

EFFECTIVE DIGITAL TRANSFORMATION IN THE CONTEXT OF HIGHER EDUCATION

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Abstract

Digital technology has significantly changed almost every aspect of our lives including educational. A huge potential offered by digital technologies, still to be fully explored, ensures the digital transformation of higher education. The aim of this article to contribute to the discussion of an effective digital transformation in the context of higher education based on the latest education trends and frameworks of leading global vendors and to explore the main aspects of digital transformation process implementation. It also intends to analyze the essence of digital transformation listing main challenges, problems and key principles. A literature review about the digital transformation was made, basing on the analyses main aspects and key principles were listed. The emphasis is on the theoretical implications for the effective digital transformation in the context of higher education.

Keywords: digital transformation, digital technologies, higher education, educational trends.

1 INTRODUCTION

Digital technology has significantly changed almost every aspect of our lives and education is among of them. According to the Vizag Declaration on Global Guidelines for Digital Learning issued by UNESCO in 2018 digital technologies are beginning to transform traditional relations of knowledge and learning in order to achieve long-held pedagogical ideals. A huge potential offered by digital technologies, still to be fully explored, ensures the digital transformation (DT) of education at each level including higher education [1].

The term "digital transformation" has been used to describe how the digital revolution or digital age, as it has been named by leading Google specialists Schmidt and Cohen [2], is impacting on DT of individuals, teams, organizations, industries, institutions, economies, regions and societies.

Digital Business specialists Warner and Wager has defined DT as the use of new digital technologies, such as mobile, artificial intelligence, cloud, block chain, and the Internet of things technologies, to enable major business improvements to augment customer experience, streamline operations, or create new business models [3].

DT of education is considered as an inevitable process of change content, methods and organizational forms of educational work, which takes place in a rapidly developing digital educational environment and is aimed at solving problems socio-economic development of the country in the conditions of the fourth industrial revolution (Industry 4.0) and the formation of digital economies [4].

The term Industry 4.0 and DT are often used interchangeably to describe how new digital technologies such as Artificial Intelligence, Virtual Reality, big data analyses, cloud solutions, Internet of Things, Robotics can transform all aspects of our lives including education.

Despite of growing interest of DT phenomenon parties involved are not able to provide the detailed structure and framework for DT of education. As it is important to understand how DT reshape the manner in which organizations and institutions emerge, operate and develop.

The aim of this article to contribute to the discussion of an effective digital transformation in the context of higher education based on the latest education trends and frameworks of leading global vendors. It also intends to analyze the essence of digital transformation listing main aspects and key principles.

2 METHODOLOGY

The research undertaken for this study is theoretical and based on a study and overview of the existing literature in the topic. Within the scope of the research the literature consulted includes articles specifically on digital transformation (*Edelmann, Haug, Iovan, Marge, Mergel, Osburg, Warner, Wager 2019*), transformation in education (*Leal Filho, Raath, Lazzarini, Vargas, Souza, Anholon,*

Quelhas, Haddad, Klavins, Orlovic, 2018), digital transformation in the context of higher education (Tulchinskij, 2017; Mahlow, Hediger, Jackson, 2019), DT frameworks of leading global vendors (Microsoft, Alcatel-Lucent, 2019) and pedagogy of higher education institutions in the digital age (Meshkov, Sadovnikova, 2010; Uvarov, 2019). Mentioned terms are transdisciplinary fields considering many disciplines such as economics, information technology, philosophy, communication studies, pedagogy, psychology and others. The focus of this article will be on pedagogical and educational aspects. To review the essence of digital transformation in higher education terms analyses approach has been applied, by separately defining: digital transformation and digital transformation in the context of higher education, framework of digital transformation.

3 RESULTS

Within the framework of II Conference "Digital Transformation of Education and Artificial Intelligence" held in September 2019 in Moscow, the definitions of **DT of organization** and **DT in education** have been specified.

In the context of organization or enterprise DT is the usage of digital technologies for dramatic improvement of labor productivity. It is a deep transformation of the following: production and organizational operations; processes; employee responsibilities and models for productivity increase. DT is based on developing digital technologies, using their accelerating impact on society, taking into consideration what has already happened, ongoing future-oriented technological changes [4].

Iovan and Marge [5] indicate DT as the deep transformation of organizational business activities, processes, competences and models to fully influence the changes and opportunities of a combination of digital technologies and their accelerating impact on society in a strategic and priority-oriented manner, taking into account current and future changes. It is a fundamental change in how an organization gives value to its customers.

DT in itself is as a consequence of achieving organizational transformation through the adoption of digital technologies and realignment of organizational processes [6].

Microsoft offers their definition of DT as the use of new, fast and frequently changing digital technology to solve problems often utilizing cloud computing, reducing reliance on user owned hardware but increasing reliance on subscription based cloud services. Some of these digital solutions enhance capabilities of traditional software products [7].

According to Westerman and Bonne [8] DT in the enterprise is understood how to deeply transform production and organizational operations, technological processes, duties of employees and the quality of their activities, which is necessary for a radical increase in productivity and efficiency of the enterprise as a whole.

Moreover, in the process of DT of the enterprise the following aspects are specified: to turn customers into partners; to reveal the creative potential of the staff; to transform products into services; to make business processes flexible, scalable and natural; to revise or develop a new business model [9].

While, in the context of education, DT is specified as updating of planned educational results, educational content, methods and organizational forms of educational work, as well as evaluation of the results achieved in the evolving digital educational environment for significant improvement of educational results of each student. It is designed to provide: mastering of pre-selected content by students (that is socially defined), achievement of externally formed and independently selected goals by students, support and development of students' ability to learn, formation of their educational independence, generation and development of their personal identity in the process mastering both socially defined and self-selected content [4].

DT is a physical and philosophical change designed to meet the ever growing demands of the students, faculty and campus to create a learning environment where everything connects [10].

The world in general, and organizations and institutions in particular, is changing faster than ever. DT takes organizations and educational institutions to the next level.

Industry 4.0 needs Education 4.0, so DT of education is the necessity to meet the nowadays requirements. As Industry 4.0 is as leading scientifically – technical research as qualitative changes of production culture. The high level of competences is required from the staff. So the alliance between education and industry should be restored [11].

In order to explain the basic **frameworks of any DT** the focus on digitalization providers was made. Microsoft is a leading global vendor of computer software, hardware, mobile and gaming systems, and cloud services indicates the basic concept of digital transformation despite the directivity of organization as digital transformation is not just a basic hardware or software upgrade. It is a deep and detailed change designed according to the demands of the students, faculty and campus with overall connected learning environment. This is an ecosystem that combines technology, services and security to bridge the digital gap to create collaborative, interactive and personalized learning experiences. DT positively impacts student learning by opening a world of endless possibilities and collaboration.

The following issues have been indicated as driving forces: campus security, information security, student success, IT strategy, data enablement, student centric services, affordability, digital integration, artificial intelligence [7].

One more American leading corporation Alcatel Lucent offered their concept of DT, indicating that it starts with a strategy. A clearly defined strategy that leverages opportunities presented by the new technology while meeting the objectives of the stakeholders. The following four steps necessary to develop a DT strategy for education:

- 1 Connect everything to support tomorrow's digital world. Set up strong strategic partnerships and build an ecosystem connecting the people, processes and things to build a communications network that is high capacity, secure and smart.
- 2 Deploy analytics to automate, understand and save money, necessity to use real life, real-time data to drive strategic initiatives that improve performance, roll out upgrades and make infrastructure decisions.
- 3 New business models are needed, updated software and on-demand services to make the procedure cheaper, more flexible and simpler to manage than traditional systems.
- 4 A single, simple platform needed or on-premises or in the cloud, the ultimate goal of digital transformation is to provide a single platform as the foundation of the network and communications infrastructure for the institution [12].

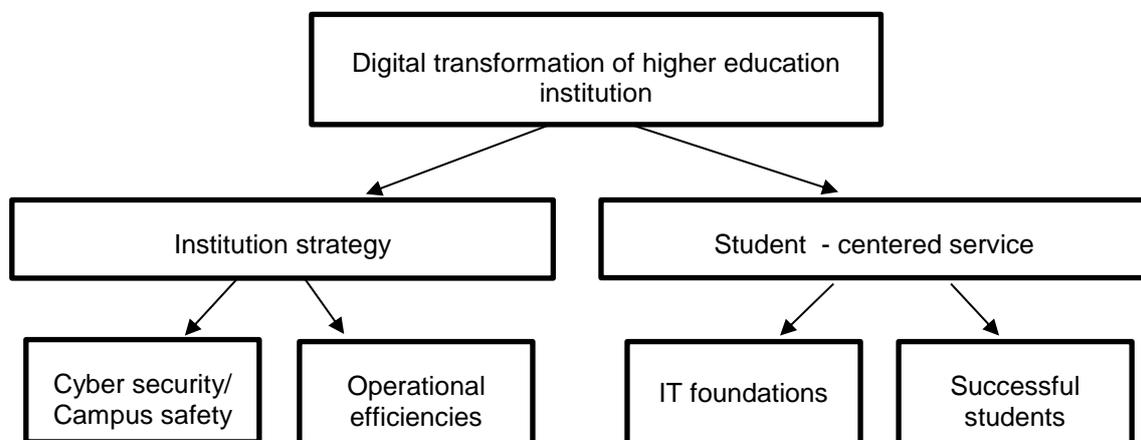


Figure 1. Digital transformation of higher educational institution [12]

According to Figure 1 the key factors of Alcatel-Lucent strategy were indicated as institution strategy and student – centered service. In order to provide the IT foundations, the successful work of student, cyber security and safety as well as operational effectiveness, the following components are needed: network infrastructure, mobility – steller, collaborative working rainbow, Internet of Things and solved security issue.

So DT of higher education is creating a world of difference by rethinking the digital tools that are used in the classroom. Digital tools are driving new levels of collaboration and innovation to create a campus of endless learning possibilities [12].

Although technology has a central role in DT, still DT is not just about technology: it is about profound transformation of the company, of the processes and skills needed to integrate and take advantage of the opportunities of new technologies. In this context, the use of technology is only a means of

generating DT and not an end in itself. DT is a massive effort, especially for larger and more stable organizations. If well done, it will result in a company better suited to customer requirements and resistant to the rapid evolution of technology [5].

Some companies see DT as a way to optimize processes and cut costs, while others view it as an opportunity to create new value by offering something new, all the perspectives are valid and correct [13], while in the terms of higher education DT has its effect on two main business parts:

- 1 Services transformation focuses on creating new education products and transforming existing products into digital ones. This usually means converting offline lectures into video ones, creating digital texts and quizzes. Moreover, it includes providing digital means for communication between students and teachers.
- 2 Operations transformation would basically require a digitalization of all the common operations educational institutions have such as students' admission, registration for programs and courses, examination, program development, and their quality assurance. In addition, supporting services as study planning, facility management, teacher allocation, scheduling [14].

The conducted investigations show that educational reforms carried out in recent decades have provided insufficient results. As today the number of jobs require a high level of performance, overall literacy and the ability to solve problems using information and communication technologies. In order to solve the problems posed to education by Industry 4.0 the DT is required with personalized, result-oriented model of the organization of educational processes. It should follow the model of work organization specified for modern high-tech enterprises [15].

Till recently **the implementation of DT** in education wasn't associated with the renewal of the organization of the educational process. Most managers and teachers considered DT as a tool for improving the traditional organization of the educational institution.

According to Dobrica [16] the usage of digital technologies does not result in DT. DT is about doing things differently—creating a completely new business model by using modern information and computer technologies. DT leverages existing knowledge to profoundly change the essence of the organization—its culture, management strategy, technological mix, and operational setup. It places the customer at the center of all its decisions and actions. In the context of education, it makes the process personalized for the student. That is specified according to paradigm shift in education.

Therefore the vertical structure of educational paradigm should be considered as the framework for DT in education, including educational objectives, content, methods, learning materials, organizational forms, roles and attitudes of the participants of learning process [17].

The following aspects are required for implementation of DT in education:

- to change or update learning objectives and content;
- to proceed from teaching and educating everyone to learning and the upbringing of each, by changing the organization and methods of educational work;
- to review and optimize the sets of used educational, methodical and organizational solutions, information materials, tools and services;
- to revise traditional business processes to include all interested parties in this work;
- to implement the rapidly growing potential of digital technologies, including artificial intelligence, computerizing and digitalizing of all types of work with information [4].

As DT offers new ways of respecting contexts. Technology helps with contextualization in learning to overcome the challenges of teaching abstract methods derived from concrete situations [18].

Besides this in the process of DT of higher education, it is necessary to develop new models of educational organizations with synthesis in the base:

- new highly effective pedagogical practices, which are successfully implemented in the digital educational environment and are based on the use of information and communication technologies;
- continuous professional development of lecturers;
- new digital tools, information sources and services;

- organizational and infrastructural conditions for implementation of necessary transformations (including support of educational institution, its heads and founders, formation appropriate mood in the team, support lecturers in the development of new roles and methods of work) [4].

Summing up, the essence of the DT of education is the achievement by each student of the necessary educational results through the personalization of educational process based on the use of the growing potential of the information and communication technologies, including the use of artificial intelligence techniques, virtual reality tools; educational institutions of the digital educational environment; providing public broadband access to Internet, work with big data.

If to speak about **key principles for DT** the following aspects have been specified: consistency, update of learning objectives, update the content of education, update of organizational forms of educational work and update assessment of education results.

Consistency is important factor for DT in education. Digital technologies provide a solution improving the means of planning and organization of the educational process, the introduction of active methods training and transition to a personalized and result-oriented organization model of the educational process. It is important to indicate that DT of educational institution is a multi-year work that affects everything levels of education and is impossible without the active participation of students, lecturers, management staff, all interested parties, including parents and employers, politicians and members of the public [5].

DT of higher education includes: the development of digital infrastructure for education; the development of digital teaching materials, tools and services, including digital assessment; the development and dissemination of new models of organization and teaching methods [4].

This work includes the use of digital resources (sources, tools, environments, services, professional digital tools or their educational adaptations) by students in their academic work, which are used in everyday and professional activities. Updating educational outcomes and content education, methods and organizational forms of educational work, based on the use of information and communication technologies, including the production areas, should be accompanied by an update business processes, procedures and staff regulations. Here changes of all components are coordinated and supplement each other [18].

During the DT of higher education, the digital tools and services should be created and widely implemented that let to: supplement the fixed educational standard with new explicitly described and reliably verified outcomes; upgrade studying content, taking into account the realities of the digital economy, the requirements of interdisciplinary (in terms of integration of scientific fields) and readiness for life in technologically rich environment; expand the range of methods and tools of educational work, which will increase its effectiveness and the time of the participants of the educational process will be saved; differentiate and combine different forms of the organization of the educational process, which will ensure the achievement of the required educational results of each individual and will provide opportunities for the development and satisfaction of his cognitive interests; use widely criteria-based assessment of learning achievements in the course of formative and summative assessment [4].

Updating learning objectives - today, everyone recognizes two essential facts: the content of higher education must be updated and at the same time to reflect the civilizational changes. In addition, durable knowledge, skills, abilities and attitudes in mathematics, computer science and technology, including digital literacy, project and algorithmic thinking are necessary in the conditions of digital economy. The formation and development of students' ability to learn, cooperate, think critically, communicate effectively, and create new ideas becomes mandatory new [10].

As nowadays the main attention and time of educational work is paid to communication of numerous data to students, familiarization with the known information, the transfer of knowledge. Appropriate actions are within the scope of computationally tractable and as the spread of artificial intelligence methods increasingly executed by the computer. Information search tools allow you to find the required data and actual information in the network, intelligent algorithms-fill the necessary knowledge and facilitate understanding [4]. However, digitalized learning is not capable to form at the computer unique human abilities to examination and transfer of the mastered knowledge and skills in new situations.

Here, Mezirow's theory of transformative learning should be described. According to which, transformative learning is learning that occurs when an adult engages in activities that cause or allow them to see a different worldview from their own. Afterwards adults work to integrate the implications

of that different worldview into their own worldview, thereby enlarging it. This process of changing to person's worldview and the enlarging of it is called transformative by Mezirow [19].

The following four processes of learning had been indicated by Mezirow, as: 1. to elaborate the existing point of view; 2. to establish new points of view; 3. to transform our point of view; 4. to transform ethnocentric habit of mind.

The basic aim of the learning process was to transform the existing point of view through new knowledge or even to influence ethnocentric habit of mind. The following key elements of transformative learning were named by Mezirow: disorienting dilemma, critical reflection and rational discourse. 22 years later Mezirow has added seven more elements for the transformative learning as:

- 1 a disorienting dilemma –as significant stimulus to undergo a meaning perspective transformation;
- 2 self – examination with feeling of fear, anger, guilt or shame;
- 3 a critical assessment of assumptions;
- 4 recognition that one's discontent and the process of transformation are shared;
- 5 exploration of options for new roles, relationships and actions;
- 6 planning a course of action;
- 7 acquiring knowledge and skills for implementing one's plan;
- 8 provisional trying of new roles;
- 9 building competences and self-confidence in new roles and relationships.
- 10 a reintegration into one's life on the basis of conditions dictating by one's new perspectives [20].

Formation of the ability to solve practical problems in new situations, use the experience of such a transfer to self-development of innovation has always been a desirable educational result. However, purposeful formation of such ability, and assessment of students' ability to expertise and transfer their experience remains outside the framework of a systematically organized educational process. Digital transformation of education is designed to shift the emphasis in training from the development of abilities in the field of algorithm (work with data, information and knowledge) to the development of specific human abilities (the ability to expertise and transfer mastered knowledge and skills in new situations). Out of world economic forum proceedings such educational results should be achieved by each student [21].

Without this, it will not be possible to solve the problem of training personnel for the digital economy, to overcome the negative trends that DT generates on labor market. All of this points to the need to redefine traditional goals in the course of digital transformation educations. Widespread adoption of digital tools, using methods of artificial intelligence, makes this work especially relevant.

Update content of education - in DT of higher education, in addition to describing new educational outcomes, the traditional content of education should be clarified and rethought. Reducing the amount of material actually studied provides time for students to: build their own knowledge in the course of training; develop basic competencies that scientists and engineers use in their practical work; reflective comprehension and deeper understanding of the nature of the studied phenomena.

The allocation of basic concepts helps to form a conceptual structure for students, which facilitates the acquisition of new knowledge. Thorough study of basic concepts in the framework of compulsory courses, as well as participation in the implementation of scientific and engineering projects helps a deep and conscious assimilation of modern natural concepts in the development of natural-scientific disciplines: specialized courses in high school; continuing education in higher specialized educational institutions; continuous progress in life-long learning [18].

Updating organizational forms of educational work - the main task is to harmonize in a single educational achieving two goals: formation of pre-selected, socially defined, set of knowledge, skills, abilities and attitudes that are necessary for life; development of students' ability to learn, to independently set educational tasks, as well as tasks and goals of personal and professional development [4].

In the conditions of constant changes caused by Industry 4.0, there is a growing need for continuous education, including self-education, in a motivated educational students' work, which is necessary for mastering universal competencies, including non-web / critical thinking, creativity, communication, etc.

These competence, as well as the ability to read, write, count, should be owned by everyone, not just a select few [22]. However, in the current organization of educational work required results not all students achieve. Training oriented on the result, means that students master the material without gaps that all planned educational outcomes in full are reliably formed in each of them.

Just as DT of enterprises changes the organization of their activities, DT of higher education is associated with a change in the organization of educational work, the expansion of the traditional lecture system. At the traditional organization of training one content of educational work, one way of its presentation, one as a rule, the pace of educational work is extended to all students.

The differentiated organization of training assumes that one content of educational work, one way of its presentation, one pace of study work are used for a dedicated group of students. At the individualized organization of studying different content of the study work and different, in case of necessity, methods of its presentation, as well as the different pace of educational work are used for different students taking into account their individual characteristics.

Traditional, differentiated, individualized and personalized learning are theoretical (didactic, organizational and pedagogical) models. In practice, they can be implemented by many ways. They do not depend on each other, do not follow each other and do not oppose each other, and successfully coexist, complementing, supporting or displacing each other [4].

Personalized and results-oriented, personalized and effective organization of training is not a new pedagogical idea. The main task — formation of educational independence is solved. The learner consciously takes responsibility for their studies, which creates conditions for hard work to overcome difficulties, develop character and develop abilities.

Personalized and results-oriented organization of training is aimed at improving performance educational work. It involves evidence-based achievement planned educational outcomes of each student along with the development of his abilities and personal potential. To solve the emerging organizational and methodological we need a full range of modern digital tools and resources that help to build an educational process that fully implements the didactic principles in relation to each student. This transformation of the work of the educational institution it is natural to call it a DT. Transition of the educational organization to work on the basis of ICT is associated with a number of system changes, including: transition from training material to the achievement of learning outcomes; change of roles of participants of educational process; move to personal study plans; the transformation of space and ways of conducting educational work; updating the regulations of the educational organization; formation of digital educational environment for automation of routine operations and support of participants of educational work [23].

Therefore, in order to achieve the learning outcomes, the following aspects should be taken into consideration: changing roles participants of the educational process, transition to personal study plans, the transformation of the space and ways of carrying out educational work, the digital learning environment, regulations updates work of the educational organization and assessment of educational result.

Assessment of education results - the widespread availability of information and communication technologies, the development of methods of Artificial Intelligence and Virtual Reality to create prerequisites for automating the work on the assessment of educational results of students. Formative assessment is largely embedded in the delivered turnkey software solutions of digital educational and methodical complexes. This assessment is carried out at each in addition to educational work, it ensures its effectiveness. PRO-platforms, of course, include tools for the organization of mutual assessment, of learner achievement portfolios (digital portfolio), etc [16].

DT allow widespread implementation of authentic assessment practices, which are commonly used in the implementation of competence approach. Here the students demonstrate achieving the necessary educational outcomes (knowledge, skills and abilities) in situations that as close as possible to the conditions of real life and professional work. This assessment is often used in vocational education, however, its distribution is limited by its high cost and organizational difficulties of carrying out such procedures. Today, reliable digital tools have been developed to automate the assessment rather complex human abilities (for example, the ability of students to cooperate in solving problems [24]). In professional education, computer simulators have long been used for authentic assessment.

Organization of assessment of practical knowledge and skills students in a mixed reality environment in the near future will allow to make such type of estimation mass. However, serious pedagogical

research and methodological developments are needed to ensure that these potential opportunities become reality.

Technology is an essential component of learning and educational process nowadays. With digital applications, tools, instruments and resources, students can create content, interact with experts, collaborate with peers and participate in simulation activities and work. Personalized and individualized experiences put students at the center of learning and empowers students to take control of their own learning through flexibility and choice [25].

4 CONCLUSIONS

It is concluded that DT in the context of higher education is observed within two directions: strategy of higher education institution and student-centered service. For the strategy of higher education institution DT is specified as the usage of digital technologies for dramatic improvement of labor productivity, a deep transformation of the following: production and organizational operations; processes; employee responsibilities and models for productivity increase; taking into consideration what has already happened, ongoing future-oriented technological changes. While, in the context of student-centered service, DT is specified as updating of planned educational results, educational content, methods and organizational forms of educational work, as well as evaluation of the results achieved in the evolving digital educational environment for significant improvement of educational results of each student.

Thus, the essence of the DT of higher education is the achievement by each student of the necessary educational results through the personalization of educational process based on the use of the growing potential of the digital tools, including the use of artificial intelligence techniques, virtual reality tools; educational institutions of the digital educational environment; providing public broadband access to Internet, work with big data. Rapidly developing and cheaper digital devices and technologies allow to widely introduce new models of organization and conduct of educational work and new pedagogical practices.

DT of higher education is associated with qualitative changes in educational work. These changes are necessary to form the ability of each member of society to live and work productively in a changing digital economy, continuing their education throughout all life. The essence of this change is the use of rapidly developing digital technologies for a consistent transition to a personalized result-oriented organization of educational process.

So DT in this regard should provide for a coordinate solution of main aspects, including:

- development of material infrastructure: data centers, communication channels and access devices for use digital teaching materials;
- development, approbation and implementation of digital educational and methodological complexes in mathematics, computer science, technology and dissemination of technological transfer to other disciplines as well, using adaptive learning algorithms and assessments based on artificial intelligence and other end-to-end technologies;
- development of online learning, digital substitution of paper content and educational programs of institutions and products with low quality;
- development, testing and implementation of platform of universal functionality of digital educational environment for identification and authentication of users.

Summing up, the key principles for digital transformation include the following aspects: consistency of the process, update of learning objectives, update the content of education, update of organizational forms of educational work and update assessment of education results.

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