Elena Merzon

Digital perspective benchmarking in solving indeterminate equations

The article was prepared within the framework of the project "Resonant branding mechanisms for territories in the DUDR system: Digital university - Digital region" (Project No. 0-1240) & "Factor Analysis of Benchmarking Technologies for Management of Smart-Uni-Q Systems (Descriptive Approach of Quality in the Frame of EHEA)" (Project No. 0-1238) under support Federal State Budgetary Educational Institution of Higher Education "Moscow Pedagogical State University.

Oskar Raif. Riabov

Abstract. The authors of the article offer a discussion about digital perspectives in education in the conditions of stable and, or crisis events. Contingently, by indeterminate equations, the authors mean events that require the necessary and sufficient efforts to equalize and transform an unknown quantity into a known and clear one. In search of the clarity, the world pedagogical community is looking for answers to the question: how to combine rapidly growing digital education with steady accumulation of competencies in its use, the significance of digital hygiene and an arsenal of necessary resources, mastering of novelties in the profession and the state of confusion because of the sharp transition to distance learning at all stages of learning and the competition between formal and informal digital technologies? The authors apply benchmarking technology in considering the question, that is, the identification of various experiences and the comparison of the best practices to real situations, questions from the readers and opponents.

Keywords: education management, internal and external benchmarking, digital perspectives, crisis events, digital resources.

Digital perspectives benchmarking in the face of education increasing uncertainty is a complex and multifunctional identification process. Nevertheless the authors decided to reflect on it, on the grounds of managerial experience and a comparative analysis of European digital education practices. The authors employ Skelton's definition used in international education in defining the concept, which considers benchmarking "... as a process of identifying, studying and adapting the best practices and experiences of organizations to improve the performance of their own organization" [21]. World strategies, at least to some degree of "understandable tomorrow" [15], have changed the search for new life strategies during crisis events.

This refers directly to digital education. The study, comparison and adaptation of digital education practices is now more relevant than ever in the whole world, because the mirrors of the perception of the professional life of teachers at schools and universities have reflected images of the "unpredictable future" in the light of solutions to indeterminate equations [20]. By indeterminate equations, the authors mean equations containing more than one unknown or more than one variable. From the point of view of mathematics, an indeterminate equation has an infinite number of solutions, and, usually, mathematicians look for a solution in integers or rational numbers [7].

To one degree or another, teachers of the world are faced with the mathematics of life, because there appeared an equation in their professional activity that requires a solution. For those who have forgotten mathematics, we recall that the equation is an equality with an unknown member that actually needs to be found [7]. Besides, if an equation has two or more variables, it includes the corresponding number of unknowns. Actually, they need to be calculated. But if there is a rule and an order of calculations in mathematics, it is more complicated to find a solution in modern teachers' life events, although it would be useful to apply mathematical formulas.

Digital Agenda for Europe, the flagship European strategy for information computer technologies, states that by 2025 90% of professions will demand the highest IT skills from a job market candidate [17]. Although, it is true that no one has explained to the world pedagogical community what the highest IT skills are and how they manifest themselves in crisis events, in social and psychological uncertainty including at least one unknown – the ending time of expected or unexpected crisis events. The Communiqué of the European Commission has long been

anxiously informing the world pedagogical community that according to the results of "closed polls" about the quality of using the most innovative digital educational technologies, such as the MOOC systems – Massive Open Online Courses (https://www.mooc.org/) – out of the 2,000 school principals surveyed, only a third had an idea about them. Another third was still confident in the IT competencies that they demonstrated. The rest of the principals could only verbally present electronic textbooks, educational software, podcasts, simulations, educational games and etc. from the digital educational format available in their schools in case they need to use total distance education. "Digital revolution by united efforts" is a slogan that was proclaimed by the world pedagogical community in the hope that it would be easier to find a solution to the indeterminate equation of time in the complex and unclear problem of the future digital school together than to solve the problems alone [6]. Benchmarking of the process studies the entire "kitchen" of the process of obtaining the result, its (process) quality and compliance with standards. In other words, it is a "qualitative" (along with quantitative) analysis of what is done and how, as well as an analysis of factors and conditions that affect how it is done" [16].

Such an approach to solving the problem of creating a single digital school space of an unexpected present and vague future made it possible for educational systems of various states wishing to "enter" a single educational space, to harmonize themselves and get as close as possible. However, the history of the use of ICT methods in education and even more so the history of the use of digital technologies in different countries still vary significantly. In this regard, all the interested participants in the process of creating a single digital school of the future – students, teachers, parents, online communities, commercial and non-profit organizations – need to combine their efforts in order to "track" and increase the level of "digit" in their educational organizations.

The global crisis events of March, April 2020 (www.who.int) have proved it. Teachers from all over the world, no matter where they are engaged in pedagogical work, have begun to discuss the need to launch new resources that could become a kind of "tournament table" of global digital education. The reason for it was the need for quick decision-making on the use of a particular educational platform and the recommendation of the platform to the learners. That is why it required an informational and analytical resource of "quick destination" that would become a kind of digital education navigator in special conditions. The

resource contains statistics about the level of informatization and digitalization of various educational organizations around the world as well as the one whose resources can be used by others at the time of collapse and unpredictability. Thus, participants in the process of creating a digital school of the future interested in information will be able to familiarize themselves with it in order to find out where active actions are still needed, what specific steps should be taken to achieve a goal that is often blurry and not fully understood.

As for the use of mathematical models for solving equations, progressive educators are involved with maximum accuracy in solving problems of finding such values of arguments (variables, unknowns) in which equality between the value of the demand for digital education and the value of the level of IT competencies is achieved. Nevertheless, additional conditions may be imposed on the possible values of the arguments. The European Commission on Education has already launched the European Hub of Digitally Innovative Education Institutions [18]. This resource demonstrates the high degree of high-quality application of digital innovative practices in the organization of training, and their creators are already awarded the European Award of Digital Excellence supported by the International Council on Open Distance Education (ICDE) and international economic cooperation and development organizations.

Moreover, institutes of intellectual integration (www.rbs-ifie.at) are already operating in Europe, they are becoming a virtual platform for school and academic institutions helping to join efforts in the introduction of informal digital education technologies and to form teachers' requests for continuing education programmes, taking into account the achievements of their schools' competencies in the field of digital economy [12]. In general, the world pedagogical community, just like other specialists in the field "man – man", do not distance themselves from the tasks set by time, and are active in business communications with experts in the information industry.

As far back as September 2015, the International Expert Council of the World Economic Forum on the Future of Software and Society published the report "Deep Change – Technological Tipping Points and their Impact on Society". As a result of the study, which involved 816 leaders and experts of the information science industry, the experts obtained data on the most vulnerable points of digital education and its use in various economic, social and psychological conditions. According to the study, all the turning points should occur before 2025.

Since 2018, teachers and learners "have formed" various cognitive platforms in order to understand conceptually what "cloud technologies", the Internet of things bank, artificial intelligence, big data, virtual and augmented reality, Blockchain and its most important application "Cryptocurrency" are. Or what are various types of computer platforms that create a sharing economy?

No less important in order to understand the concept of digital technologies and how they can be incorporated into the educational process is an understanding of such phenomena as unmanned vehicles, 3D printing, robotics and new materials, genetic engineering and synthetic biology, and etc. But it is rather an expected anxiety, which in reality turns out to be psychological, for the effectiveness of the learning process, the adoption of distance learning only in combination with the "live" one, the search for effective platforms, a discussion about the need and, or sufficiency of digital education in primary school [13].

What do the transformations order? Now, few people argue that industry 4.0 is an inevitable transformation in the labour market, and therefore in the education market. The inevitable consequence of industry 4.0 is the psychological adaptation of all of us to the digital environment and the awareness of the threat of losing our jobs and "not taking advantage" of basic education. It would it seem a paradox, but according to the chairman of the World Economic Forum 2016 Klaus Schwab, all of us are witnesses of the fourth technological revolution and the sixth technological mode: there is a merger of technologies, the boundaries between the physical, digital and biological spheres are erased [4]. If a year ago while reading this quote we focused more on "... the borderline between the physical and the digital ..." now during the 2020 global pandemic, "... the line of the "biological" has become clearer to us. For the past few years, the modern pedagogical world has reduced the essence of the issue to training a person proactively and psychologically for the reconfiguration of the world of technical capabilities and the acquisition of specific skills while maintaining the value of education in general, the value of developing critical thinking and the ability to learn independently.

In accordance with the ideas of Industry 4.0, the first industrial revolution (the late 18th – the early 19th centuries) was caused by the transition from the agricultural economy to industrial production due to the invention of mechanical devices, the use of steam energy and the development of metallurgy. The result of the second industrial revolution

(the second half of the 19th century – the beginning of the 20th century) was the use of electric energy, followed by conveyor production and the division of labour. The third industrial revolution (since 1970) is an intermediate one and is associated with the use in production of electronic and information systems that provide intensive automation and robotization of production processes. The forecasted fourth industrial revolution means the emergence of a fully digital industry based on the mutual penetration of industrial and information technologies. As experts predict, the scope of cyber-physical systems will not be limited to production and will be extended to all types of human activity, including a variety of industrial systems, transport, energy and military systems, all types of life support systems from medicine to smart homes and cities, as well as many economic systems. The creation of full-fledged cyber-physical systems ... in the future will lead to approximately the same changes in interaction with the physical world that the World Wide Web brought about in its time (from the materials of the webinar "Alphabet of the Digital Economy" by Yu. Yu. Cherny, Moscow State Pedagogical University [1]).

The essence of the latest technological structure is to replace multiple information by significant, by the necessary knowledge, which is the priority of a producing rather than a consuming economy. According to the forecast of the world leading economists, at the current pace of development, this way of life will have been completely formed by the middle of the 21st century [19].

A study by the University of Oxford (The Future of Employment: How Susceptible Are Jobs To Computerization) is widely quoted in the media, in which, using mathematical analysis with nine variables, a list of the most probable professions that may disappear from the list of professions in the modern labour market was calculated. This included numerous clerks, operators of machines, machine tools and laboratory devices, punch press operators, controllers, testers, various builders, repairmen, as well as the personnel that we used to see at fast-food cafés, at reception desks in hotels, airports, some engineering specialties in the design of engineering systems, speakers, etc. These examples are trivial for the teacher. But the reason for the unresolved equation is only the fact that the teaching professions also staggered in their stability precisely due to the vital need to introduce digital teaching tools. What does benchmarking of the social and psychological aspects of the digital learning environment show and how to respond to digitalization in the context of global and regional development strategies?

A modern teacher, living anywhere in the world, of course, understands that the problem has approached education from an unexpected direction. This is not only a question of what to do if robots and new technologies are already beginning to force an educated person out of the profession. First of all, it is a question of the effectiveness of applying IT competencies in various educational conditions and in various life circumstances. In this case, we are talking about training in the conditions of equal distribution of digital and live learning, and about learning only in the distance mode with its dominant in the use of digital resources.

What should be learned to compete with "smart machines" and, or not to compete, but to interact with them? The emergence of software with artificial intelligence, which was facilitated by the "rediscovery" of neural networks in the early 2010s, allows trusting the computer routine to the office administrative authorized system. In this sense, both internal and external benchmarking determines leaders quite simply.

Internal benchmarking is carried out in one educational organization, but it involves many, statistically sufficient, subjects performing the same functions in digital education. In this case, the internal expert, or independent expert, determines the best practice based on the criteria for the effectiveness of the organization as a whole.

External benchmarking compares similar activities of different educational organizations and companies in various areas of digital education. In its turn, external benchmarking can be divided into: competitive (competing educational organizations with equal opportunities are studied in one "market"); functional or industry-specific (similar to competitive, but studies a larger number of educational organizations in one region or several regions); global (a large amount of data is being studied for various educational organizations in order to identify the most successful experience regardless of industry) [14].

We must note the fact that no matter what benchmarking may be it seldom includes parents. Meanwhile it was precisely the parents who became the first, albeit intuitive experts, during the crisis period, as to what extent the educational organization found a solution to the indeterminate equation of operational and effective digital contact with the learners. Parents of first-graders who brought their children to school in 2020 are already concerned about the digitalization of the educational environment of the school in which their child will be studying over the next 11 years. This is important for the parent, because he wants to be

sure that in 2031 his child, being a school-graduate, will fully possess the competencies of managing this digital environment to the extent that will be required by the development of the digital economy over the next 11 years. What can we say, for example, about 2050, the year when graduates of 2031 will have already received higher professional education and, having mastered in the chosen professions, will be managing the digital economy as specialists?

A few impressive numbers should be given here. The global turnover of robots is monitored by the International Federation of Robotics – IFR. According to its estimates, in 2010s, it grows annually by 12%. In 2016, the result was 294 thousand copies, out of which 191 thousand were sold in Asia, 56 thousand in Europe, 41 thousand in North and South America. The forecast for 2021 is 521 thousand robots sold, and their total number in the industry should exceed 3 million. In monetary terms, the mechanical labour market is growing by 5% per year and will reach $ 41 billion in 2021 [5].

We frequently hear in pedagogical discussions: "And yet not everyone will be fired, will they?" Of course, even the most advanced robots are subject to only linear logic, template behaviour. Therefore, the work that is difficult to systematize possesses the greatest potential for being preserved. The list of qualities and skills required from a person has just begun to be discussed by specialists, but one thing is clear – such qualities and skills as originality, improvisation, critical thinking, and the ability to assess difficult situations and make decisions gains advantage. Those who know how to manage and convince, as well as create in the field of fine arts and handicrafts, are not threatened by the loss of their profession. In total, the researchers listed 109 professions for which the probability of computerization is less than 3%; all these professions adequately combine not only linear and rational intelligence, but also emotional intelligence and empathy [5]. According to the experts' opinion, "safe" specialties with a low automation probability index include, for example, such ones as a physiotherapist, emergency dispatcher, psychologist, narcologist, prosthetic surgeon, nutritionist, choreographer, investigator, dentist, interior designer, motivational trainer, computer system analyst, recruiter, social worker, forester, rehabilitation consultant, logistic, etc. [5]. If we carefully read the list of these professions, we can find their general "human assisting value", which is difficult to automate. The profession of a school teacher occupies a special place of honor in the list of promising professions, as it is not only a conglomer-

ation of competencies and pedagogical techniques, but also an eventual spiritual unity that can build relationships and profound knowledge of the new.

There is no single recipe for what skills you need to possess today in order not to lose your profession in the future. On the one hand, maximum specialization will be required, on the other hand, versatility and a broad outlook. Since everything is changing so quickly, will one have to study all your life? Experts predict that in some specialties this will become an obligatory part of the annual cycle: 9 months' work, 2 months' study and 1 month's leave. Evidently, those who initially have a craving for self-education will be more successful than others.

In the series of projects of the Higher School of Economics of the Russian Federation "12 solutions for new education", Project 2 is devoted to the "School of the Digital Age", the mass use of digital educational games and digital simulations since 2020. The Project developers inform teachers that new digital tools can be introduced into the traditional educational process of the school based on existing standards and textbooks and will serve as a transitional form for teachers to learn new teaching methods that meet the requirements of the Digital School project. Additional specific innovations regarding the work of teachers involve the introduction of modern technological solutions to radically simplify reporting and reduce routine types of work for teachers and heads of all educational institutions; transition to new type of contracts with providers of the Educational Resource Centres (Centre). This includes training and certification of teachers to work with new resources, ongoing counseling of teachers, organization and support of project teams, involvement of teachers in the development of training modules and other educational resources on the basis of the Centre; creation, updating and promotion of open online courses of the best teachers and university professors in basic and specialized subjects of basic and high school, as well as subjects of additional education, including those for children who are not able to study relevant subjects at school [2]. The small obstacle is the fact that vital crisis events changed the plans, the demand for innovations being at its peak in February 2020 in Europe and in March 2020 in the Russian Federation. Since this project and its ilk were not advancing projects, by and large, it remained in the field of expected results, not benchmarking practices.

The discussion of the robot tax, informal education and the value of human capital are of concern in the indeterminate equations of digital

education. Although pedagogical discussions on the topic of the "digital footprint" frequently come down to a discussion of the use of digital technologies in teaching, many teachers around the world have been keen on robotics and attract students to this work. Yet, it is necessary to think from the point of view of a new critical thinking vector whom this robot is to be "fed" by. The answer is that there is still an important topic of discussion about the digital world, and this is the topic of taxes, such as robot tax. Some financiers call to curb robotization by introducing a tax on every used robot. Incidentally, such an idea was also put forward by pedagogical unions, but almost always it was nothing more than a call. However, in a number of countries, such as the USA, Canada, Japan, there were influential supporters of this opinion. For example, Bill Gates, the founder of Microsoft, has repeatedly expressed the view that if a robot performs duties on a par with a person, we need to think about taxing his work at the same level as human labour.

The educational opportunities of billions of people connected to each other by digital mobile devices with gigantic power and memory, providing access to all the knowledge of mankind through the worldwide Internet, are truly limitless. However, the openness of education and its structural character have now determined and will determine in the digital age formal or informal trends in the continuity of knowledge [5], the individual's ability to reflect on his intellectual abilities and, what is important, limitations.

A new classification of continuing education forms adopted by UNESCO [3] meets these measurements. The psychological paradox in the digital world of opportunities is the appearance in this classification of a new dimension of education – the so-called informal education, which is outside of any form and directed deep into the person and his knowledge of himself. Following the modern vector of the world economy development, dictating the need for formal and non-formal education, it is necessary to pay attention to the thorough education of a person who has not lost interest in knowing his own inner world, while being capable of critical thinking, deep reflection and constant search for the meaningfulness of his life events. This factor of the psychological measurement of time in the digital age is its distinguishing feature [10, 11]. As for the crisis events, they added uncertainty and a number of unknown quantities.

One psychological vector is the vertical of the speed of the digitalization process, and the second psychological vector, horizontal, is the per-

son's search for himself and the necessary competencies for life in the digital space. In this case, psychologically justified are such key points of state development programmes as creating an ecosystem of the digital economy in which effective interaction is ensured, including cross-border interaction, the creation of necessary and sufficient conditions of an institutional and infrastructural nature, the transformation of traditional sectors of the economy, and the formation of a creative society to ensure transition to the knowledge economy [8, 9]. Certainly, in the first place it is important to pay attention to competency-based training and staff assessment, and training, in our opinion, should be carried out in the format of benchmarking practice. As for the socio-psychological training of highly qualified personnel, it must be effectively carried out in the context of a review of the 21st century education philosophy as a whole, taking into account today's uncertainty in understanding the future. On the one hand, we are surrounded by more and more machines and robots, digital format technologies, and on the other hand, the value of human capital, human contact and human creativity, the significance of the dialogue with ourselves and our community, reflection of our own inner world are increasing.

With the advent of the concepts of "digital technologies" and the recognition of the importance of the already listed changes that the world, national and regional education systems are undergoing, not only the features of digital technologies come to the fore, but those competencies that teachers and learners acquire and develop in the context of world benchmarking.

References

1. The Alphabet of the Digital Economy: Webinar Materials [Electronic resource]. URL: https://webinar.bar/mifirecords (Access Date: 28.03.2020)
2. Higher School of Economics of the Russian Federation "12 solutions for a new education". Project 2 "School of the Digital Age" [Electronic resource] // www.hse.ru/ [website]. [2018] URL: https://www.hse.ru/twelve/ part2 (Access Date: 28.02.2020)
3. Gordina O., Gordin A. Informal and non-formal adult education: theory and practice: Monograph. Irkutsk: VSGAO Publishing House, 2010. P. 8.
4. Grunin M. Davos prophecies // Moscow Region: a magazine about people and opportunities. Moscow, 2016. No. 5-6. pp. 8 – 11.
5. Dmitrienko I. Competitor with an iron grip [Electronic resource] // profile.ru [website]. [2018] URL: https://profile.ru/society/konkurent-s-zheleznoj-khvatkoj-3368/ (Access Date: 27.03.2020)

6. Kasyanova L. How the EU will build a digital educational space [Electronic resource] // news [website]. [2013] URL: http://www.cnews.ru/articles/kak_es_budet_stroit_tsifrovoe_ (Access Date: 17.03.2020)
7. Mathematics: Encyclopedia. Moscow: Big Russian Encyclopedia; Drofa, 2003. 847 p.
8. Merzon E.E., Ryabov-Raiff O. The ambiguity of digital education problems // Human Psychology in Education. 2019. No.1. Pp. 27-35.
9. Ryabov O. Intellectual potential and paradigms of digital thinking // "Digital Economy — Analytical View": Materials of the International Scientific and Practical Conference held on June 29, 2018 - in Kazakh, Russian, English. Kostanay, 2018. pp. 19-23.
10. Ryabov-Raif. O., Merzon E.E. New Principles of Learning in the Digital Age // Talent University Bulletin 2.0, 2018, No. 3-4. Pp. 40-45.
11. Sibgatullina I.F. Informal Methods in International Postgraduate Education / Collection of scientific articles of the International Pedagogical Conference "Priorities of the conference in the field of extensible politics in Azerbaijan: modern approaches", Materials of the conference, November 25. 2016, Baku: ARTPI Center for Educational Technologies. Pp. 53-60.
12. Sibgatullina I.F., Nugumanova L.N. Informal education and benchmarking in the system of learning cities // Visual Anthropology - 2019. City – University: living space and visual environment: materials of the III International Scientific Conference, August 28-30, 2019, Veliky Novgorod / edited by S. S. Avanesov, E. I. Speshilova. Veliky Novgorod: Novgorod State University named after Yaroslav the Wise, 2020. Pp. 489-499.
13. Sibgatullina, I. F. Running time in digital education / I. F. Sibgatullina, O. R. Ryabov; scientific ed. D.M. Shakirova. Kazan: GAOU DPO IRO RT, 2019. Issue. 4. 76 p.
14. Harrington H.J., Harrington J.S. Benchmarking at its best! / Transl. from English under the editorship of B. Reznichenko. St. Petersburg: Peter, 2004. 176 p.
15. Shulman E. The country of "understandable tomorrow": cultural tools of political science // School of Anthropology of the Future, RANESS, December 13, 2019 URL: http://ppr19.ru/prognoziruemoe-proektiruemoe-zhelaemoe-budushhee-_-shulman.htm / Russian
16. Benchmarking in Higher Education / edited by Norman Jackson and Helen Lund. Society for Research into Higher Education & Open University Press, 2000. 258 p.
17. Digital Agenda for Europe [Electronic resource]. URL: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A52010DC0245
18. European Hub of Digitally Innovative Education Institutions [Electronic resource]. URL: https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs
19. Sibgatullina Irena F. European Integration Education Vector in the Global

Economy Market // “Digital Economy — Analytical View”: Materials of the International Scientific and Practical Conference held on June 29, 2018 – in Kazakh, Russian, English. Kostanay, 2018. Pp. 19-22.
20. Sibgatullina, I. F., Merzon, E. E., Seibgll, A. (2019) Talent management under conditions of digital transformation in education. Psychology in Education, Vol. 1, No. 2. Pp. 169–175.
21. Skelton, Melissa. The Continuing Value of Benchmarking. APQC, January 2003.