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Introduction of mobile education in the educational process in the university

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ABSTRACT

The goal is to consider the possibilities of a virtual educational ecosystem using mobile devices, interactions of students and teachers, faculties and laboratories of the university, interactive activation of educational material and monitoring of the student learning process. The research methodology includes methods of system analysis, synthesis, decision-making, multi-agent systems and situational modeling. Results of the work: 1) a systematic interpretation of the category "mobile training" is proposed, its "pros" and "cons" are classified; 2) an informological scheme and a methodological scheme of mobile training are proposed; 3) practical examples of training (on the example of training managers in the field of tourism) using the organization of modeling, independent work of students are considered; 4) shows examples of approaches to making team business decisions and conducting situational modeling; 5) a systemically significant conclusion was made that simple, auxiliary tasks and simple memorization of facts students transfer to independent work, freeing up time for creative cooperation.

KEYWORDS: educational equipment; development; system analysis.

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Introducción de la educación móvil en el proceso educativo en la universidad

RESUMEN

El objetivo del artículo es considerar las posibilidades de un ecosistema educativo virtual utilizando dispositivos móviles, interacciones de estudiantes y profesores, facultades y laboratorios de la universidad, activación interactiva de material educativo y seguimiento del proceso de aprendizaje estudiantil. La metodología de investigación incluye métodos de análisis de sistemas, síntesis, toma de decisiones, sistemas multi-agentes y modelado situacional. Resultados del trabajo: 1) se propone una interpretación sistemática de la categoría «formación móvil», se clasifican sus «pros» y «contras»; 2) se propone un plan informológico y un plan metodológico de formación móvil; 3) se consideran ejemplos prácticos de formación (por ejemplo, de directivos de formación en el ámbito del turismo) utilizando la organización del modelado, el trabajo independiente de los estudiantes; 4) muestra ejemplos de enfoques para tomar decisiones empresariales en equipo y llevar a cabo el modelado situacional; 5) se llegó a una conclusión sistémicamente significativa de que las tareas simples y auxiliares y la simple memorización de los hechos los estudiantes lo transfieren al trabajo independiente, liberando tiempo para la cooperación creativa.

PALABRAS CLAVE: equipo educativo; desarrollo; análisis de sistemas.

Introduction

Modern learning technologies, especially digital ones, are the result of the communicative and technological evolution of society, education and changes in consumer preferences of students and the labor market.

"Mobile learning" is a relatively new concept in the modern world. This category implies the use of mobile communication means (personal computer, mobile phone, laptop, and tablet) in the educational process, for effective training.

According to UNESCO, since the beginning of the pandemic COVID-19 more than 1.37 billion students in 138 countries have been out of closed schools and universities, as well as 60 million teachers. I had to switch to online training, find funds for its development. It required technical acceleration of training video streams, virtualization of storage of training materials and adaptation of training methods to new conditions.

In Russia, according to Rosstat, they planned for education in 2021-2023 over 60 billion rubles. But the "pandemic adjusted" - 3 trillion rubles are planned (1062854 million

rubles by year, 2022 - almost 1035634 million rubles, 2023 - 1094133 million rubles). A significant amount will go to the development of online educational resources.

Mobile training received an additional "boost" during the COVID-19 pandemic. It has become relevant with the development of the capabilities of mobile devices, networks and audiences of young fans of gadgets, for which the mobile device and Internet access from it have become a familiar way to obtain information and training. Everyone likes portability, agility and efficiency.

Mobile devices are not only a smartphone, tablet, netbook or laptop, but also all means of mobile access to educational resources, a teacher (tutor), interactive forms of activating educational material and control.

The prerequisites for mobile training include Seymour Peypert and his idea of using the latest technologies to overcome differences in the quality of education (for example, LOGO, 1969).

Tutor is an intermediary between students and educational resources and technologies (Clarke, et al., 2008). Some consider the ancestor of m-Learning, mobile learning, Rafael Ballagas and his team, which formulated the principle of BringYourOwnDevice (BYOD). This is a methodology (a set of technologies) for encouraging employees to use their personal gadget in the workplace.

There are versions of what to bring:

- 1) own device (BYOD);
- 2) its own technology (BYOT);
- 3) your phone (BYOP);
- 4) your computer or tablet (BYOPC).

Back in 2009, INTEL successfully connected employee devices to the Intranet. However, until 2011, corporate and consumer interests were tested. BYOD is little dependent on administrators, the technology only directs the use of devices into the right direction. Corporate data works directly on the company without "spreading." Insider does not increase. But some companies are in no hurry to accept and apply the concept.

Although BYOD should be kept under control, this concept is in demand. It's used to retain young, talented, highly qualified specialists everywhere. Companies note an increase in performance and comfort in the BYOD environment. It helps to become more productive,

improves convenience and corporate spirit. More than 45% of applicants consider it right if the company supports the device.

Students are free to use their devices in the learning process. Graduates are suspicious when the employer prohibits the use of his gadget - only equipment provided by the company. It's not always better.

Conflicts arise, such as the planning and maintenance of the training process in the network infrastructure, the supplier and the service provider, with the support of the quality of the network educational service. It's dangerous that service management will "remember" itself as an infrastructure seller. Fines, penalties, network degradation arise. Information, resource becomes a tool of influence, manipulation of consciousness and in learning. A traditional organization is replaced by a virtual one.

The introduction of mobile technologies was also facilitated by international conferences that help:

- 1) rethink the principles of mobile training;
- 2) systematize and classify its problems;
- 3) create relevant models of mobile training;
- 4) improve mobile technologies in training;
- 5) create and verify mobile training methods, integration approaches;
- 6) to form a unified mobile training strategy;

7) to investigate the emergence and systemic potential (Kaziev, et al., 2018) of mobile education in a modern university.

In Russia, mobile training is being introduced intensively. In particular, this is evidenced by the statistics of the M-Video chain of stores, in which in 2020 smartphones worth more than 30,000 rubles (they are considered more popular among students) were bought 40% more than before the pandemic COVID-19.

In Russia, mobile training has become part of continuous and flexible education according to GEF, which should solve two basic problems:

- 1) comfortable organization of the educational process (similar to content with usability) for both the teacher and the student;
- 2) motivation to increase the competencies of not only teachers, employees and students, but also corporations, private businesses to participate in mobile education.

The introduction of mobile technologies into education is vital for expanding the scope of the educational process beyond the university, students with health restrictions, and the rapid dissemination of new methods and training programs.

Therefore, the main goal of this article is to develop information and methodological schemes of mobile education, supported by the independent work of students in teams conducting situational modeling, creative cooperation "anywhere, at any time, with any resource".

The hypotheses of this study were: providing a comfortable organization of the teaching process for the teacher and student, as well as motivation of teachers and students, participation of corporations and private business in mobile training, infrastructure unity of their key business processes.

1. Materials and methods

Mobile training methodology allows you to use and integrate Internet resources and mobile technologies into the educational process and effectively form professional competence with their help. Such technology allows you to organize research activities of trainees.

Using Web Quests technology allows educators to solve the following important problems of m-Learning:

- 1) increase motivation;
- 2) improvement of educational achievements;
- 3) use of graphical visualization methods;
- 4) the formation of a professional culture - information, communication and media.

Using this technology, creative tasks are solved; the educational activity itself is full optimized.

Students and teachers were given unlimited opportunities to develop their educational space and share it. Despite the huge potential of mobile technologies, which is in demand in education, it is not used enough. This is due to the lack of digital literacy of teachers and leads to the emergence of a digital divide. Access to digital technologies is an urgent task of digital and mobile transformations of education.

Although the concepts of "mobile learning" and "mobile technology" are intertwined, these categories are different. "Mobile learning" is multivariable defined. For example, it's often characterized as any training dominated by mobile devices (Traxler, 2005).

UNESCO interprets (UNESCO, 2015) mobile training as the use of mobile technology in the educational process, its organization. Regardless of the place of training, both autonomously and jointly with ICT.

UNESCO in South Africa has been implementing (since 2009) the Mobile Phone Stories project to introduce teenagers to reading using cheap mobile phones. In Cambodia (since 2013), the Pink Phone project has been implemented for simple exchanges during training, as part of one online MOOC training course.

In Russia, there is the GOST 52653-2006 standard, according to which mobile training is electronic training through mobile devices, without taking into account the location of the trainee (GOST, 2006). Both mobile applications and capabilities, mobile learning technologies are developing (Dokazanov, et al., 2018).

One of the major mobile education projects was the Nokia Life project (2009) using SMS. More than 91 million citizens of India, Indonesia, Nigeria and China were able to join education in the field of agriculture, health, ecology and entrepreneurship, in particular, raising children, farming, HIV prevention, and women's business startup.

The effectiveness of mobile technologies in teaching languages, for example, English, has been demonstrated at a language university in Japan (Thornton, Houser, 2005) and a non-language university in Russia (Titova, Danilina, 2018).

Pilot projects and applications for mobile training have been launched in Russia (Izhuninov, 2020). The technology of delivery and presentation of educational content, organization of control and assessment of competencies is being developed, for example, using the integration of mobile applications and technologies:

1) Kahoot! - a system of training, presentations, video conferences, games, allows the teacher to create questions, and students to answer using mobile devices, with music, points and a list of leaders;

2) Poll Everywhere - a system of testing using a simple phone via SMS, polling in a browser or Twitter;

3) Plickers - a system for creating a class on one mobile device, generating questions with multiple choice of answers recorded on different sections of a sheet of paper (card);

4) Class Responder - a system in which a teacher creates an account, assigns a class code, students are authorized, answer questions using mobile devices, the teacher sees answers, controls the absorption of material;

5) Socrative - a real-time testing system, questions are visible on mobile devices, together with possible explanations, each student adjusts the pace of performance for himself, and you can compete in response speed;

6) PeLe, Peer Learning Assessment - P2P-system of mutual assistance in teaching, including the help of students themselves;

7) SurveyMonkey - a service for creating and maintaining online surveys, with its own database of respondents and operations such as "search," "visualization," "ordering" "upload," etc.

There are also many mobile blog services, dictionaries, podcasts, storytelling, quests, etc. For example, the system for creating interactive lectures using SRS surveys (Titova, Talmo, 2015), visualization, gamification and robotization.

Hybrid methodologies and related training procedures may be used in the near future:

1) Blue-Bot - the simplest robot, in a transparent case, the interaction of its parts is visible, works with a mobile device on Android, iOS, Mac, Windows platforms, the robot can activate 200 commands (this is very good for a beginner);

2) Root-Coding - for gamification, training in programming skills (LOGO type) in interactive coding, Root-robot climbs the wall, senses the environment, reproduces the melody, etc.;

3) Dash/Dot - a pair of robots (with applications that help program them) that allow you to create communication (Bluetooth) puzzles, LOGO programs;

4) Arduino is an open-architecture IDE-based designer connected to a mobile device with sensors, an expansion card, a router, a C++ library and an Arduino IDE, it's good for an advanced student, since there is a VisualStudio environment, and the system itself is easily integrated into any learning system.

A teacher (tutor) for mobile training is a multilaterally developed teacher. He should know the basics of the Internet of Things (IoT), SMART training (Sherstobitova, et al.,

2020), distance learning and control technologies, the methodology of modern training - projects, creativity, scenario simulation, teambuilding and other modern technologies.

For example, in a pandemic of COVID-19, students are offered to solve projects that teach (self-training) the design of robots controlled from a mobile device, in particular:

- 1) a disinfectant robot (for example, ultraviolet light) that disinfects with "cold steam";
- 2) a robot recognizer of infected people in the stream, determining whether the interlocutor is infected (according to breathing, pulse, other symptoms);
- 3) operation of a saturation meter, smear taking, 3D painting and interactive data transmission via a wireless terminal.

Existing mobile learning methods and technologies allow (Nemtinov, et al., 2021) to use multimedia resources (audio-video, graphics, images), network courses, directories and dictionaries, SMS, Twitter, Skype, etc.

Of great importance is a full-fledged educational portal adapted for mobile devices (Abdrasheva, et al., 2016). For example, this is the portal of the Russian Open University of New Information Technologies (INTUIT).

The relevance of mobile learning is manifested, in particular, in the development of mobile technologies, increased mobility of students, business-processes and educational structures (Lai, Hong, 2015).

But the data itself can be controlled by gadgets. For example, MDM (Master Data Management) - systems (technologies, applications) are actively used to manage data using proven actions and familiar gadgets.

They are all adaptable to mobile learning goals by selecting or blocking other applications, restoring files, etc.

2. Results and discussion

Our analysis allows us to use the following simple and complete system category: mobile training - training using the infrastructure of mobile devices and technologies, independent of spatial and time restrictions of access. The category is evolutionary, which allows you to explore the self-organization of mobile environments in training.

Mobile gadgets in the field of education have "pros" and "cons."

In our opinion, the following features of mobile devices can be considered "pros":

1) arouse interest, attract those who want to resume such interest to the education process;

2) rationally, inexpensively (in a "paperless way"), fully and comfortably engage in self-education at any point of access to the Internet, with any gadget, preserving its mobility, which has already become an "attribute" of students;

3) the ability to independently, with effective feedback, build and implement individual educational ecosystems, trajectories, plans and even personalized courses and programs, which is important for students with limited physical capabilities;

4) allows the participants of the educational process to move freely in space-time;

5) increases the potential of formative assessment, diagnosis of emerging educational and practical problems;

6) it is possible to conduct the lesson outside the computer class;

7) the ability of the teacher (tutor) to concentrate directly on the training process;

8) building a model of the trainee and tracking the course of training, a training profile with material and technology correction, including using a voice assistant or testing without the participation of a tutor, as well as training tools to everyone familiar;

9) the possibility of dynamically changing (adapting) the form of classroom work, for this there are many different practical-oriented technologies - from listening to educational material to joint design and team activities, solving cases;

10) variety of forms of social interactions based on mobile infrastructure and mobile learning process;

11) the possibility of situational, scenario training and game mechanics (gamification), with the placement of the instructor in a virtual environment or in a real (laboratory, game situational) environment.

Mobile devices also have "cons", these include the following circumstances:

1) difficulties with small screen size, uncomfortable scrolling, unstable adaptability and cross-browsers;

2) low battery capacity, the need for timely recharging of the device (often emergency);

3) in general, lower reliability indicators than personal computers (fault tolerance, continuous operation time, etc.);

- 4) difficulties in performing tasks for processing large documents, graphic objects, Excel tables, etc.;
- 5) the difficulty of focusing the student, his telephone dynamic switches that interfere with focusing;
- 6) insufficient recognition of diplomas and even certificates of universities, educational centers obtained through mobile passage of the program;
- 7) low connection speed in the network;
- 8) paid usage mode for many mobile applications;
- 9) an unworked policy and a single platform for mobile training in many universities, for example, for the development of competencies, you will still need the help of a group, tutor, methodologist and administrator;
- 10) lack of full-format and flexible platforms and applications that allow creating (supplementing) content using mobile devices.

Multimedia helps increase motivation of trainees and trainees. If you send out web quests (Scrapkin, Yakubova, 2018), small modules containing, for example, a quantum of educational material, its control and writing essays, you can effectively use mobile devices in training, accepting feedback interactive communication. Students are also encouraged to develop mobile learning applications (for example, student development to work with a portfolio of students, Magomedova, Rajabov, 2014).

The methodology and organization of mobile training is important. We used different forms and techniques and integrated them. In particular, for future managers in the field of tourism, we proposed to solve the problem of modeling the flow of tourists from Russia to Turkey using mobile technologies.

At first, data was collected on the Internet on tourist flows using phones. The data were then processed statistically (mean, variance, deviations, dropout of rough data, etc.) in Excel medium. Next, the command task was to build a flow mathematical model taking into account the following parameters:

- 1) t - simulation time;
- 2) T - horizon (time limit) of simulation;
- 3) $x(t)$ - number of tourists at the moment t , $0 < t < T$;
- 4) $a(t)$ is the specific influx of tourists, $0 < a < 1$;

- 5) $b(t)$ - specific outflow of tourists, $0 < b < 1$;
- 6) $x(0)$ - the initial flow of tourists (at the time of the opening of the direction).

Using these parameters, with the participation of a tutor, students build a mathematical model of the dynamics of the flow of tourists in the audience. For example, some students took it in a simple and understandable recurring form:

$$x(t + 1) = (a + 1)x(t) - bx^2(t), \quad x(0) = x_0.$$

Students during their independent work, mobile exchange of opinions, data from various websites of the tourism business, results and business solutions. They investigate (predict) tourist flows at various points in time, seasons, form and make a team (Scheinbaum, 2018) business decision.

All work within Excel, and the most advanced team (advanced student) also implements the program (C++) of simulation prediction. Making a business decision on the development of the direction, service is based on the results of simulation experiments, mobile communication. The program simulates the evolution of travel companies.

The following important pedagogical and technological possibilities of mobile training are being activated:

- 1) instant assessment of a student's task (action) and feedback in a problem situation;
- 2) tracking the assimilation of knowledge;
- 3) the operational transition of the student to the next productive level (not always to a higher level);
- 4) visualization, virtualization of situations and results;
- 5) panel discussions;
- 6) equalizing the opportunities of students with a lower level of competence, shy and shy;
- 7) possibility of discussions and lively discussion of errors, etc.

It should be noted that modeling using various virtual mobile environments is popular in Russian universities. In particular, Virtual PetroLab applications for smartphones and tablets (Shelyago and Shelyago, 2019).

We conducted a small comparative experiment to study two modules in two groups of students (24 and 22 people). The student was asked to choose what kind of training

(content delivery, control) he wants: mobile or traditional, classroom, in a computer class. Both versions used the Moodle platform and provided appropriate feedback. At the same time, 38 students (83%) chose the mobile option.

An important conclusion from the experiment is: students transfer routine actions and tasks of simple memorization to independent work, and most of the educational and personal time of self-education they share competencies, cooperate creatively, i.e. master the skills that they need in professional activities.

The most important quality of mobile training is its interactivity, creativity. However, it is strengthened or weakened by the level of creativity of course authors, tutors, methodologists and technologists-administrators, for example, LMS systems, simulators, virtual laboratories, Serious Games, for example, the game training platform 3D GameLab (Lam, et al., 2019). Professional podcasts, promotions, interviews, blogs and social networks support such systems.

Figure 1 shows the information logic diagram of mobile training in an enlarged form. The general system-methodological scheme of mobile training is similarly presented (Figure 2).

Note that for commercial universities, mobile education is ideal, because it moves most of the educational processes and technologies (applications) to the student's space, which is relevant in pandemic conditions.

Mobile training, education in universities passed the first stage of mass and emergency ("quarantine") activation. Practical experience of training in conditions of uncertainty and multi-criteria has been accumulated. A difficult little experience is still difficult to analyze. But a similar analysis is already being carried out. Some results of this analysis allow us to adapt for m-Learning systems of the Zoom class, BBB, MOOC, Inquiry-based Learning, Flexible Learning, Blended Learning, Flipped Classroom, etc.

These systems transform the role of the teacher in the educational process (Prokhorenkov, 2016), especially during the current transition in Russian universities to new GEF educational standards, which provide for more than 50% of the independent work of students, the development of general cultural and professional competencies.

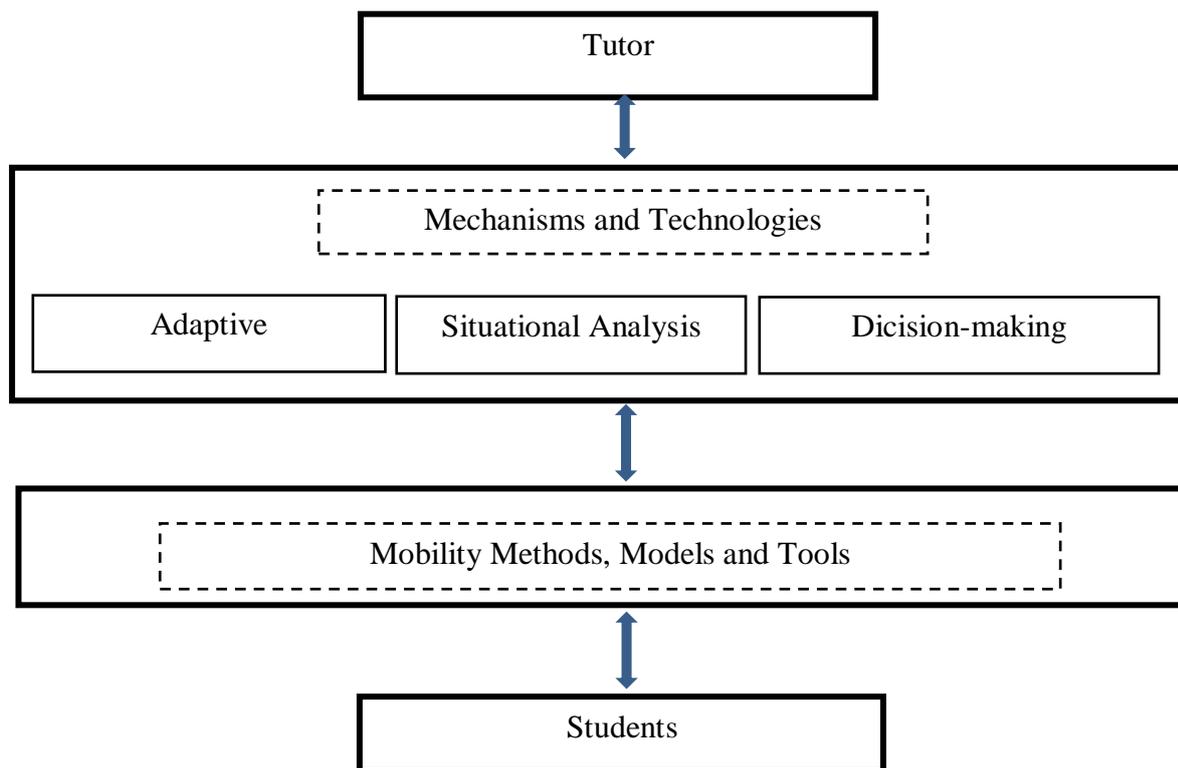


Figure 1. m-Learning info-logical scheme

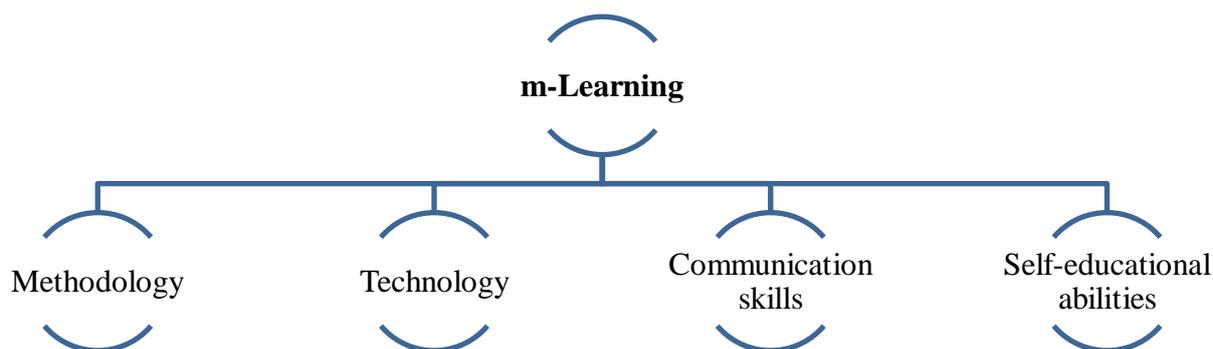


Figure 2. m-Learning methodological scheme

Students are prepared for mobile communications, web resources, they can study independently. But this is often not a consequence of the student's high competence, but a consequence of the task and the proposed methods, competencies of the teacher. Therefore,

there is the potential for student mobility if you use not only subject-oriented content as a "buffer", but also a multitasking mobile environment that allows you to make decisions in effective, productive conditions of psychological, pedagogical and technological communication of content to the student himself. For example, environmental risk forecasting and management tasks.

Tutors are needed - mobile process coordinators, application developers, appropriate infrastructure, interactive methodology, security policy, etc.

Not only mobility is important, but also the intellectuality of technology and tools. Intelligence in mobile training systems is supported using the following tools, procedures:

- 1) fuzzy sets, logic;
- 2) expert and heuristic;
- 3) analytical (for example, the Learning Analytics class);
- 4) identification of parameters, scale, profile;
- 5) situational activity of students;
- 6) multi-agent, for example, class P2P, etc.

Mobile activity of students and educational resources, interactions, elimination of unnecessary intermediate links forms the market of mobile educational technologies and applications for private (self-education) and professional consumption (training, retraining, upgrading of competencies, obtaining an additional specialty).

Mobile systems in training are innovative solutions based on the above procedures.

Conclusion

The use of mobile technologies and educational means in universities leads to reengineering, a radical restructuring of the educational infrastructure at the university. Flexibility, multi-criteria and adaptability of educational processes are needed here.

The most susceptible to mobile learning are distributed, remote access processes (content, tool), telecommunications (webinars), 3D visualization of model and real-world situations (educational situational experiment), interface support, etc.

Mobile Learning Infrastructure Support:

- 1) serves as a source of information, a means of summarizing, systematizing and controlling knowledge, skills;

2) facilitates the assimilation of material, allows developing observability and logic-combinatorial thinking;

3) leads to the activation of cognition, the emergence of interest in training, increased visibility, satisfaction of requests of various directions, including interdisciplinary ones;

4) entails the specificity of events, organization and rationalization of the educational process.

Thanks to mobile training, you can save time, the strength of the teacher and student by simplifying the educational material and accelerating the training.

The above possibilities are due to didactic features, such as information and emotional expressiveness, a large number of techniques of in-depth penetration into the essence of mastered phenomena, their demonstration in dynamics, real reflection of reality, etc.

It's necessary to train tutors, technologists and mobile training methodologists. There is a lack of trained system administrators and managers - according to the training process itself, and not education managers; if these competencies coincided with someone, then this is just wonderful.

Mobile training in universities meets the requirements of the GEF, this is a promising direction. But it needs to be integrated with research and methodological processes. Support for adaptive mobile learning technologies is required. It's important to focus on cognitive, creative, social and special competencies of university graduates.

The evolution of m-Learning (as well as e-Learning) involves the development of infrastructure capabilities. But it has a feature to lag behind, while the technological component of the evolution vector can be ahead of the methodological, didactic components. A complex process needs relevant tools that reduce complexity, free from nonlinearities, uncertainties.

Digital, mobile learning environments affect all aspects and aspects of competency-based education. But it's important not only their application, but also the readiness of the university for them, its potential for professional and personal self-development of the future specialist.

Vocational education is understood not only as strengthening the orientation towards the graduation of professionals or the individualization of their training, but also as support, monitoring, audit (control) of professional activities at a university. The latter can be

implemented by creating and testing various professional mobile systems, for example, communities in social networks.

The professionalism of the student is enhanced by choosing and tracking individual mobile self-learning trajectories, as well as free access to mobile educational resources, a tutor for consultation and virtual process support.

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