# The Self-organizational Potential of SMART University and Its Evolution

Bella Kazieva[a], Kantemir Kaziev[a], Valery Kaziev[a] and Fatimat Kudaeva[a]

[a] *Kabardino-Balkarian State University named after H.M. Berbekov, 173 Chernishevsky str., Nalchik, 360004, Russia*

**Abstract**

Society, using and developing digital transformations, actively forms the demand for a highly competent specialist on the labor market and education. Professional specialists are needed in economics, management, machine learning, security, ICT, analytics, modeling, Big Data, Data Science, etc. The accumulation of primary knowledge is underway. System analysis of goals, resources, situations and processes is still ahead are needed also. Research is needed in this direction. The formulation of the principles of the evolution of SMART education is the main goal of our work. The work carried out a systematic analysis of the evolution of SMART education and SMART-university as a center for culture and personal changes in the transition to a digital society, the evolution of the digital economy. In particular, the properties of emergence of four generations of universities are emphasized. Formulated (as an integral system) 11 principles of building an evolutionary strategy and 27 basic technologies that support the evolution of SMART education. The emergent properties of the process, the peculiarities of the university's information environment were noted, the self-organizational potential of the SMART-model of education was analyzed. An example of digital competencies of a graduate in applied mathematics and computer science is given, scientific and methodological support for digital and media literacy of students has been announced. Some author's results on development of educational-methodical support of educational process and evolution of IT-infrastructure of SMART-university are given. All examples are structured so that they are adapted to increase the evolutionary potential of universities.

**Keywords** [1]

SMART, evolution, university, digital, self-organization, potential

## 1. Introduction

As declared in the program «Digital Economy of the Russian Federation», key digital transformations are expected in the coming decade, necessary to increase the competitiveness of the country and the quality of life of its citizens, as well as to ensure sustainable economic growth and national sovereignty [1]. One of the basic elements of the digital ecosystem is competent personnel in the field of creating, managing and promoting digital projects, artificial intelligence, system and predictive security and business intelligence, information and communication technologies (ICT), blockchain, situational and cognitive modeling, Big Data, Data Mining, Social Mining, Data Science, etc. It is necessary to form conditions and motivation systems for mastering key competencies, orienting the education system and the labor market according to the requirements of the digital economy.

Currently, the progress of the educational environment is associated with the collaboration of its agents (employers, the state, business, public organizations, partners), supported by an intelligent SMART infrastructure. The pedagogical functionality and structure of educational relations are

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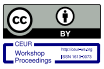
EMAIL: bella_kazieva@mail.com (Bella Kazieva); kantemir78@gmail.com (Kantemir Kaziev); kkvkvm@yandex.ru (Valery Kaziev); kfatimat@yandex.ru (Fatimat Kudaeva)

ORCID: 0000-0003-1562-7124 (Bella Kazieva); 0000-0002-3406-9511 (Kantemir Kaziev); 0000-0002-4695-0250 (Valery Kaziev); 0000-0003-4395-2274 (Fatimat Kudaeva)



changing - from paradigms and the choice of educational platforms to the «digital footprint» and eye-tracking of the student, from gamification to taking into account the design of the training scenario, from distance learning systems to open education and social network consulting.

## 2. Purpose and objectives of the study

But the evolution of SMART universities in Russia is still haphazard, despite the sufficient (close to European) level of access to digital resources (Figure 1, data from source [2], [3]).

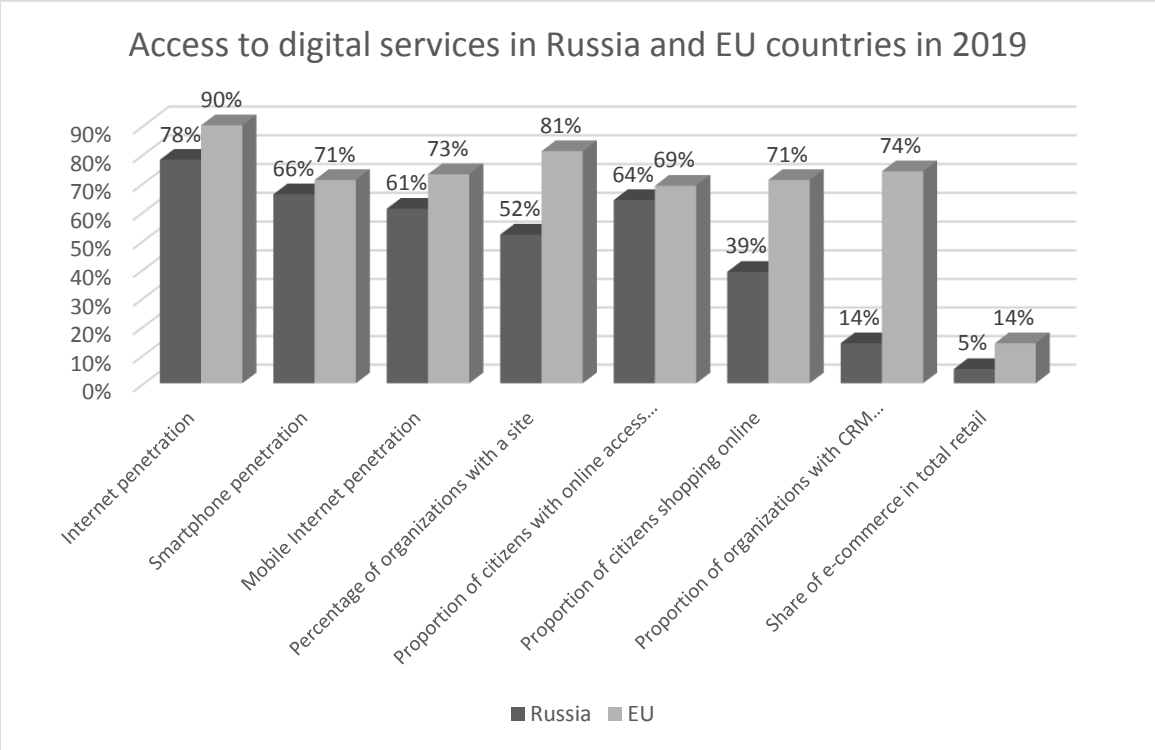



**Figure 1**: Indicators of access to digital resources in Russia and the EU for 2019 (data from source [2], [3])

Universities that do not implement digital transformations of the educational process and do not create infrastructure relevant to the digital economy are in danger of being forced out of the educational market, where both demand and the supply of network educational structures are expanding. For example, a MOOC (Massive Open Online Courses) class with versions of connective MOOC, task-based MOOC, xMOOC, or open distance courses [4]. There is both an increase in the cost of educational services of the «premium» class (for example, MBA), and its decrease in the «business» and «economy» class. Many video courses of famous scientists are freely available, for example, on the portals Coursera, Academic Earth MTI, etc. During the pandemic, there is COVID-19 a kind of «boom» in the implementation of online educational projects, including using SMART technologies. For example, PJSC Sberbank launched a number of attractive projects to increase ICT literacy for students, teachers, university staff and other educational institutions, including the School of IT Professions.

The introduction of SMART technologies in the educational process of universities will ensure the freedom and availability of resources of all types to solve the problems of modern education, developing dynamically and multi-criteria, with uncertainties. In a number of countries (Republic of Korea, Singapore, Taiwan, Japan), SMART education has shown its effectiveness (according to PISA estimates). The introduction of SMART technologies in universities is a win for the evolutionary digital economy.

## 3. Literature Review

The SMART concept [5] allows you to create an open, personalized learning environment. It is developed by education technologies and management, its capabilities have been investigated in Russia and abroad, for example, [6, 7]. The position of Smart Classroom Systems [8] concept is especially strengthened.

Development takes into account the interests of the global educational space, key factors and SMART interaction. There is no single methodology [9], we often observe only infrastructure changes. Such transformations are insufficient to consider the tasks of universities - centers of culture, generators of educational goals [10].

Most influenced our work study [11-13]. In our work [14], we examined some of the principles of this article in relation to the training of lawyers, in particular situational evolutionary modelling and decision-making in complex and big systems.

A systematic approach to analysis-synthesis, composition-decomposition of education problems, integrated educational environments is needed.

## 4. Development of methodology

The most common interpretation of the methodological category «SMART» in Russia is similar to a foreign interpretation as a concept supporting Specific, Measurable, Achievable, Relevant and Time bound.

SMART pedagogy is a new concept relevant to modern, competently oriented training [15]. In a broad sense, the transition to SMART pedagogy is a systemic process necessary to achieve a highly intelligent level as a tool for solving the problems of a post-industrial (Industry 4.0) society. Universities that implement their educational and other activities on the principles of the SMART-concept have their own key strategy. This is a strategy for digital transformation through intelligent systems and tools (SMART-environment of the student and teacher) supporting the entire cycle of educational activity.

The following types of universities are identified by emergent communication and infrastructure properties (Table 1).

**Table 1**

Types of universities

| Type of university | Description |
|---|---|
| University 1.0 («Universities of Theology») | The university as a center of knowledge, for example, religious, with a good library, professional regular lecturers, the development of these centers of worldviews, for example, theology |
| University 2.0 («Alma Mater») | Active use of the practice of inviting high-class specialists to hold lectures, practices in places (centers) of concentration of students, unification of diverse universities into universities - centers of culture and education, Alma Mater |
| University 3.0 («Open University») | Remote training, video and tele-access training, development of means of delivery of educational multimedia content to trainees and monitoring of training with simple adaptive mechanisms |
| University 4.0 («SMART University») | Virtualize learning and learning stores and workstations, globalize competencies, provide comfortable, intuitive technologies to update knowledge anywhere and anytime on any platform, address |

The use of the system approach and SMART methodology is focused on the consideration of education as a system of interactions of SMART elements (objects, entities), SMART resources (technologies, pedagogy), SMART goals and their relationships, mainly implemented by SMART technologies. This all forms a SMART environment - the unity of resources of spatial, temporal, hardware-technological, control and interaction, including pedagogical, social, media-cultural, interface [16]. The SMART University conceptual model is shown in Figure 2.

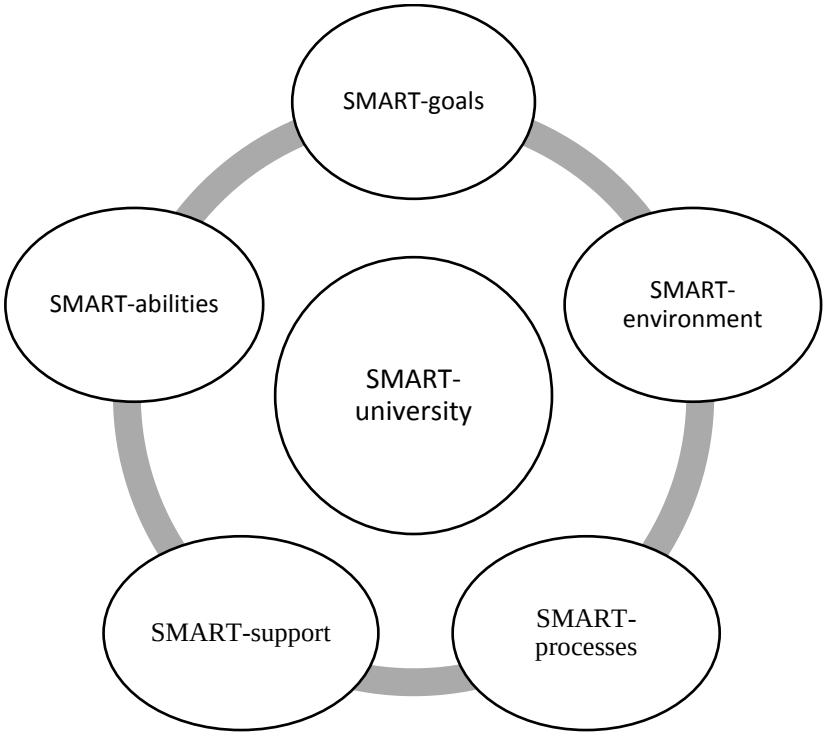



**Figure 2:** SMART University System

Immersion of students in SMART-environment actualizes hidden intellectual resources and creative beginnings, increases cognitive interest and creative approach. All this contributes to professional self-determination and social self-organization, self-motivation of the individual, the transition from the process of learning to the process of learning and self-learning - the highest (self-organizational) level of learning.

The SMART paradigm is based on a technological, self-regulating (self-organized), motivational, flexible and innovative, resource-rich education of various types and access, the acquisition of deep and wide competencies. SMART pedagogy is supported by SMART infrastructure and enjoys the support of the state, business, public organizations, partners and employers. It changes pedagogical functionality and educational relations (choosing an educational platform, aye-tracking of a student, gamification, accounting for content design, e-Learning system, social network consulting, etc.).

Innovative educational technologies themselves imply a systematic approach, focused, resource-secured and limited, structured, with certain elements (medium). The concept of SMART-pedagogy (Specific, Measurable, Achievable, Reliant & Time bound) provides flexibility, technicality and manageability of education based on intelligent subsystems, solutions and digital education processes at any point, with any resource, at a comfortable time. The concept helps implement digital strategies through the intelligent («smart») environment of a student, teacher. At the same time educational systems can be various – «leaders» (innovation leaders), «the followers following in a waterway» (innovation followers), «moderated» (moderate innovators) and «modest» (modest innovators).

## 5. Results

For each specialty, SMART University must provide the level of competencies: advanced (A - Advanced); Basic (B - Basic). But we'll add a third level – «choice of...» (C – «Choose from...»), meaning by this the ability to choose the right solution from the proposed (not to be confused with closed-form tests). In this case, we take into account the ordering of preferences, for example, A > B > C, i.e. AB – «better A, it is possible and B».

We offer an example of digital competencies in the specialty «Applied Mathematics and Computer Science» (it, of course, corresponds to Federal State Educational Standard, but is more specific and wide) in accordance with our «SMART vision» (Table 2). The example is only a demonstration.

**Table 2**

Digital Competencies of Graduate in Applied Mathematics and Computer Science

| N | Competence | Level |
|---|---|---|
| 1 | Computer and network software | BA |
| 2 | Technical support of computers and networks | B |
| 3 | ICT (LAN, Internet, Intranet) | B |
| 4 | Office Document Management (Records Management) | B |
| 5 | Computer Office (MS Office) | BA |
| 6 | Machine Graphics and Visualizers | B |
| 7 | Virtualization Tools | B |
| 8 | Databases | BA |
| 9 | Big Data and Data Center | B |
| 10 | Intelligent Decision Support Systems | BA |
| 11 | Knowledge bases and Expert Systems | B |
| 12 | Security computer (office) and network | B |
| 13 | Security of the State and its institutions, structures | B |
| 14 | The Right to the Internet and Digital Society | B |
| 15 | Strategic Management | CB |
| 16 | Project Management | B |
| 17 | Time Management | CB |
| 18 | Risk Management | B |
| 19 | Human resources management | B |
| 20 | CRM, ERP and analogs | B |
| 21 | Modeling of interactions of P2P, P4C, etc. | B |
| 22 | Modeling of interactions of B2B, B2C, etc. | B |
| 23 | Formalization and computer simulation | A |
| 24 | System Analysis and Synthesis | A |
| 25 | Web Analytics Toolkit | B |
| 26 | Cognitive Flexibility | B |
| 27 | Logic-algorithmically thinking | A |
| 28 | Problem sensitivity | B |
| 29 | Ability to self-organize, self-motivate | BA |
| 30 | Self-learning, self-development | A |
| 31 | Team Compatibility | BA |

The SMART environment of the university (university) includes:

1) accessible (open), comfortable (friendly) information resources and means of their updating;

2) means of intellectual training and obtaining knowledge, expanding competencies;

3) platforms and tools for the effective organization of research work, innovative, practice-oriented, laboratory activities of teachers, employees and students of the university;

4) platforms and tools, distributed systems of distance learning, open education;

5) the conditions and resources of personal and moral development, both students and teachers, employees who are integrated into the environment, develop them and increase the intellectual capital of the university.

The peculiarity of SMART education is that it «eliminates» intermediate links of the chain such as «educational resources and providers of educational services - consumers and their educational preferences». The system of an educational institution should dynamically adapt to this, respond promptly and systematically. For example, by reducing the educational process to an information-logically interconnected and targeted set of tasks to be solved for managing resources and processes. These processes (monitoring, expertise and heuristics, analytics, situational modeling, risk assessment, etc.) in modern education are often multifaceted, multi-criteria and uncertain. Therefore, making a successful decision in such conditions in the current «similar» state is not a guarantee of future success even if it is based on fuzzy logic and sets, neural systems.

In SMART education, it is necessary to build educational strategies, remembering the following principles:

1) «education (system, environment) and training (process, technology) are not identical»;

2) «training and performance do not always correspond to each other»;

3) «the value of content is determined not only by the frequency of appeal»;

4) «knowledge is not yet competence, but competence is not yet effectiveness»;

5) «knowledge is not technologically replicable, and information is not produced, consumed or alienated».

It is important to adhere simultaneously to the following system-wide pedagogical principles:

1) «cooperation is built and implemented on the basis of cognitive activity»;

2) «the evolution of skill occurs throughout the active life of a person»;

3) «the value of a specialist is determined both by his competencies and his attitude to corporate goals and solutions»;

4) «balance is the key to the success and sustainability of learning, and its diversity is the order»;

5) «lack of information in the educational system can stimulate dynamic chaos, complicate decision-making, self-organization of the system»;

6) «heuristic response time may be more important than response accuracy»;

7) «the student needs pedagogy for self-study and the development of the competencies necessary for highly competitive inclusion in the labor market, the teacher - for the preservation and development of inclusion in the labor and educational market, both - for linearization of nonlinear interactions with each other»;

8) «in the educational market (as in other markets) there are uncertainties, noises and delays - not only for consumers, actors, but also for investors, therefore, given the distribution of noise, it is possible to regulate the potential for their negative impact, although this can lead to an increase in transaction costs»;

9) «traditional techniques and their carriers often conflict with innovative teaching methods, their self-organizational potential and the opportunities for self-development not only of the student, but also of the teacher»;

10) «self-education, self-discipline, self-training, self-education, self-development, etc. have a self-organizational character; their evolution and education should be directed»;

11) «training should be focused on the highest level of competence (for example, Industry 4.0, Internet 2.0)», etc.

SMART technologies can also act as «guides» to system-wide pedagogical principles.

SMART education technologies include:

1) hypermedia in real mode (using a SMART document camera);

2) SaaS, PaaS, CaaS, MaaS and other models of relationships;

3) MOOC;

4) virtual educational and scientific complexes;

5) adaptive testing and simulation techniques (Performance-based test);

6) Intelligent Automated Workplaces (IAWP) and Decision Support Systems (DSS);

7) interactive boards (SMART Boards), projectors, cameras, monitors;

8) social-network communities («virtual training and consulting rooms»);

9) educational geographic information systems (EGIS);

10) computer vision and eye-tracking systems;
11) systems of analysis-synthesis of speech signals (chat bots, assistants);
12) brain activity management systems;
13) deep machine learning systems;
14) Educational Resource Creation Management System (LMS);
15) cloud structures and computing systems;
16) neuro- and fuzzy-system technologies;
17) Big Data и Data Mining;
18) Learning Analytics и Business Intelligence Systems;
19) blockchain technology;
20) standardization and certification systems (GR-management, ISO 9001:2015, etc.);
21) publication systems (ARPHA-XML review and publication of articles);
22) information and economic security systems, etc.
23) information and communication technologies (webinars, teleconferences, etc.);
24) media (for example, media connections of active educational content with a single repository that allows removing restrictions on space-time-information);
25) educational and scientific laboratories and virtual complexes (for example, the so-called «simulation worlds»);
26) distributed and cloud;
27) genetic algorithms.

## 6. Discussion

We will give the main target areas of implementation of SMART-educational structures in Kabardino-Balkarian State University (KBSU). Let us highlight the key goals:
1) optimization of operations, infrastructure projects;
2) individualization and harmonization of training;
3) support of research laboratories;
4) training, training and retraining of a wide audience;
5) availability in any space-time layer;
6) simplification of independent work and organization of work of the teacher, student, administrator and, especially, partner of the university (for example, on the basis of SMART contracts);
7) mobility in the employment of graduates;
8) tracking publications, intellectual property of the university (on content, methodology, training programs, etc.);
9) international integration, etc.

The system performance of SMART training can be assessed by the effectiveness of educational processes (an integral assessment is obtained, for example, as mentioned above or similar to [17]), the performance of functions and indicators of efficiency (for example, KPI type [18]), competitiveness and sustainability in the educational and labor markets, or by precedents and comparative analytics. Qualitative assessment is system-self-organizational, according to synergistic effects - self-education, self-discipline, self-education, etc.

Interaction takes place within the framework of the SMART-educational system and evolution, which doesn't lead to points of bifurcation, chaos. If leading to such points, then it allows you to effectively build an individual, adaptive and variable SMART-educational trajectory in order to get to the desired trajectory and circumvent critical states.

The development of the educational trajectory, the system is influenced by the choice of solutions in the small vicinity of the bifurcation points, fluctuations−stochastic fluctuations, for example, the current educational achievements of the student from average group (selective) values. This shows the measure, the degree of chaotic process, the system (at the micro level). Fluctuations can have a «hopping» effect on the result, achievements in the educational process.

We agree with the statement [19] that the development of the digital economy, infrastructures of SMART class models is not only a topical and fashionable trend. The philosophy of SMART

university is needed not only by large universities, but also by regional universities [19]. For example, what is for as KBSU. It will provide them with flexibility, technological ability, manageability, smart infrastructure and the intelligence of structures ready to innovate in education and science.

SMART pedagogy should have a system goal, the emergence property. The emergence of the SMART-learning system is manifested in the implementation of activities, processes that are not separately connected to information and communication methods of training and control. Such a goal can be immersion in research in conditions of uncertainty and fuzziness, multicriteriality of the environment.

The SMART infrastructure of the university (cluster), taking into account the infrastructure of the SMART business involved in the targeted training of students, should enable individual and creative training of the graduate. A graduate with his own professional and media worldview, competitive in a dynamic labor market and participating in the formation of the intellectual capital of the university and society.

As a support for SMART education, the authors developed and conducted introductory courses «ICT and media literacy» and «Modeling of processes and systems of the digital economy» (program « Applied Mathematics and Computer Science»). Each course includes a presentation slide series, tests (training, certification), tasks and quests, topics (cases) for creative homework. For more than 30 years, the discipline «Introduction to the analysis, synthesis and modeling of systems» [21] has also been taught in various courses. The course is freely available on the INTUIT and KBSU portal (www.intuit.ru, www.open.kbsu.ru).

Within the framework of the training discipline «Mathematical and Computer Modeling in the Digital Economy» (program «Applied Mathematics and Computer Science»), modular educational and methodological support has been developed.

Module 1. State policy in the field of the digital economy and its results.

Module 2. The main categories of digital economy and business.

Module 3. Fundamentals of digital money and cryptocurrencies, payments and sites.

Module 4. Basics of blockchain regulation of economy and business (hashing, blockchain, ICO, problems and solutions, main trends, etc.).

Module 5. Tools for effective digital business (outsourcing, e-mail marketing, directing-marketing, BYOD, Big Data, Data Mining, Social Mining, Elastic Data, GRID, IoT, etc.).

Module 6. Models and platforms of interactions of the «Crowd*» class (crowdsourcing, crowdfunding, crowdinvesting, crowdlanding, etc. [22]).

Module 7. Small business and web earnings sites.

Module 8. Digital economy technologies.

Module 9. Mathematical and computer models of the digital economy.

For each module, creative tasks and projects, tests, tasks, essay topics and abstracts were developed.

The above system analysis allows you to formulate the following statement for the development of the SMART-learning process: the adaptability and stability of the SMART-system can be provided only by self-tuning, optimal self-organizational potential of the entire infrastructure. As a practical application of this conclusion, we used it in streaming programming training (POSIX). The effectiveness of training was observed, for example, in an increase in the ability to qualitatively encode (C), which exceeded the traditional approach (procedural, even object-oriented) programming by 15% -22%.This approach is implemented at Kabardino-Balkarian State University using BYOD class technologies, a project organization and an «inverted class».

## 7. Conclusion

The SMART model covers the entire evolutionary infrastructure of the university (information, organizational, financial, etc.). It is in universities that resources are available to develop cryptomatics, verification (ProofOfWork, PoW), formal systems of transactional rules and models of relations between participants in the system. We take into account the potential of interactions between education, business and science, the current demands of society for certain highly qualified specialists, as well as innovations and investments.

The guidelines for the evolution and self-organization of SMART-university, the educational system, reflect the need to reorient to the digital economy, its services and platforms that ensure the growth of the educational level, competencies and stimulate consumer demand for the production and consumption of knowledge. The evolution of the digital economy is determined by the development of competencies aimed at the steady growth of human and intellectual potential.

In the Russian Federation, the introduction of SMART technologies is haphazard, not fast and flexible enough, much is being done in essence by enthusiasts. In this sense, formal legal, institutional support for the SMART education model is needed.

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## 9. References

[1] Program «Digital Economy of the Russian Federation» (approved by Order of the Government of the Russian Federation dated July 28, 2017 No. 1632-r). URL: http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf.

[2] Russian Statistical Yearbook 2019: Stat. Book/Rosstat R76, Moscow, 2019.

[3] Share of individuals accessing the internet via mobile devices in the European Union (EU-28) from 2016 to 2019, by device. URL://https://www.statista.com/statistics/377821/mobile-internet-usage-by-device-in-the-eu/

[4] K.A. Gavrilov, Varieties of mass open online courses. You can use these courses in the training process. URL: https://portal.tpu.ru/f_dite/conf/2014/2/c2_Gavrilov.pdf.

[5] H. Nakashima, H. Aghajan, J.C. Augusto. Handbook of Ambient Intelligence and Smart Environments. New-York: Springer, 2010.

[6] N.Y. Dneprovskaya, E.A. Yankovskaya, I.V. Shevtsova. Conceptual foundations of the concept of smart education // Open education, 6 (2015): 43-51.

[7] V.L. Uskov, J.P. Bakken, R.J. Howlett, L.C. Jain (eds.): Smart Universities: Concepts, Systems, and Technologies, 421 p. Springer, Cham (2018). URL: https://doi.org/10.1007/978-3-319-59454-5.

[8] V.L. Uskov, D.P. Bakken, A. Penumatsa, C. Heinemann and R. Rachakonda, Smart Pedagogy for Smart Universities, Smart Innovation, Systems and Technologies (2018), pp.3-16. doi: 10.1007/978-3-319-59451-4.

[9] E.Z. Zinder. Information spaces: the genesis of requirements for fundamental properties // Modern information technologies and IT education, 10 (2014): 885-896.

[10] V.M. Kaziev, A.A. Sherstobitova, M.O. Iskoskov, M.A. Selivanova and E.N. Korneeva, University Financial Sustainability Assessment Models, Smart Innovation, Systems and Technologies, 188 (Series Editors V.L. Uskov, R.J. Howlett and L.C. Jain), Springer (2020), pp.467-477. URL: https://doi.org/10.1007/978-981-15-5584-8.

[11] M. Coccoli, A. Guercio, P. Maresca, L. Stanganelli. Smarter universities: a vision for the fast changing digital era // J. Vis. Lang. Comput. 25 (2014), pp.1003–1011.

[12] J. Zhang. Technology-supported learning innovation in cultural contexts // Educ. Tech. Res. Dev. (2010), 58(2), pp.229–243.

[13] G.-J. Hwang. Definition, framework, and research issues of smart learning environments – a context-aware ubiquitous learning perspective // Smart Learn. Environ. (2014), 1(4), pp.1–14. http://www.slejournal.com/content/1/1/4.

[14] V.M. Kaziev, K.V. Kaziev, B.V. Kazieva. Fundamentals of legal informatics and informatization of legal systems. -M.: University textbook. INFRA-M, 2nd ed., 2017. -326 p.

[15] E. de Haan, P.C. Verhoef, T. Wiesel. The Predictive Ability of Different Customer Feedback Metrics for Retention // International Journal of Research in Marketing, 32(2) (2015): 195-206.

[16] T. FitzPatrick. Key Success Factors of eLearning in Education: A Professional Development Model to Evaluate and Support e-Learning // US-China Education Review A9 (2012):789-795.
[17] O. Yu. Rybicheva, Prospects for the introduction of smart technologies in the educational process, Bulletin of Vyatka State University, 4 (2019) 76-84. doi: 10.25730/VSU.7606.19.058.
[18] V. Kaziev, L. Medvedeva, N. Tyutrin, F. Khizbullin, V. Takhumova, Improvement and Modeling of the Company's Activity Based on the Innovative KPI-system, J. Fundam. Appl. Sci., 10-5S, (2018): 1406-1415.
[19] O. Yu. Rybicheva, Prospects for the introduction of smart technologies in the educational process, Bulletin of Vyatka State University, 4 (2019) 76-84. doi: 10.25730/VSU.7606.19.058.
[20] A.A. Zaslavsky, Directions for the development of the information space of an educational organization to increase the efficiency of internal management, Bulletin of the Moscow State Pedagogical University. Ser. «Informatics and Informatization of Education», 1-39 (2017): 76-82.
[21] V.M. Kaziev, Introduction to analysis, synthesis and modeling of systems, Moscow, Binom. Knowledge Lab. INTUIT, 2007.
[22] B.V. Kazieva, V.M. Kaziev, Crowdinvesting model in the activation of innovative and investment activities of the population, Economic vector, 11 (2017). URL: http://www.vectoreconomy.ru/images/publications/2017/11/innovationmanagement/Kazieva_Kaziev.pdf.