

Education 4.0 – 5.0 and the Post-Information Transformation of University Libraries

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Abstract

The report outlines the main stages of the development of society in the transition from information to post-information society, defined as the transition to industry 4.0 – 5.0. The changes caused by the widespread introduction of technology in educational models and their role in innovation in education are briefly described.

The place and role of university libraries in the conditions of radical changes in the educational models in the post-information society are presented with the main tendencies in their development during the last 10 years. The interaction between the new educational models and the changes in the functions of the university libraries, which occur during their inevitable transformation in accordance with the new conditions, is shown.

Keywords

education 4.0, post-information educational models, new university library models

1 Introduction

In the first 20 years of the XXI century, there is a general digital transformation of the economy, defined by scientists as the "Industrial Revolution 4.0" (Schwab, 2016), and the development of society passes to the next stage – a post-information society [3]. The preconditions for the changes in the educational models derive from the development of technologies and their reflection on all spheres of society. Technologies are the result of the development of knowledge, the achievements of which are visible from the creation of specific applications that characterize the stages of development of human civilizations. The role of knowledge about the life of modern society determines the importance of education to prepare professionals for the professions of the future. Universities are also undergoing transformations – from renewed curricula and curricula, to "reengineering" of the entire educational process [5]. Ensuring the digital transformation of educational models covers teacher training, teaching methods, facilities, but first and foremost – the information provision of the learning process, which is the responsibility of university libraries. They are also under pressure from the changing environment to perform their functions, catalyzed by the requirements to provide a new generation of the communication model.

2 The Knowledge Society and Industry 4.0 – 5.0

The changes in society predicted in the research of Friedrich von Hayek, Fritz Mahlup, Peter Drucker, Daniel Bell, marked the transition to post-industrial society and developed with extreme

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intensity over 60 years – from the 20s to the 80s of the twentieth century.

In the scientific literature there are disagreements on the periodization "industrial – post-industrial – information – post-information society – industry 4.0", and the strategy for "industry 5.0" is being prepared. The discussion is not only about the chronological boundaries, but also about the nature of the changes marking the transition from the industrial stage of society to the era of total connectivity, generating restructuring of the world economy and living in a digital environment. [9, 17].

For the purposes of the presented study, we accept as a guiding principle for the transitions of society in the twentieth century the approaches to the creation of knowledge, tools and technologies for its dissemination and extraction of benefits for society. The change in the role of research for society is defined by researchers as a transition from "Modus 1" – to the production of knowledge, to "Modus 2" – to problem-oriented research with specific application significance, determining the new living conditions of society. At this stage of the development of society, the main goals of science are the creation of socially relevant science in the conditions of deepening and expanding knowledge and catalyzing its potential for social impact [6].

The creation of "Associated Public Intelligence" in modern conditions includes not only the intellectual potential of society but also the convergence of intelligent systems and applications [4].

The driving force of the economy of the post-information society is research institutions and researchers, which are organized in networks, narrowly specialized research focused on a given scientific problem, also fundamental, as the organization of research is based on the mobility of scientists, flexible team configuration, the openness of the communications in the team, open access to the results of the conducted researches. In the infrastructure of the science of knowledge economy, the focus is on knowledge as a highly qualified resource, its distinctive feature is its easy transfer and transmission, and its biggest investment is researchers, a global workforce that leads to the dominant phenomenon in the era of the digital economy and globalization – the global labour supply. The constant change in the market environment affects the productions, respectively also the marketing strategies. Key skills for all market participants are investments in the development of new products as a continuous process, which fully corresponds to the exceptional dynamics of changes in technology, competitive environment and consumer attitudes [11].

EU programs to build a Single European Research Area (ERA) have been launched since the creation of the EU and are being updated, with priorities for the last 40 years focusing on creating a new research infrastructure. The stages of building an e-science infrastructure are specified in the 8 European Research Framework Programs. The latest Horizon 2020 research and innovation program (2014-2020) has set itself the strategic goal of ensuring the EU's competitiveness in the world market. The next EU research and innovation program, Horizon Europe, was due to start in 2021 with a deadline of 2027. [15, 16]

The changes that have taken place in connection with the Covid-19 pandemic have put to the test the implementation of the horizontal programs and initiatives that have been put in place and, accordingly, the restructuring of the financial resources to deal with the pandemic. The achieved level of creation of scientific infrastructure based on national innovation systems has made progress in harmonizing the development of research in the EU member states.

The Communication from the Commission to the European Parliament, the Council of Europe, the European Economic and Social Committee and the Committee of the Regions includes practical guidelines for implementing the Digital Transformation Concept: opening up education, innovative teaching and learning for all using new technologies and educational open-access resources [12, 14].

Regardless of the extraordinary circumstances, the EC continues to implement the outlined strategic goals, which for the period until 2050 are defined as building the continuation of Industry 4.0 – Industry 5.0. Industry 5.0 priority is human and social orientation. Research and innovation continue to focus on the transition to a sustainable, human-oriented and green technology-friendly economy, including a review of existing value chains and energy consumption practices. The aim is to conserve resources, tackle climate change, and last but not least, social cohesion and stability. In the three main directions, respectively, 6 main priorities are specified until 2024 [2]:

- Economics for people – human-oriented artificial intelligence (AI White Paper); qualification and retraining and digital skills (Skills Program and Action Plan in the field of digital education);
- European green deal – resource-efficient and sustainable industries; transition to a circular economy (Green Deal);

- Europe for the digital age – a competitive and leading global industry; accelerating investment in research and innovation (Industrial Strategy).

The Strategy for the effective application of information and communication technologies in education and science of the Republic of Bulgaria for the period 2014-2020 also includes the Concept for the digital transformation of the Bulgarian industry [19].

The achieved results show an approximation to the EU criteria for the development of digital transformation of the Bulgarian economy, outlining the disparities in regions and industries, to which efforts and financing for proportional expansion should be focused. 8 Competence Centers have been established, which unite universities, research institutes and high-tech companies and are aimed at developing state-of-the-art technologies in the priority areas defined in the EU Framework Programs after 2020.

3 Education 4.0, the "Triangle of Knowledge" and the Universities

Identification of funding sources and other support and thanks to individuals and groups that assisted in the research and the preparation of the work should be included in an acknowledgement section, which is placed just before the reference section in your document.

Updating the role of the so-called "knowledge triangle", which includes education, research and turning it into innovation with immediate implementation in business, requires a key role to be taken by universities, which must prepare for the renewal of the intellectual potential for maintaining the development of research and business in line with the new conditions for development.

The established pedagogical models in traditional education are being transformed into a digital online environment, as their change is dictated both by the changed conditions for implementation and by the implemented EU strategies for training specialists for the future.

Modern technologies allow the combination of traditional models of learning – cognitive, behavioural, social constructivism, with the ability to personalize learning and strengthen motivation for self-development technologies. It requires knowledge and operation in a digital environment by the learner and the trainer, including the ability to navigate large amounts of information, extract and systematize data, assisted by all possible forms of communication in the online environment

The education-business relationship is under the pressure of the inconsistency of the educational system, which bears the marks of the industrial age, and the greatly changed environment for the realization of the trained specialists. First of all, its limited impacts on the formation of the required quality new generation of professionals stand out.

Determining factor for achieving the new goals of education is adaptability and socialization of the acquired knowledge and skills of students, to have knowledge and competencies that ensure immediate application of new technologies in business, as well as successful integration and development of a high-tech environment for living and working XXI Century [8, 10].

The introduction of the concept of "Open Education" in 2013 is dictated by the current needs of business and communities to create the conditions for innovative and effective education systems and to create better conditions for European citizens to benefit from flexible and adaptive learning models and have better prospects for personal fulfilment through lifelong learning [1].

The European Digital Competence Framework (Digital Competences 2.0), adopted in 2017, identifies 5 key competencies: information and data literacy; communication and collaborations; creating digital content; security; solving problems. [2]

In the Framework of Digital Competences for Citizens 2.1, 8 levels of proficiency in digital skills have been added, which are specified with examples of their application. They are fixed in a two-dimensional system with an indication of the criteria of Digital Competence 2.0 and respectively four criteria for defining complexity and novelty in comparison with Digital Competence 2.1.

Each subsequent level complicates the requirements for the ability to define tasks and problems, independence in their implementation and cognitive skills, which evolve from "remembering" to "creating" new knowledge.

In the transition period from traditional to digital learning, of which we are contemporaries, hybrid learning models are used. These include traditional teaching methods using information and communication technologies.

Digital competence has been present for the last 30 years in the EU Framework Programs (FP 7, FP 8), which are implementing the strategy for building the information society and the "knowledge economy" in Europe. The key competencies are defined in the EU cluster of information and communication technologies as criteria for the degree of readiness of a country to train staff – creators of the knowledge economy. [13]

As a result of the implemented projects in the implementation of flagship initiatives of the Europe 2020 strategy, progress has been made in the last 4 years in the field of innovative and modernized education and training, specifically with the implementation of the programs: "Program for new skills and jobs", "Youth on the Move, the Digital Agenda and the Innovation Union [15].

For the universal introduction of e-learning, mobile and personalized learning it is necessary to provide sufficient thematic scope and volume of information resources, virtual libraries, mobile communication devices, including laptops, tablets, smartphones, and last but not least – wireless internet connection. For personalized (ubiquitous) learning, which includes the possibility of its implementation at any time, from any place, with any teacher, for each student it is necessary in addition to the presence of rich virtual libraries with lectures and exercises in all or major disciplines of the curriculum, and also of virtual laboratories. In accordance with the initiative of the European Commission for "opening education through new technologies", it is necessary to provide access for all learners to learning content, to help from a teacher, so that they can learn at any time and in any place, provided communication device – computer, laptop, tablet or smartphone [1].

Each university has a website where you can get not only complete information about the university but also information about the educational and administrative services offered. The site must also have a link to an e-learning or distance learning platform. In this way, each university presents itself with its virtual model, which creates prerequisites for its successful transformation into a virtual educational environment. The most important mandatory structural elements of virtual educational environments are e-learning platforms, virtual libraries, virtual laboratories, as a complete model of the virtual educational environment are virtual departments, virtual faculties, virtual universities, virtual campuses.

Other innovative educational technologies include the smartphone as a virtual personal assistant to the student, the use of social networks (YouTube, 100 Ways To Use Facebook In Education), communication platforms, specially developed applications, videos with a virtual board Chinese Baidu Duer, BlackBerry Assistant (BlackBerry OS), Cortana (Windows), Siri, iOS mobile devices, Alphabet products (Google now) The training models used are gaming, gaming, cloud technologies, which have been widely used in the last 5 years. The benefits of using cloud technologies in universities are primarily related to their potential to create different cloud-based educational environments increase the efficiency of the learning process through the use of cloud video conferencing systems. The development and use of intelligent technologies and the Internet of Things in the educational process are also growing. In line with the adopted EU priorities in the Strategy for the Development of Education until 2020, it was envisaged to implement policies and take measures to strengthen creativity, innovation and digital competencies in early childhood and primary education. The Covid-19 pandemic has accelerated the transformation of educational models into digital environments, with online learning being seen as a natural continuation of traditional but increasingly oriented e-learning materials and the use of tools on modern platforms to create diverse learning content [12].

In Bulgaria, with small breaks and exceptions, almost all year round all schools and all universities are in distance learning. The accelerated introduction of distance and e-learning in the universities in Bulgaria in the last 5 years has created favourable conditions for the continuity of the educational process.

The balance for the past year is that 18 universities teach 36 bachelor's and 115 master's programs, which outlines the trend for enhanced digital transformation of education and the transition from traditional to distance and e-learning [20].

One of the key programs for stimulating the digital transformation of university education in the EU is the adopted and implemented operational program "Science and Education for Smart Growth", which establishes centres of excellence and competence in structural sectors of the economy, medicine, creative industries, digitization of cultural heritage; entertainment and educational games.

The transition from conventional software, called by some authors "social software" because of its function to create an environment for communication and the formation of virtual communities, to platforms for creating electronic content and education is two sides of a single process. The merging of

these two environments with different functions into a single whole leads to the enrichment of educational tools. Launched in 2019, the initiative for European universities focuses on the cohesion of education, research and innovation with services for society. The leading institution is the European Institute of Innovation and Technology through the created Knowledge and Innovation Communities, which direct 25% of EU funding for education to support the regions, especially to stimulate cooperation with EU higher education institutions [13].

4 University Libraries and the Models of Education 4.0- 5.0

The discussion on the role of the university libraries of Bulgaria in the modern information environment is relevant and is invariably held at all scientific and professional forums organized both in Bulgaria and in Europe.

The European Commission's White Paper presented in March 2009 estimated that the library holdings of European libraries were estimated to contain more than 2.5 billion books, but only about 1% of archival material had been digitized. The measures adopted, including the financial resources set aside over the last 10 years, mobilize Member States' efforts to provide online access to works in digital form, to ensure the information on education, research, lifelong learning, but with the highest priority for the preservation of cultural heritage, which is realized with one of the largest projects in the EU – Europeana.

Along with the problems of preservation of the library funds of university libraries, the issue of their visibility in the modern information environment and the adequate inclusion of the stored knowledge in the cycle of knowledge creation in all scientific and applied directions is becoming more and more topical. The presence of university libraries in the online environment and maintaining active communication with stored knowledge is a necessary condition for accelerating the cycle of creating new knowledge and especially – achieving digital transformation of educational models.

At the same time, the immediate provision of access to the published research results by enriching the digital collections in the whole spectrum of university publications creates preconditions for visibility of the research results in Bulgaria for the academic community in the world. For libraries, the range of problems is expanding, adding new features and, consequently, new user requirements for opening collections, including the use of 3D animation, virtual, augmented reality, visualization with the latest publicly available tools for access to full-text content.

Leading world libraries (BL Labs in the British Library and Innovation lab in the Library of Congress) share good practices from the creation of innovation laboratories in libraries and their role in their repositioning in the innovation process. The development of new functionality of university libraries under the pressure of increasing volumes of digitized objects and changes in consumer attitudes to search and access to information leads to structural and organizational innovations, such as the creation of specialized departments ("innovation laboratories", "data laboratories").), Which support both the academic community and the general public in their access and retrieval of data from large arrays of digitized content, visualization and curation of digital collections [7].

The digitalization of Bulgaria's scientific heritage entered its intensive phase after 2011, when a number of projects funded by the European Commission were implemented, such as: Athena (2008–2011), AthenaPlus (2013–2015) Carare (2010–2013) and Linked Heritage (2011–2014) in support of the European Digital Library – Europeana. Digitized objects are also available for access in the World Digital Library.

Along with the experience in digitalization and the creation of electronic repositories, metaresources, university libraries in Bulgaria also develop educational activities with the involvement of librarians in digital competence training for researchers, teachers and students (project "Creating educational programs in the field of cultural heritage").

The introduction of modern library technologies and their integration in the educational process in academic libraries stimulates the creation of electronic repositories from published publications of university professors and provides open access to the content of digitized collections from the library fund, priority indexing, metadata transfer, creation of depositories and monographs with open access, the creation of electronic resources for information provision of courses in bachelor, master and doctoral programs.

University libraries also create portals for electronic periodicals, which make it easier for researchers and educators to publish online, and speed up the indexing of content on the Internet [18].

For students and researchers with special needs in the university, libraries are equipped and provided access to specialized workstations, respectively computer configurations and specialized software for seamless access to collections. With the creation of the National Automated Library Information System NABIM (NALIS) the generation of an online consolidated catalogue from the catalogues of the largest scientific and university libraries in Bulgaria was achieved, which creates conditions for trouble-free participation in both national and international library exchange.

5 Conclusion

The transformations in the educational models in the conditions of the emerging industries 4.0 and 5.0 can be summarized in two main directions – changes in the process of creating and using knowledge and changes in the educational models for preparing the generation that will create and apply new knowledge in new ones. conditions. In the science-education-business triangle, irreversible changes are taking place, the external manifestations of which are the massification of higher education, the participation of business, which benefits from the transformation of research results into innovation, creating a resource for investing in new knowledge.

The next phase of the world economy, which is defined as Industry 5.0, is under construction. The EC is taking measures to provide the potential for the management of the complex process of transformation, which includes technological, economic and last but not least – social transformations. The implemented projects under the Digital Competence Framework Program 2.0 and its development in 2.1 with the inclusion of eight levels of digital skills and the full application of the achieved results provide the necessary conditions for the training of specialists with key competencies for the XXI century. University libraries change their communication model in accordance with the needs of higher education and society, with the application of innovative technologies and following the changes in the environment for their functioning.

The developed Concept for digital transformation of the Bulgarian industry (Industry 4.0) creates preconditions for modernization and competitive positioning of the Bulgarian economy in the medium and long term.

References

- [1] A. I. dos Santos, Y. Punie, J. C. Muñoz. (2016) A Support Framework for Higher Education Institutions 2016 Available at: <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC101436/jrc101436.pdf> (Accessed: 12 August 2021)
- [2] C. Redecker. (2016) Digital Higher Education in EU. Available at: <https://www.slideshare.net/eteaching/digital-higher-education-in-the-eu-dr-christine-redecker> (Accessed: 12 August 2021)
- [3] K. Schwab: K. Шваб. (2016) Четвъртата индустриална революция. С., Изд. Хермес, 2016. 240 с. (K. Shvab. Chetvartata industrialna revolutsija. S.,Izd. Hermes, 2016. 240 s.)
- [4] K. Varbanova-Dencheva: K. Върбанова-Денчева. (2003) Интелектуални комуникации и съвременни технологии. Алтернативи пред научните библиотеки. Акад. Изд. М. Дринов. С, 2003. 105 с. (K. Varbanova-Dencheva. Intelektualni komunikatsii I syvremenni tehnologii: Alternativi za nauchnite biblioteki. Akad. Izd. Prof. M. Drinov, Sofia, 2003. 105 s.)
- [5] K. Varbanova-Dencheva, S. Denchev, I. Peteva. (2014): K. Върбанова-Денчева, С. Денчев, И. Петева. Интегрирана среда за електронно образование – модели за създаване и обмен на учебно съдържание. В: Електронно обучение. Сб. докл. Нац. науч. конф., Русе, 2014, с. 200-208. (K. Varbanova-Dencheva, S. Denchev, I. Peteva. Integrirana sreda za elektronno obrazovanie – modeli za sazdavane i obmen na uchebno sadarzhanie. V: Elektronno obuchenie. Sb. dokl. Nats. nauch. konf., Ruse, 2014, s. 200-208).

- [6] L. Ivancheva. (2017) The rise of modern technoscience: some conceptual considerations from the perspective of S&T studies. Papers of BAS, Humanities and Social Sciences, Vol. 4, 2017, No 2, p 196 -207.
- [7] M. Mahey, Al-Abdulla, A., Ames, S., Bray, P., Candela, G., Chambers, S., Derven, C., Dobрева-McPherson, M., Gasser, K., Karner, S., Kokegei, K., Laursen, D., Potter, A., Straube, A., Wagner, S-C., and Wilms, L. (2019) Open a GLAM Lab. Digital Cultural Heritage Innovation Labs, Book Sprint, Doha, Qatar, 23-27 September 2019.
- [8] M. Luke Gissy. (2007) М. Люк Гиси, Не наливайте ново вино в стара бутилка. Available at: https://www.karieri.bg/management/317549_mark_ljuk_gisi). (M. Lyuk Gisi. (2007, 9 mart). Ne nalivayte novo vino v stara butilka) (Accessed: 22 August 2021)
- [9] P. Drucker. (2000) П. Дракър. Посткапиталистическото общество. С., Изд. ЛИК, 2000, 301 с. (P. Drakyr. Postkapitalisticheskoto obshtestvo. Sofia: LIK, 2000. 301p.)
- [10] R. Rich (1992): Р. Рич. Трудът на нациите: Как да се подготвим за капитализма на XXI век. София: УИ Св. Кл. Охридски. (Rich, R. B. (1992). Trudat na natsiite: Kak da se podgotvim za kapitalizma na XXI vek. Sofia: UI Sv. Kl. Ohridski)
- [11] S. Naidenova (2016): С. Найденова. Информационни предизвикателства пред въвеждането и използването на XBRL. В: Обществото на знанието и хуманизмът на XXI век. Сб. докл. XIII Нац. науч. конф. с межд. участие, 1 ноември 2015. София: За буквите – О писменехъ, с. 539-549. (Naydenova, S. (2016). Informatsionni predizvikelstva pred vavezhdaneto i izpolzvaneto na XBRL. V: Obshtestvoto na znaniето i humanizmat na XXI vek. Sb. dokl. XIII Nats. nauch. konf. s mezhd. uchastie, 1 noemvri 2015. Sofia: Za bukвите – O pismeneha, s. 539 – 549).
- [12] 100 Ways To Use Facebook In Education: Available at: (<https://www.teachthought.com/technology/100-ways-to-use-facebook-in-education-by-category/>). Slavin, R.E. (1990). Cooperative Learning. New Jersey: Prentice Hall. (Accessed: 21 August 2021)
- [13] EU Education Innovation: Available at: https://ec.europa.eu/education/policies/innovation-in-education/the-european-institute-of-innovation-and-technology-eit_bg (Accessed: 12 August 2021)
- [14] EU: Available at: (<https://www.consilium.europa.eu/en/press/press-releases/2020/12/01/new-european-research-area-council-adopts-conclusions/>) (Accessed: 25 August 2021)
- [15] Horizon 2020: Available at: https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/H2020_BG_KI0213413BGN.pdf (Accessed: 21 August 2021)
- [16] Horizon Europe: https://ec.europa.eu/info/sites/info/files/research_and_innovation/strategy_on_research_and_innovation/presentations/horizon_europe_bg_investirame_za_da_oformim_nash_eto_bdeshche.pdf (Accessed: 22 August 2021)
- [17] Industry 5.0: Available at: https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/industry-50_en (Accessed: 12 August 2021)
- [18] NALIS: <http://unicat.nalis.bg/?lng=bg>
- [19] [19] Strategy BG: www.strategy.bg/StrategicDocuments/View.aspx?Id=904 (Adopted 30 August 2017 Ministry Union of Bulgaria) (Accessed: 25 August 2021)
- [20] Universities: Available at: <https://www.distancionno-obuchenie.com/universiteti/> (Accessed: 19 August 2021)