data protection on such independent platforms has not yet been investigated. Since the information database is located on an independent computing platform, the owner of the educational platform cannot guarantee security with respect to external intervention processes. In addition, a computational analysis in terms of the use of information technology was conducted, which resulted in the justification and improvement of the test analysis model, which improved the learning process and the quality of education. The application of the method of analysis to improve the educational process on the basis of information technology was substantiated. The use of information and communication technologies provides intensification of specialist training, as a result of which the objectives are achieved, that is, the maximum amount of professional training for the minimum possible time of processing educational material.

References

[1] A. Sun, G. Gao, T. Ji and X. Tu, “One Quantifiable Security Evaluation Model for Cloud Computing Platform,” 2018 Sixth International Conference on Advanced Cloud and Big Data (CBD), Lanzhou, China, 2018, pp. 197-201, doi: 10.1109/CBD.2018.00043.

[2] A. Yasmeen, M. Yasmin and M. S. Saleem, “Cognitive Learning in Outcome-Based Education: A Case Study of Bachelor of Science in Electrical Engineering,” 2019 International Conference on Innovative Computing (ICIC), Lahore, Pakistan, 2019, pp. 1-5, doi: 10.1109/ICIC48496.2019.8966711.

[3] C. M. C. Rezende, A. C. G. Inocêncio, T. B. De Oliveira and A. P. F. V. Boaventura, “Educational Technologies for Brazilian Basic Education,” 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), Coimbra, Portugal, 2019, pp. 1-5, doi: 10.23919/CISTI.2019.8760595.

[4] C. P. Morrey, “Pathway Mapping for an Educational Program,” 2020 Intermountain Engineering, Technology and Computing (IETC), Orem, UT, USA, 2020, pp. 1-5, doi: 10.1109/IETC47856.2020.9249219.

[5] C. Wei and L. Yuan, “Reflection on College Informationized Teaching Model under the Background of Educational Informationization,” 2019 IEEE International Conference on Computer Science and Educational Informatization (CSEI), Kunming, China, 2019, pp. 81-83, doi: 10.1109/CSEI47661.2019.8939017.

[6] E. Doko and L. A. Bexheti, “A systematic mapping study of educational technologies based on educational data mining and learning analytics,” 2018 7th Mediterranean Conference on Embedded Computing (MECO), Budva, 2018, pp. 1-4, doi: 10.1109/MECO.2018.8406052.
[7] G. Fox and S. Jha, “Conceptualizing a Computing Platform for Science Beyond 2020: To Cloudify HPC, or HPCify Clouds?” 2017 IEEE 10th International Conference on Cloud Computing (CLOUD), Honolulu, CA, 2017, pp. 808-810, doi: 10.1109/CLOUD.2017.120.
[8] G. McGrath, J. Short, S. Ennis, B. Judson and P. Brenner, “Cloud Event Programming Paradigms: Applications and Analysis,” 2016 IEEE 9th International Conference on Cloud Computing (CLOUD), San Francisco, CA, USA, 2016, pp. 400-406, doi: 10.1109/CLOUD.2016.0060.
[9] G. Soltan, G. Zunimova and G. Sarsenbayeva, “The Algorithm for Designing Competency Oriented Educational Programs Based on the Data Analysis of Academic Processes,” 2020 Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology, Yekaterinburg, Russia, 2020, pp. 1-4, doi: 10.1109/USBEREIT48449.2020.9117787.
[10] Haryono, Y. Utanto, Budiyono, E. Subkhan and S. Zulfikasari, “The Implementation of Educational Technologists' Competencies in Improving Learning Quality,” 2019 5th International Conference on Education and Technology (ICET), Malang, Indonesia, 2019, pp. 76-80, doi: 10.1109/ICET48172.2019.8987215.
[11] J. C. Ponce Gallegos, B. A. Toscano, A. Silva Sprock, J. Muñoz Arteaga and N. Aguas, “Educational Inclusion in Higher Education: Mexico,” 2019 XIV Latin American Conference on Learning Technologies (LACLO), San Jose Del Cabo, Mexico, 2019, pp. 204-211, doi: 10.1109/LACLO49268.2019.00043.
[12] J. Renz and C. Meinel, “The “Bachelor Project”: Project Based Computer Science Education,” 2019 IEEE Global Engineering Education Conference (EDUCON), Dubai, United Arab Emirates, 2019, pp. 580-587, doi: 10.1109/EDUCON.2019.8725140.
[13] K. Chrysafiadi, S. Papadimitriou and M. Virvou, “Which is better for learning: a web-based educational application or an educational game?” 2019 International Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS), Berlin, Germany, 2019, pp. 1-6, doi: 10.23919/SPECTS.2019.8823232.
[14] L. He, Q. Liang, R. Wang, Z. Yin and X. Wei, “Curriculum Design with the Integration of STEAM and Educational Game,” 2020 International Symposium on Educational Technology (ISET), Bangkok, Thailand, 2020, pp. 127-129, doi: 10.1109/ISET49818.2020.00036.
[15] M. Bahrami and M. Singhal, “A dynamic cloud computing platform for eHealth systems,” 2015 17th International Conference on E-health Networking, Application & Services (HealthCom), Boston, MA, USA, 2015, pp. 435-438, doi: 10.1109/HealthCom.2015.7454539.
[16] M. Pasyeka, V. Sheketa, N. Pasieka, S. Chupakhina and I. Dronyuk, “System Analysis of Caching Requests on Network Computing Nodes,” 2019 3rd International Conference on Advanced Information and Communications Technologies (AICT), Lviv, Ukraine, 2019, pp. 216-222, doi: 10.1109/AIACT.2019.8847909.
[17] M. Qian, B. Zhao and Y. Gao, “Exploring the Training Path of Design Thinking of Students in Educational Technology,” International Conference on Computer Science and Educational Informatization, Kunming, China, 2019, pp. 315-319, doi: 10.1109/CSEI47661.2019.8938895.
[18] Medykovskyy M., Pasyeka M., Pasyeka N. & Turchyn O. (2017). “Scientific research of life cycle perfomance of information technology.” 12th International Scientific and Technical Conference on Computer Sciences and Information Technologies, CSIT 2017, pp. 425-428. doi:10.1109/STC-CSIT.2017.8098821
[19] Mykhailyshyn H., Pasyeka N., Sheketa V., Pasyeka M., Kondur O. & Varvaruk M. (2021). “Designing network computing systems for intensive processing of information flows of data” doi:10.1007/978-3-030-43070-2_18
[20] O. Mishchuk, R. Tkachenko and I. Izonin, “Missing Data Imputation through SGTM Neural-Like Structure for Environmental Monitoring Tasks.” Advances in Intelligent Systems and Computing. Vol. 938. 2020, pp. 142-151, doi:10.1007/978-3-030-16621-2_13
[21] P. Chou, “Little Engineers: Young Children's Learning Patterns in an Educational Robotics Project,” 2018 World Engineering Education Forum - Global Engineering Deans Council (WEEF-GEDC), Albuquerque, NM, USA, 2018, pp. 1-5, doi: 10.1109/WEEF-GEDC.2018.8629609.
[22] P. Lushyn, Y. Sukhenko and O. Davydova, “Particularities of Students’ Educational Trajectories and “Projectories”: A Psychosemantic Dimension,” 2020 IEEE Problems of Automated Electrodrive. Theory and Practice (PAEP), Kremenchuk, Ukraine, 2020, pp. 1-4, doi: 10.1109/PAEP49887.2020.9240866.
[23] Pasieka N., Sheketa V., Romanyshyn Y., Pasieka M., Domska U. and Struk A. “Models, methods and algorithms of web system architecture optimization.” Paper presented at the 2019 IEEE International Scientific-Practical Conference: Problems of Infocommunications Science and Technology, PIC S and T 2019 – pp. 147-152. doi:10.1109/PICST47496.2019.9061539

[24] Pasyeka M., Sheketa V., Pasieka N., Chupakhina S. and Dronyuk, I. (2019). “System analysis of caching requests on network computing nodes.” 3rd International Conference on Advanced Information and Communications Technologies, AICT2019 - Proceedings, pp. 216-222, doi:10.1109/AIACT.2019.8847909
[25] Pasyeka M., Sviridova T. and Kozak I. “Mathematical model of adaptive knowledge testing”. 5th International Conference on Perspective Technologies and Methods in MEMS Design, MEMSTECH 2009, pp. 96-97.
[26] Pasyeka N., Mykhailyshyn H. and Pasyeka M., “Development Algorithmic Model for optimization of Distributed Fault-Tolerant Web-Systems,” 2018 International Scientific-Practical Conference Problems of Infocommunications. Science and Technology (PIC S&T), Kharkiv, Ukraine, 2018, pp. 663-669, doi: 10.1109/INFOCOMMST.2018.8632160.
[27] S. G. Temesio Vizoso, “Open educational resources in an individualized education plan,” 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), Coimbra, Portugal, 2019, pp. 1-3, doi: 10.23919/CISTI.2019.8760670.
[28] S. M. Bhalerao and M. Dalal, “Improved social network aided personalized spam filtering approach using RBF neural network,” 2017 International Conference on Intelligent Computing and Control (I2C2), Coimbatore, 2017, pp. 1-5, doi: 10.1109/I2C2.2017.8321938.
[29] S. Papadimitriou, K. Chrysafiadi and M. Virvou, “Evaluating the use of fuzzy logic in an educational game for offering adaptation,” 2019 International Conference on Computer, Information and Telecommunication Systems (CITS), Beijing, China, 2019, pp. 1-5, doi: 10.1109/CITS.2019.8862064.
[30] Shepard M.E., Sastre E.A., Davidson M.A. et al, “Use of individualized learning plans among fourth-year sub-interns in pediatrics and internal medicine.” Med Teach. 2012. pp.316-324
[31] Sikora L., Lysa N., Fedyna B., Durnyak B., Martsyshyn R. and Miyushkovych Y. (2018). “Technologies of development laser based system for measuring the concentration of contaminants for ecological monitoring.” Paper presented at the 2018 IEEE 13th International Scientific and Technical Conference on Computer Sciences and Information Technologies, CSIT 2018 - Proceedings, 1 93-96. doi:10.1109/STC-CSIT.2018.8526602
[32] T. A. Tabishev, M. V. Alikaeva and A. L. Betuganova, “Electronic Informational and Educational Environment and Organization of the Educational Process of a Modern University (on the Materials of the Kabardino-Balkar State University),” 2019 International Conference "Quality Management, Transport and Information Security, Information Technologies" (IT&QM&IS), Sochi, Russia, 2019, pp. 569-572, doi: 10.1109/ITQMIS.2019.8928402.
[33] X. Meng, C. Cui and X. Wang, “Looking Back Before We Move Forward: A Systematic Review of Research on Open Educational Resources,” 2020 Ninth International Conference of Educational Innovation through Technology (EITT), Porto, Portugal, 2020, pp. 92-96, doi: 10.1109/EITT50754.2020.00022.
[34] Y. Romanyshyn, V. Sheketa, L. Poteriailo, V. Pikh, N. Pasieka and Y. Kalambet “Social-communication web technologies in the higher education as means of knowledge transfer.” IEEE 2019 14th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT). – Vol.3. – 2019. – Lviv, Ukraine. – pp. 35–39.
[35] Zharikova M. & Sherstjuk, V. (2017). “Academic integrity support system for educational institution.” 2017 IEEE 1st Ukraine Conference on Electrical and Computer Engineering, UKRCON 2017 - Proceedings, pp. 1212-1215. doi:10.1109/UKRCON.2017.8100445
[36] Shkitsa, L., Kornuta, V., Kornuta, O., Bekish, I.: The model of informational space for innovation and design activities in the university. Sci. Innov. 15(6), 14–22 (2019). https://doi.org/10.15407/scin15.06.014Shkitsa, L., Kornuta, V., Kornuta, O., Bekish, I., Bui, V.: Information support of design innovation activity of the technical university. Manag. Syst. Prod. Eng. 28(2), 127–132 (2020). https://doi.org/10.2478/mspe-2020-0019
[37] Shkitsa L., Kornuta V., Kornuta O., Bui V., Bekish I. (2021) In-campus Way of the Insight Transfer Technology. In: Ivanov V., Trojanowska J., Pavlenko I., Zajac J., Peraković D. (eds) Advances in Design, Simulation and Manufacturing IV. DSMIE 2021. Lecture Notes in Mechanical Engineering. Springer, Cham. https://doi.org/10.1007/978-3-030-77719-7_32
[38] Shkitsa L., Kornuta V., Kornuta O., Bui V., Bekish I. (2021) In-campus Way of the Insight Transfer Technology. In: Ivanov V., Trojanowska J., Pavlenko I., Zajac J., Peraković D. (eds) Advances in Design, Simulation and Manufacturing IV. DSMIE 2021. Lecture Notes in Mechanical Engineering. Springer, Cham. https://doi.org/10.1007/978-3-030-77719-7_32