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LEAN MANAGEMENT AND SMART EDUCATION

GESTIÓN DE LEAN Y EDUCACIÓN INTELIGENTE

Alena Nikolaeva[1], Olga Demyanova[2], Rasulya Aetdinova[3]

		
Alena A. Nikolaeva	**Olga V. Demyanova**	**Rasulya R. Aetdinova**

RESUMEN
El objetivo de esta investigación fue estudiar la Estandarización para formar "diagramas de flujo personales" con toda la información relacionada con las actividades educativas y de investigación de un estudiante para que los profesores comprendan el nivel de interés de un estudiante para el proyecto específico o Living Lab. Nuestro hallazgo muestra que la creación de una base de aprendizaje en línea sobre habilidades básicas de especialidades permitirá reducir considerablemente el tiempo de instrucción del residente con el maestro al estudiar los campos de conocimiento más simples y liberar tiempo para estudiar materiales más complejos que requieren contacto personal del estudiante con un maestro.
Palabras clave: Educación digital, sistema educativo, educación inteligente.

ABSTRACT
The aim of this research was to analyze the standardization for forming "personal flow diagrams" with all information connected with educational and research activities of a student so the teachers can understand the level of interest of a student to the specific project or Living Lab. Our finding shows Creation of e-learning base on basic skills of specialties will allow considerably reduce time of resident instruction with the teacher when analyzing the simplest fields of knowledge and to release time for studying more complex materials requiring personal contact of the student with a teacher.
Keywords: digital education, education system, smart education.

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[1] Kazan Federal University, Kazan, Russia, email: Aa.niko@gmail.com
[2] Professor, Doctor of science, associate professor, Head University / Institute of Management, Economics and Finance, email: 89053185835@mail.ru, phone number: 89053185835
[3] Associate professor, candidate of science, associate professor, Naberezhnye Chelny Branch, email: RRAetdinova@ksu.ru, phone number: 396618

INTRODUCTION

New models of digital education are created in the conditions of increasing penetration of digital economy into activity of economic systems.

Origin and development of digital education are the results of objective transformation of the general education system in conditions of forming a new digital civilization.

The “intellectual” means "actual” and the intellectual education is automated, manageable and available educational process from any point – the most difficult system for creation and forming new mechanisms for quality assurance in higher education institutes, increase in efficiency of value creation flows, including the organization of network training, creation of the space stimulating and creating thinking to continuous enhancement.

Integrated next-generation technologies may equip students to continue their education, their entire lives, and address three goals: fortifying student skills, increasing education’s ROI (Returns on Investment), and enabling students to be innovative and entrepreneurial. Education technology providers will likely need to shift their focus from content to connections.

The general feature of the school digital learning environment has been invariably one of unilateral control, where the ICT (Information and Communications Technology) experts controlled every facet of the technology and its teaching.

They chose, configured and controlled the use of both the hardware and software, invariably opting for one device, one operating system and a standard suite of applications.

The students were taught within class groups, using highly structured, sequential, teacher directed, regularly assessed instructional programs.

The school knew best. The clients – the parents and students – were expected to acquiesce. There was little or no recognition of the out of school learning or technology or desire to collaborate with the digitally connected families.

The teaching was insular, inward looking, highly site fixated.

In reflecting on school’s teaching with the digital between 1993 and 2016 there was an all-pervasive sense of constancy, continuity, with no real rush to change. There was little sense that the schools were readying the total student body to thrive within in a rapidly evolving digitally based world.

Significantly by 2016 only a relatively small proportion of schools globally were operating as mature digital organizations, growing increasingly integrated, powerful

higher order digitally based ecosystems.

RESULTS AND DISCUSSION

In Europe till 2025, creation of the Single European University being an informal merging of the universities in single educational space by means of Internet network is planned. This initiative has a number of specific projects on implementation: it is a unified student card, mutual recognition of diplomas within new "Sorbonne process", joint operation on enhancement the higher education system, strengthening of knowledge of foreign languages, providing training process throughout all life; widespread introduction of innovations and digital technologies in educational process, network of the European universities, social protection of teachers, investment attraction in an educational industry and protection of cultural heritage of the European identity (Badarch, 2017).

According to Tsvetkova (2015), within promotion of the digital education ideas, a special role is played by a concept of resource availability for smart education, that is their openness and free access for all comers, at the same time the major emphasis is placed on a problem of open educational resources quality in Web 3.0 space based on clouds and mobile computing.

This idea is positioned as a concept of global "knowledge network" as main objective of deploying the available environment of digital education in the information society uniting (connecting) various educational resources in global network open for creativity of the citizens including educational clusters and in global media (Badarch, 2017).

Table 1. Strategic vision of a role of the smart universities

Approach	Smart education	Result
Catalan university	Educational paradigm	The innovative approach in training applied in order to provide well thought interactive environment of training for any student, in any place and at any time, using resources of various digital technologies along with other forms of training materials which are suitable for the open environment of training
Canadian recommendation on training	The concept of training through all life	An opportunity to Analyze at own speed at any stage of life, thus, creating the positive relation to education value during all life
USA	Smart education and technologies of knowledge-management economy	Increase in competitiveness of the country and its further development connect with stimulation of system of electronic training and the subsequent transition to society of knowledge

Source: Nikolaeva, Demyanova and Aetdinova (2016)

However, we see that at the heart of any smart educational institution is the university's general resource availability.

The main goal of smart education is to create the extending system (Pull system) from a final consumer (an employer, a government, a customer, a parent, and a pupil) to the SMART University by forming of valuable educational trajectories and products.

In case of implementation of such approach by means of open virtual system, it would unite a high-quality improvement of cooperation between school students, university students, teachers, and administrative personnel of the universities and other stakeholders.

This cooperation will be performed not only in traditional forms, such as training, seminars, briefings, conferences and round tables, and also webinars, and strategic sessions.

Formation of the smart universities needs to start with the solution of such tasks as:

- Development of effective SMART University model as a factor on improvement of education and educational services quality;

- Implementation of effective SMART University model in higher education institutions of Russia;

- Creation of the international SMART University network;

- Formation of trajectories for network educational service systems;

- Formation of lean thinking space.

Solution of these tasks will allow them to create:

- Effective model on implementation of a lean management practice into the universities;

- Recommendations on formation of the digital environment for higher education institutes in partnership with other higher education institutions;

- Training courses for developers of by-products;

- Virtual international network;

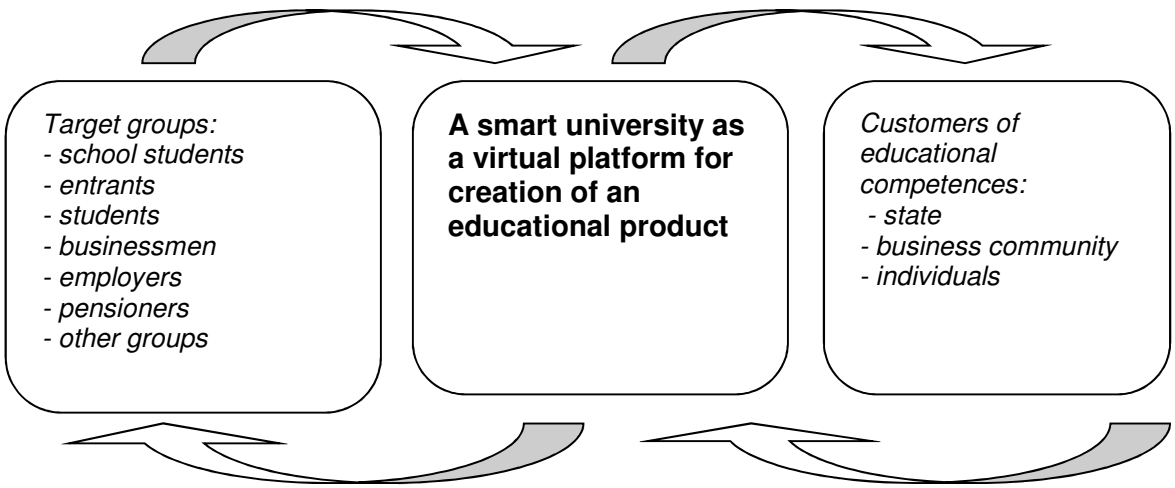
- Systems of trajectories for network educational services;

- Lean thinking space (Demyanova, 2016).

Fig. 1 provides the schematic diagram of a smart university. Its cornerstones are

two main flows of value creation: they are the flow of creation of professional competences and the flow of creation of an educational product. Result of implementation of the educational products shall become creation of new generation of specialists capable to create innovations.

Fig. 1. Conceptual scheme of a SMART University



Source: Nikolaeva, Demyanova and Aetdinova (2016)

These flows will be productive and effective only in case of availability of the dynamic and constantly developing center – a SMART University.

The smart university concept is implemented mainly through creation of an extending system.

At the same time, a smart university is not just an integrator of customers and consumers of an educational product, but it is a live flexible system where requirements to professional competences are created or cultivated, and educational products are created. Such model of functioning can be reached only in case of collaboration with other educational institutions (Living Labs), the entities and the organizations; implementation of the "acquired competences - use of knowledge" model, the fixed improved quality of distance training, QFD application – the analysis, where QFD could be an alternative or addition to Living Lab (Demyanova and Ishkova, 2017).

The concept of smart education combines flexibility and availability of a large number of sources, a big variety of multimedia, and capability to be quickly adjusted with regard to the level and needs of the listener.

Smart education shall be manageable, providing flexibility of educational process, be constantly oriented to changes in the external environment. It is an essentially new educational environment combining efforts of teachers, specialists and students for use the world knowledge and transition from passive to active content. And the technologies which were earlier in the process of their development now are modified on the basis of information and knowledge in the procedures which are based on network experience exchange and interaction of social services, a cloud computing, big data, various devices, natural interfaces, and IT consumerism.

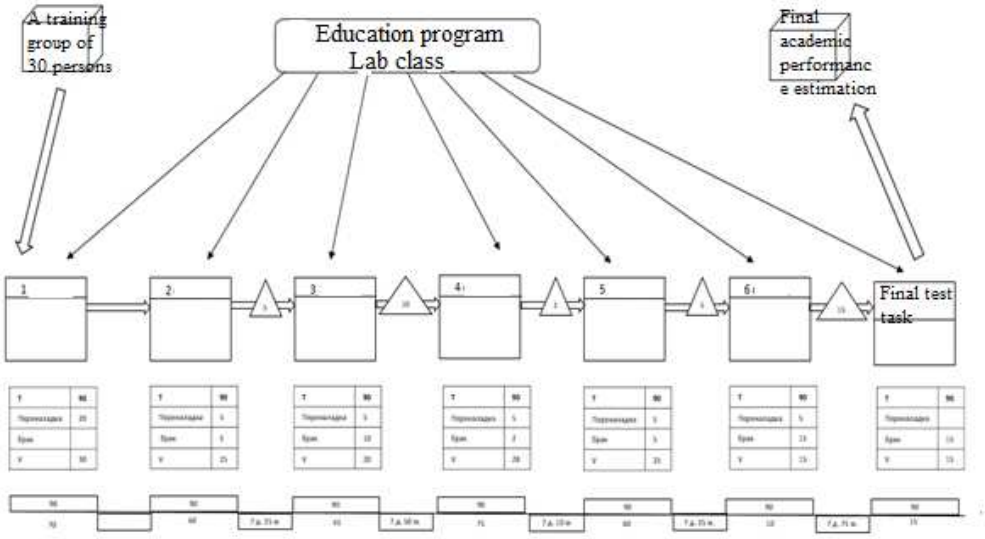
Another important aspect is distribution of the extending system of target groups' influence on a smart university, on the one hand, and on the other hand, provision of a certain set of professional competences for new challenges, formation of new market niches, and advancing development industries.

Such a concept can be realized in case of implementation of a lean management as a philosophy of activities and thinking.

Let's consider content of such tools in detail.

1. Development of a value creation flow diagram for the educational process representing transactions which introduce the added value in educational process, except for all possible types of losses. The flow diagram allows considering all chain entirely starting from a final consumer to an entrant; it is possible to review the diagram in accordance with the requirements of a specific discipline. Development of a value creation flow diagram reflects a current status of educational process with its actions, transactions, and expectations which don't add value for a final consumer, in other words those actions for which a final consumer shan't pay or pending to pay, are graphically displayed (Aetdinova, 2013).

Fig. 2. Example of the value creation flow diagram development for the current educational process on holding testing lab classes



Source: Nikolaeva, Demyanova and Aetdinova (2016)

From the flow diagram we see that time spent for all training process of a group of 30 students on holding of final testing lab takes 630 minutes, time for expectation and correction of a "defect" - 35 days and 185 minutes. At the same time, time for the added value which is important to the final consumer and which he is ready to pay for takes only 335 minutes for 30 people and 11,2 minutes per 1 person, respectively (Aetdinova, 2016).

The main problems and the reasons of expectation and defect are:

- disagreement between materials of lecture and seminar occupations;

- the absent/ill students;

- failure to carry out homework;

- readjustment of the service equipment (computers and multimedia equipment), etc.

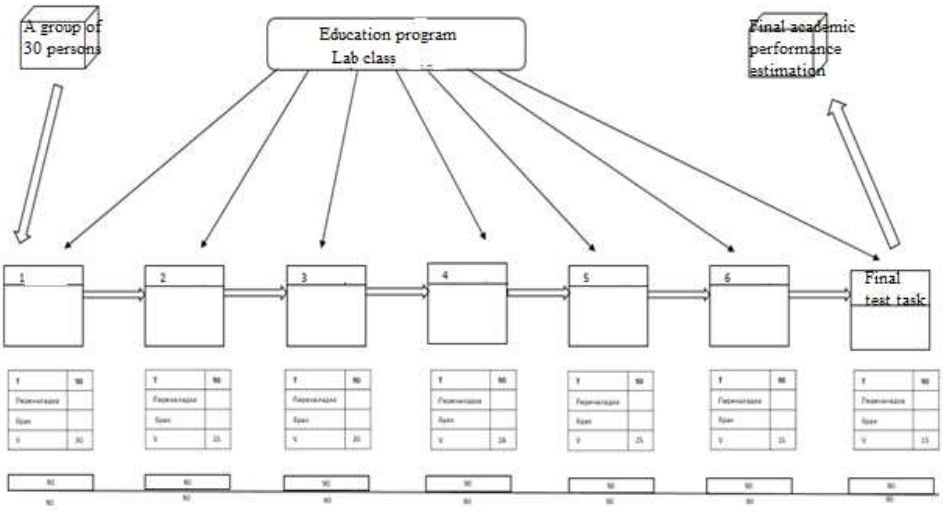
The main solutions are:

- use of the SMART University opportunities. Remote tracking and preparation of homework, correction of audit engagements for the students who are absent for any reasons;

- TPM implementation (Total Preventive Maintenance) for all hardware necessary for carrying out testing of students.

- Use of the standardized transactions.

Fig. 3. Example of the value creation flow diagram development for the future educational process on holding testing lab classes



Source: Nikolaeva, Demyanova and Aetdinova (2016)

Time spent for all process and time spent for creation of the added value are equal to 630 minutes for 30 people in this model, and is equal to 21 minutes per 1 person (Demyanova et al, 2017).

It allows to increase efficiency of acquisition of competences by each listener of a course and to reduce losses at a stage of seminar occupations.

The flow diagram allows us to see a "cycle time" – the time spent for the entire operating cycle and also to determine a "step time" - the time entire divided to frequency with which the final consumer expects graduation of a specialist from the SMART University. The step time shall set the work speed (training speed) which shall correspond to the available demand precisely (Vumek, 2016). The flow diagram of value creation can be provided both in "current", and in "future" conditions. It is reasonable to reflect an optimal variant of a value creation chain where process "bottlenecks" of future condition will be shown in the flow diagram. Process bottlenecks are the places where processes are slowed down or stop. One more purpose for reviewing the flow diagram with a current status is reducing all possible expenses (determination of main types of losses) and with which method is it possible to increase efficiency of process. Tayiti Ono was one of the main creators of the Toyota company production system which identifies 7 types of

losses:

• Losses due to an excess production;

• Losses of time because of expectation;

• Losses in case of unnecessary transportations;

• Losses due to excess handling stages;

• Losses due to excess inventories;

• Losses due to unnecessary movements;

• Losses due to release of defective products;

• Unrealized creative potential of employees (Demyanova and Chulpan, 2017).

"Supermarket" and Kanban systems may be used in the process of SMART University creation at all levels of educational process, where the consumer is an employer. The "supermarket" system will allow the final consumer to receive those personnel which are necessary in the specific place at the specific time. The kanban is an element of the extending system which will provide consecutive transfer of orders from a consumer to stages of educational process. Technologists of the SMART University will allow the Kanban system operation to track and visualize by means of IT technologies. The kanban is one of the most effective and sound tools for production management processes (Demyanova and Chulpan, 2017).

Table 2. The Kanban scheme for accomplishment of the term paper during 1 semester (4 months**)**

Example of the Kanban flow diagram	Level 1	Level 2	Level 3	Level 4	Level 5
	К 15.09	К 15.10	К 15.11	К 15.12	К 30.12
	Choice/approval of a subject	Performance of work for 25%	Performance of work for 50%	Performance of work for 75%	Delivery of the ready term paper
	Control/check	Control/check	Control/check	Control/check	Control/check
	Availability of the document	Availability of the document	Availability of the document	Availability of the document	Availability of the document
	Admission	Admission	Admission	Admission	Admission

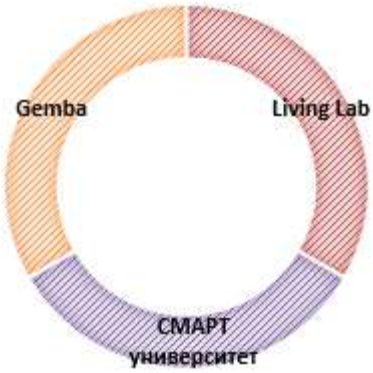
Source: Nikolaeva, Demyanova and Aetdinova (2016)

In case of implementation the Kanban method in the electronic system of the SMART University, the task is issued proceeding from terms of expectation of

ready result. The system "extends" process in time, and availability of electronic forms allows material acceptance to perform directly in electronic form, then material is checked by teachers, and the decision on opportunity/completion and transition to the next stage is made. When the following stage is resolved, system highlights a flow diagram with other color (for example, yellow). The course is completed at the third level or execution is transferred to the initial stage for several weeks until the end of delivery of the term paper, except for the specified reasonable excuse of failure to carry out of a task is excluded (Demyanova & Ishkova, 2017).

Creation of the SMART University needs to be considered through application, and not just knowledge acquisition. Use of Living Lab and Gemba if it is about the project, to create it must be focused directly on the place of value creation, for example, at the entity. The SMART University allows to perform project developments far off from the university). Gemba in the conditions of a SMART university can represent that place where value is created. In case of project implementation by students together with the organization on the project to transfer the main actions to the entity, so we will be able to track all nuances and to analyze a problem most in detail.

Fig. 4. Using Living Lab and Gemba



Source: Nikolaeva, Demyanova and Aetdinova (2016)

To determine external changes, personnel are need for the QFD (quality function deployment) analysis. [Nikolaev A.A., Learning organization as a possibility of forming of new quality of training in HIGHER EDUCATION INSTITUTIONS, that is scientific and practical LEAN – a seminar "Implementation of the concept "Economical production" in the Republic of Tatarstan". The purpose is to build additional education as production cycle with the step time depending on requirements of the market. Development of training under specific need of the market / the final consumer is necessary now. This opportunity is given by a SMART University, Living Lab and the QFD analysis. The quality function deployment represents the tool visualized by means of special matrixes used by the team of developers of the project. QFD is a view of the specialists having

knowledge in different industries (usually they are economists, technologists, designers) on formation of a new product based on "the consumer's voice" and consumer preferences.

The Application Kaizen is a fixed or continuous improvement and updating of training courses. It is provided by teachers and all training materials (lectures, practical tasks, seminars, etc.) and updated by independent commission of experts. Kaizen is the philosophy which allows each process to enhance by involvement of creative potential both of students and teachers, and administrative personnel.

5S tool (sorting, rational arrangement, cleaning, standardization and enhancement) is used for rationalization of educational activities in administrative documentation, educational materials on virtual and real desktops of employees and students. This tool will facilitate transition to the SMART University and will allow data in information flows to structure.

To visualize and standardize all training processes of the SMART University (mobile applications, computers, message boards) a unified interface is created for the possibility of intuitive perception of information.

Buildings of faculties and departments should be arranged as U-shaped cells. The scheme in which excessive "movements" and "expectations" will be limited should be designed. It is possible to monitor excessive movements by means of spaghetti charts. These movements can represent both movements of students, and movement of necessary administrative information. Some processes of the SMART University can be completely transferred from physical to an electronic type based on spaghetti charts. A physical educational process should be reconstructed with maximum efficiency from the point of view of obtaining and use of skills and knowledge, formation of Lean thinking.

Table 3. The spaghetti chart for administrative transaction in the SMART University by Nikolaeva, Demyanova, and Aetdinova

Stage No.	Movement, in meters	Time spent for movement	Expectation min
1	500	10	15
2	200	4	15
3	300	6	15
4	300	6	15
Total	1300	26	60

Source: Authors (2018)

The general spent time for movements and expectations for signing constitutes 86 min. These losses from movement are well shown by the Spaghetti Chart which can be applied not only to visualization of movement in administrative departments, but also in other types of educational process and activities of the university.

Table 4. Process decisions in the SMART University using the Spaghetti Chart for transfer a document in an electronic form

he stages	Movement, in meters	Time spent for movement	Expectation min
1	0	0	10
2	0	0	10
3	0	0	10
4	0	0	10
total	0	0	40

Source: Nikolaeva, Demyanova and Aetdinova (2018)

Having excluded physical component in movement of the document, time expenditure decreased from 86 to 40 minutes.

CONCLUSIONS

Standardization is used for forming "personal flow diagrams" with all information connected with educational and research activities of a student for understanding by teachers of a level of interest of a student to the specific project or Living Lab. It is performed by means of SMART technologies in the University.

Creation of e-learning base on basic skills of specialties will allow considerably reduce time of resident instruction with the teacher when analyzing the simplest fields of knowledge and to release time for analyzing more complex materials requiring personal contact of the student with a teacher.

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