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EXPERIENCE OF (FOR) SCIENCE AND HIGHER EDUCATION IN TIMES OF THE CORONAVIRUS CRISIS CAUSING COVID-19 DISEASE

Abstract

The coronavirus causing COVID-19 disease, among many other effects, has re-evaluated the world of science and higher education. Experts representing the world of science have become indispensable for developing strategies to fight the pandemic, and their knowledge has become valuable not only for developing and producing an effective vaccine. Relying on modern and innovative facilities of higher education institutions, representatives of the business sector, state and local administration and science, must jointly participate in finding practical solutions to the problems of the state and society. Countries affected by the pandemic need such a system of research and higher education, in which science will serve social and economic development, university graduates will find absorbing work, and those in power will benefit from an independent expert base, regardless of which political option is at the helm of government. Given the new challenges faced by researchers and higher education in times of the coronavirus pandemic that causes COVID-19 disease and the changing economic and social conditions resulting from the pandemic, this paper examines the role and importance of the scientific world both during and after the pandemic.

KEYWORDS

science and higher education, pandemic, COVID-19, knowledge, innovation, economy

SŁOWA KLUCZOWE

nauka i szkolnictwo wyższe, pandemia, COVID-19, wiedza, innowacja, gospodarka

1. INTRODUCTION

Resourceful and sensible societies emerge from crises with new knowledge and are strengthened by ideas for tackling their countries' weaknesses. They draw this new knowledge and innovations from the experience of overcoming the crisis and the output created by their intellectual elites, concentrated in academic and scientific centres. Passive societies in times of recession seek external help, remaining in the expectation that rescue can only come from outside their own state and national structures. Observing the methods and tools used in developed countries to help universities and scientific and research centres, we have to choose our support system, our own "shield of help" for the whole system of higher education (although the usefulness of this corona-crisis symbolic term, emphasising protection, passive counteraction, rather than active modernisation to new conditions, is debatable).

The slow putting out of the COVID-19 outbreak in most European countries will foster deeper reflection not only on the medical side of the ongoing pandemic but also on further epidemics or other types of crises that may await us in the future, which may result in accelerated remodelling of current lifestyles, but also of the model of functioning of the State.

Public universities and representatives of the world of science have often been discredited, both by undermining and disregarding research and the limitations of budget cuts. The primitive economisation of the education sector accounted for by profit instead of fulfilling the mission assigned to this sphere. Meanwhile, it has once again turned out that it is the world of science that bears the responsibility for developing prescriptions and solutions to rescue societies and economies from various dangers – not only for inventing a vaccine that would protect health and life and give a chance to return to a sense of security but also for providing answers to several questions and doubts, such as: how to mitigate losses related to the recession, how to defend human and civil rights during a pandemic, how

to protect culture, how to conduct elections, etc. The current crisis is an excellent opportunity – but also a necessity – for the world of science to enter more deeply into the digital space, to develop (new) forms of exchanging ideas and best practices, to intensify cooperation – both intra-sectoral, inter-university, and with businesses, government, local government, and also on an international level.

Living during and after the coronavirus crisis also requires addressing the issue of trust in information – answering the question of who and which news can be trusted. The pandemic has violated a sense of security – about health, about life, about the satisfaction of needs, about loved ones, and so on. People then look for answers, explanations, and finally for guidance and instructions – and they have the right to expect that those provided by the “official” channels of communication will be reliable. However, this is not always the case. We found out that in a crisis when society was flooded with an excess of information, not always apparent, too often contradictory, when we had to deal with disinformation, in search for authorities, trust in the world of science and scientists increased significantly because they, with their knowledge and qualifications, became the best and most reliable sources of information (although, unfortunately, also here there was “information noise”). It turned out that when the situation became uncertain and the future was a great unknown, scientists, researchers were perceived as people with passion that escapes rigid political and economic rigours. Media practice verified the usefulness of the knowledge and communication skills of representatives of the world of science, but it was from them that explanations and instructions and forecasts were expected above all.

2. WHO TODAY WRITES ASSIGNMENTS FOR HIGHER EDUCATION?

The reality of the corona crisis is forcing changes in the structure of the labour market. Demolishing national economies, ploughing through the labour markets, forcing a change in working methods (including an even stronger transfer of activity to virtual space) is one of the pandemic’s effects. The first signals from the economies of Poland and other countries are very alarming, as they indicate a long-term process of returning to the state from before the “manifestation” of COVID-19. These are not only purely economic data, which may inspire pessimism after comparing April 2020 with April of the previous year (a 22.5% drop in VAT revenues, a 21% drop in excise duty, a 32% drop in PIT and a 68% drop in CIT). The pandemic has revealed the global economy’s vulnerability to the collapse of its essential resources, to the disruption of “supply chains”. That has led many governments to recognise the need to bring some manufacturing back home, which means at least some redirection of skills and vocational

training and the programmes that provide them, both in vocational schools and universities.

University graduates will enter a labour market that is transforming before our eyes. The change in the style of work, transition to remote work and related limitations (social isolation, new style of human resources management, task-based, not hourly character of work), but also new challenges for employees (ability to separate work and rest in the place of residence) and a new dimension of professional (permanent) education, improvement of qualifications and training – these are all part of the new challenges, which should be answered by scholars and teachers of management, IT, administration, labour law or psychology. Therefore, universities should take centre stage and become the driving force of innovation and the main initiator of economic development in the country¹.

The effect of the pandemic may be an increase in disproportions between wealthy students and those from poorer environments, resulting in limited opportunities for the latter. A government looking for savings in education is a misguided one – we will need good teachers, even more guidance counselors, methodologists, educators and psychologists, who should help young people find their way in the changing circumstances. The lesson from the pandemic is that without care, support and direct contact with academics, it is challenging for students to concentrate on independent work. These are economic, personality and family problems, limitations in financial resources, equipment and Internet access. Anyone who thought that online learning could simply and completely replace face-to-face contact between lecturers and students quickly found out that this is a tough task for lecturers, students, and their families.

Higher education has undergone some changes in recent decades with the development and implementation of national and regional qualifications frameworks to improve the quality and relevance of education. However, the corona crisis seems to have pointed to the need to modernise existing criteria and learning outcomes to develop in students the ability to adapt flexibly to changing circumstances and in a changing world. Contrary to the widespread perception that the higher education system and universities should educate students primarily and directly for the needs of the economy, we consider it necessary to emphasise that modern education should, especially nowadays, provide students with personal development, skills and competencies enabling them to cope with the changing socio-economic and cultural conditions in which they will have to function.

During the SARS-CoV-2 pandemic caused by the Covid-19 virus, knowledge and technical support in online academic didactics (e-learning) played a key role. The online course preparation consisted of didactic (materials, ways of interaction) and technical aspects. It was the responsibility of the teaching researcher

¹ *Poza horyzont: kurs na edukację: przyszłość systemu rozwoju kompetencji w Polsce*. [Beyond the horizon: a course for education: the future of the competence development system in Poland] Report, J. Hausner (ed.), S. Mazur [et al.], Kraków 2020, p. 98.

to prepare the didactic part and acquire extended technical skills. Acquisition of knowledge, skills, and technical competencies of academic staff was possible thanks to training sessions for employees and doctoral students organised free of charge, thanks to such tools as Centre for Open and Multimedia Education, or applications: Teams, Zoom, Meets. The training was conducted mainly via the Internet – covering advanced functions of the educational platform and applications enabling smooth and efficient delivery of classes. Students and lecturers were informed how to solve possible technical problems resulting from arising barriers (psychological, technical and time).

The principles of e-learning education formulated by the authors of the article, which became guidelines during the pandemic, put more emphasis on interaction with students than on the development of sophisticated, automated tools; creating a social group of participants of the classes, working in a team with the integrator and assistants; individualising the level of difficulty of the course, focusing on well-defined objectives so as not to overload the programme; focusing on multimedia, especially recording audio files; planning student activities, checking the degree of learning, e.g. by automating the testing; separating the learning process from the stage of certification and allowing multiple tests during the learning phase, monitoring the learning process through open questions in evaluation forms, and conducting regular classes in real-time. During the pandemic, these principles were fundamental but should also be applied when returning to in-class/hybrid teaching.

Greater cooperation in the post-pandemic world of science is inevitable, primarily to address global challenges such as unemployment, poverty, migration, local wars, climate change or further pandemics. Science knows no limits, neither cultural nor formal, and today it is global². In the EU, projects have emerged that focus on the joint development and delivery of higher education courses and programmes, virtual learning environments and financial support³. The fight against the COVID-19 pandemic is further proof of the importance of sharing data and results openly. The European Commission has launched a European data platform to share research results and data between scientists working on combating the virus; this is to be the first element of a “European cloud for open science”. The state support for Polish researchers to participate in interdisciplinary and multi-sectoral teams at global, continental and regional levels should allow them to contribute to solving COVID-19-related problems and new problems that Pol-

² R. Palacios, D. T. Covas, L. C. Pereira Júnior, S. Cimerman, *After the pandemic: the role of science in the future of the countries*, “The Brazilian Journal of Infectious Diseases” 2020, Vol. 24, issue 3, pp. 189–190.

³ G. Di Pietro, F. Biagi, P. Costa, Z. Karpiński, J. Mazza, *The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets*, <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC121071/jrc121071.pdf>, European Commission, 2020 (3.02.2021).

ish society will face after the end of the pandemic. The crisis has highlighted the importance of research and innovation, e-learning and ITC tools (the overall market for online education is projected to reach 350 billion USD by 2025), and the problem of funding science at an appropriate level concerns not only national budgets but also the long-term EU budget.

It is impossible to recount all the effects of the pandemic on the functioning of higher education and universities – we will synthesise a few of those diagnosed. Firstly, the broad reach of remote learning can have a positive impact – students will be more familiar with the technology. Online courses and examinations reduce some of the costs of universities (e.g. rent of lecture rooms, less administrative maintenance of buildings) and students (rent of accommodation, cost of staying in another city). Of course, the issue of the quality of education under these new conditions must not be overlooked, but this is a separate and broad topic (previously, this quality also varied greatly, although now the range of factors determining its level has widened). Providing high-quality online education is expensive and requires thoughtful investment. Secondly, the pandemic experience verified the organisational efficiency of universities, and in the future may result in their greater flexibility of operation. Within a few days, universities had to change the system based mainly on teaching in lecture halls into an online system and persuade academic teachers (often untrained, without experience) to work in the e-learning system. Therefore, the academic staff is also subject to verification of their efficiency in completely different technological conditions. Third, some researchers suggest⁴ that the conditions of the pandemic have increased inequality and scientific patriarchy. In addition, women are more likely to face structural, social, cultural and financial obstacles and are less likely to collaborate internationally in research work. That raises the question – how do we create a level playing field and build more inclusive international research teams?

The role of the Internet during the COVID-19 pandemic has significantly increased in learning processes⁵, the management of companies and their day-to-day functioning, and everyday life (e.g. online shopping). The use of modern technologies to support learning at home has increased, but accessibility is an issue. For example, in Canada, it was calculated that over 30% of students do not have access to the Internet or digital devices at home in one of the provinces. In the event of a deepening economic crisis, many families who have lost their livelihoods will have to choose between maintaining Internet services and meeting their family's existential needs.

⁴ H. Fletcher-Kennedy, E. Sebastian, M. van der Kamp, *Smashing barriers for women in international science*, University World News, 30 May 2020, <https://www.universityworldnews.com/post.php?%20story=20200529085407898> (31.12.2020).

⁵ A. McDougall, G. Orlov, D. McKee, *Learning during the COVID-19 pandemic*, <https://voxeu.org/article/learning-during-covid-19-pandemic> (31.12.2020).

Therefore, it is crucial to understand that the time has come – and the corona-crisis has only accelerated this process – for other innovative solutions, which should be the work of modern academia and universities where new products, technologies, etc., are developed. The shock we experienced in the winter and spring of this year has made many societies realise that science and research and development cannot be placed last in the hierarchy of budgetary expenditure and that, in the event of threats, society cannot be protected without rationalising expenditure on health care as well. On 27 November 2008, the Coalition for Open Education was established in Poland by four institutions representing education and science: the Modern Poland Foundation, the Interdisciplinary Centre for Mathematical and Computational Modelling at the University of Warsaw, the Polish Librarians' Association and the Wikimedia Polska Association. Each year more institutions and organisations join the Coalition. These include the Foundation of the Institute for Regional Development, the EBIB Association, the Center for Citizenship Education, the New Media Foundation, Zachęta National Gallery of Art, the AGH University of Science and Technology in Cracow, the University of Łódź, the Polish Linux User Group and others⁶.

In 2015, Poland adopted a preliminary document, “Directions for the development of open access to scientific publications and research results in Poland”, in which it is recommended to move towards open access for all stakeholders⁷.

The European Commission proposed the European Open Science Cloud (EOSC) in April 2016, which was funded under the EU research programme “Horizon 2020”. The EOSC portal includes services such as data catalogues, data transfer services or training portals. Its advantage is that it offers scientists and researchers a virtual environment with open and seamless services for storage, management, analysis and re-use of research data, across different scientific disciplines and among the EU Member States. In July 2020, four organisations – GÉANT, CESAER, CSIC and GARR – founded the EOSC Association, including 138 members and 49 so-called observers (research institutions, research funders, or other research centres can apply for membership). The mission of the Association is “to accelerate the creation of new knowledge, inspire education, spur innovation and promote accessibility and transparency”⁸. Polish participation in EOSC-related projects includes EOSC-Synergy, EOSC Hub, EOSCpilot, DEEP-Hybrid-DataCloud, GÉANT, INDIGO DataCloud, XDC – eXtreme Data-Cloud⁹.

⁶ http://koed.org.pl/?page_id=6495&lang=pl (1.06.2021).

⁷ [https://www.gov.pl/web/edukacja-i-nauka/otwarty-dostep-do-publikacji-naukowych; file:///C:/Users/CSSTiRL%208/Downloads/20180413_Kierunki_rozwoju_OD_wersja_ostateczna.pdf](https://www.gov.pl/web/edukacja-i-nauka/otwarty-dostep-do-publikacji-naukowych;file:///C:/Users/CSSTiRL%208/Downloads/20180413_Kierunki_rozwoju_OD_wersja_ostateczna.pdf) (28.05.2021).

⁸ <https://pg.edu.pl/biblioteka-pg/eosc> (4.03.2021).

⁹ <https://www.eosc-synergy.eu/europe/poland/> (29.05.2021).

One of the members of the EOSC Association from September 2020 is the Gdańsk University of Technology, which organises, among others, the Pomera-nian Open Science Conferences, which aim to collect and present experiences of various Polish universities and scientific institutes in opening research data from different scientific disciplines. That includes the experience of universities – the Gdańsk University of Technology, the Medical University of Gdańsk and the Uni-versity of Gdańsk, in implementing, for example, the “MOST DANYCH” (*Data Bridge*) project which aims at developing organisational and legal aspects of shar-ing research data, tools and repositories for research data, Data Stewardship and its professionalisation, principles for sharing research data in various scientific disciplines, and discusses projects and initiatives supporting sharing research data¹⁰. The Gdańsk University of Technology is also the organiser of Cambridge Data Week, a series of week-long webinars on research data management topics, which discuss innovative ways to support researchers in data management, suc-cesses and future trends in data re-use, and the relationship between reproduc-ibility and data management¹¹.

Another exciting initiative that supports open access in science is the par-ticipation of Poznan Supercomputing and Networking Center (PSNC) in the EOSC-FUTURE Consortium, which in the technology part is focused on improv-ing the AI (Artificial Intelligence) of the EOSC portal to users, and in the Science Engagement part, contributes its extensive experience in cooperation with com-mercial partners through the Digital Innovation Hub to support the integration of small and medium-sized enterprises into the EOSC portal and the overall cultural environment of Open Science¹². PSNC provides access to e-Infrastructure for the scientific community, creating a specific R&D environment for proof of concept, prototyping and large scale pilot projects, creating innovations based on ICT, i.e. implementation of specific applications for various fields of science and industry, spreading knowledge and awareness of modern technological capabilities among various social groups and finally active fight against digital exclusion¹³. An exam-ple of technical support offered by PSNC is the edition of the Festiwal Słuchowisk (*Festival of radio plays*), held on the weekends of November and December in 2020, organised entirely in the virtual form¹⁴, or support for remote education, for example, by conducting classes by experts from the Innovative Education Labora-tory, who presented the possibilities of enhancing *students’ creativity through the use of BBC Micro:bit – a pocket computer changing the way of developing digital skills, improving skills in the use of digital archives in education*, or improving

¹⁰ <https://pg.edu.pl/openscience/wydarzenia> (14–16.04.2021).

¹¹ <https://pg.edu.pl/openscience/wydarzenia> (23–27.11.2020).

¹² <https://www.pcss.pl/projekty/eosc-future/> (20.05.2021).

¹³ <https://www.pcss.pl/#dziedziny-aktywnosci> (14.06.2021).

¹⁴ <https://www.pcss.pl/pcss-udzielilo-nam-ogromnego-wsparcia-o-wspolpracy-w-ra-mach-festiwalu-sluchowisk-w-miesieczniku-poznanski-prestiz/> (29.04.2021).

competence in project implementation and teamwork thanks to *the Kanban board and free applications Taiga and EduMeet*¹⁵.

The Polish Optical Internet PIONIER is operating in Poland, a nationwide broadband optical network that forms the basis for scientific research and development work in computer science and telecommunications, information technology (networks, etc.), applications and services for the information society. Built entirely from the State Committee for Scientific Research funds, it currently connects 21 centres of Municipal Academic Networks and five High-Performance Computing Centres using their optical fibre connections. PIONIER is the first in Europe nationwide academic network using its optical fibres for data transmission in DWDM technology and 10 Gigabit Ethernet¹⁶. PSNC provides an educational platform PIONIER Research & Classroom, which includes a programming environment adapted for implementation of projects in Data, Computer Vision and Neuro-linguistic Programming (NLP). Upon completion of the course, its participants can create their own AI algorithms and have a deep understanding of the processes and applications of this technology. As part of its ongoing programme, PSNC provides training in Artificial Intelligence (AI) and creating innovation using Design Thinking. In March 2021, an article was published in “Nature” describing the results of international research work on the prediction of the development of the Covid-19 pandemic using advanced models and computing power of the resources of the supercomputer “Eagle”¹⁷. In the framework of cooperation with partners from the UK, developed within the VECMA project, the software for validation, verification and uncertainty quantification (VVUQ) of advanced computational models was used to analyse the epidemiological model CovidSim developed by Imperial College London. CovidSim was the primary model used by the UK government to predict the development of the coronavirus epidemic in the British Isles. In the early stages of the epidemic, its estimates influenced, among other things, a change in the approach of policymakers from trying to achieve herd immunity to a lockdown policy. Conducting the necessary research required some demanding calculations, most of which were carried

¹⁵ The conference “Better education” was held under the slogan “Let’s give students and teachers a chance for effective cooperation!” and was organised in March 2021 in cooperation with the Office of the Town and Municipality of Września and the John Paul II Local-Government Primary School No. 6 in Września. It focused on the popularisation and practical use of ICT in educational processes. The conference dealt with the popularisation of the implementation of programming skills among primary school pupils and the development of programming competences among pupils at other educational stages. The interest in the practical part of the conference was enormous – a total of 600 participants registered, <https://www.pcss.pl/warsztaty-laboratorium-innowacyjnej-edukacji-pcss-na-konferencji-lepsza-edukacja/> (23.05.2021).

¹⁶ <https://www.eosc-synergy.eu/europe/poland/> (29.05.2021).

¹⁷ <https://www.eosc-synergy.eu/europe/poland/> (29.05.2021).

out at the Poznan Supercomputing and Networking Centre, which provided the resources of the Eagle cluster¹⁸.

It is expected that universities' social role and involvement in helping businesses reduce the financial impact and socio-economic damage caused by the pandemic, support public health, and protect society from the harmful effects of the pandemic will increase. Increasing public spending on nationally relevant objectives will only be possible if the national economy is internally efficient and competitive in an international environment. That cannot be achieved without new products, patents and innovative solutions developed by the national scientific and research community. Unfortunately, in successive versions of the "anti-crisis shields" prepared by the government, there is no specific recipe for universities and scientific and research centres, which should support the public authorities precisely in such difficult situations. It is necessary to remind society and governments of the value of academic autonomy and freedom and that the universities fulfil their missions better when they are free and strong. The new situation has also made all concerned aware of the role of science and the "tension between evidence-based policy and policy driven by political interest groups". The University World News described a positive example from South Africa, which had set up a cross-party ministerial advisory committee composed exclusively of medical experts, while such bodies were absent in Italy, the UK or the US.

3. THE MAGIC OF BIG NUMBERS

From the formal and organisational point of view, our higher education system is quite rich and complementary. It comprises higher education institutions, federations of entities of the system of higher education and science, the Polish Academy of Sciences and its scientific institutes, (industry) research institutes, international scientific institutes established under separate acts operating on the territory of the Republic of Poland (i.e. Łukasiewicz Centre and institutes operating within the Łukasiewicz Research Network), the Polish Academy of Skills as well as other entities, which may be said to conduct mainly scientific activity and perform it independently and continuously. The statistics relating to higher education also seem impressive. According to the Central Statistics Office (CSO, Polish GUS), there were 383 higher education institutions in Poland in 2018, most

¹⁸ W. Edeling, H. Arabnejad, R. Sinclair, D. Suleimenova, K. Gopalakrishnan, B. Bosak, D. Groen, I. Mahmood, D. Crommelin, P. V. Coveney, *The impact of uncertainty on predictions of the CovidSim epidemiological code*, "Nature Computational Science" 2021, Vol. 1, pp. 128–135, 22 February 2021, <https://www.nature.com/articles/s43588-021-00028-9> (4.09.2021).

of which (as many as 230) were non-public universities. In that year, 901 801 students attended classes at public schools.

Interestingly – there were almost three times fewer students in non-public universities (328 453). Among the students, the majority took full-time courses (809 259 students, against 420 995 students on part-time courses). For a long time, we have also seen a growing interest in studying in Poland from young people abroad, among whom students from the former USSR dominate. In 2018, 78 257 foreigners studied at Polish universities, mainly from Ukraine (39 203) and Belarus (7 314). The university boom, which has lasted for two decades, resulted in almost half of young people choosing to study, placing us – with a net enrolment rate of over 40% – at the level of developed European countries.

Today, when the lockdown has shaken all spheres of our life, without systemic support with national funds (and perhaps also with the EU funds) of the whole organisation of higher education and scientific and research education, we may lose what was so laboriously built over the years. Already in the first weeks of the pandemic, there was a noticeable outflow of part-time students who had so far combined their studies with work in commerce or catering. We do not know whether international students will return and whether new ones will arrive, uncertain of the economic situation in their home countries. We also do not know with what intensity and for how long will we fight the crisis in Poland, which, after all, will also affect the study opportunities of thousands of young people, often financed by their parents during their studies. We also have to ask whether our universities' expanded and modernised facilities will be sufficiently filled with people willing to study, which – irrespective of the wealth of the State – should be treated as a lever for national development.

At the same time, some know that there has been a significant acceleration, described as the fourth industrial revolution for higher education, involving the rapid adoption of technology, virtualisation, and innovation.

4. AMBITIONS AND OPPORTUNITIES

The agreement declared by the political elite to increase the role of Polish science and Polish universities in modernising the country has in recent years acquired an actual dimension. According to the Ministry of Science and Higher Education, in 2019, science outlays were increased by a record amount of 5 billion PLN since 1989; an increase of another 4 billion PLN is planned for 2020. The CSO data confirm the positive trend – science outlays reached 1.21% of GDP in 2018 (1.03% in 2017). In turn, outlays on research and development in 2018 amounted to 25.6 billion PLN (a 24.6% increase compared to 2017). The budget

act for 2020 allocates more than 31 billion PLN for higher education, science and R&D activities, which is 3 billion PLN (11%) more than in 2019. In this list of big numbers, the human potential cannot be ignored – approximately 81.5 thousand people are engaged in R&D activities in Poland. Dominating in this group are people with doctoral degrees (PhD) (54 thousand), the next group is PhDs with habilitation (21 thousand), and professors are a group of nearly 11 thousand people. These numbers are impressive at first sight, but only until we look at the scale of financing of Polish science against the background of Europe.

In our discussions on the standard of living and economic development, we rightly compare ourselves within the family of European countries. However, this comparison can be (and often is) a source of complexes. The same goes for tracking the places Polish universities occupy among the world's annual rankings. Nothing happens without reason. The two highest-ranked Polish universities (the University of Warsaw and Jagiellonian University) were placed between the sixth and eighth hundred in the world ranking. At the same time, only the Adam Mickiewicz University in Poznań and the Gdańsk University of Technology managed to get into the first thousand of the world universities.

While we are optimistic about treating higher education and science better and better in recent years, let us not succumb to the magic of large numbers, which do not reflect reality unless we know the international context of our ambitions, our efforts and our possibilities.

When in 2017 Poland spent 1.03% of its GDP (4.83 billion EUR) on R&D, the EU average was 2.07% of GDP. On the old continent in 2017, the leaders in R&D spending were Sweden (3.33% of GDP), Austria (3.16%), Denmark (3.06%) and Germany (3.02%). It is worth remembering that the German 3.02% with the GDP nearly seven times higher than in Poland translates into almost 21 times higher amounts. With such a distance, not only are we getting further away from the European lead each year, but the growing economies outside Europe will also push us. Economically strong Asian countries perfectly understand the role of science in strengthening economic competitiveness (South Korea spent 4.22% of GDP on R&D in 2017, Japan 3.28% of GDP), but increasingly also by other Asian or South American countries growing economically in strength. Moreover, in the US, the top ten universities, including Pennsylvania, Stanford and Harvard, spent around USD 11 billion on R&D in 2017.

It is, therefore, all the stronger an argument to properly appreciate the sphere of science, research and development in the public interventions of the Polish State, currently focused on the social sphere. As the CSO states in its publication *Research and development activity in Poland in 2018*: “As in previous years, the main sectors financing R&D activities in 2018 were the enterprise sector, and the government sector, whose funds accounted for 53.3% and 35.4% respectively (compared to 52.4% and 38.3% in 2017) of all outlays incurred for conducting

scientific research and development works”¹⁹. The acceleration of scientific and research activities in our country now seems possible mainly through the redirection of funds from the state budget (possibly from the EU), because unfortunately, times of great uncertainty and struggle for survival await economic entities. Without state activity, the time of recession may be prolonged.

5. ACTIVE OR PASSIVE STATE?

The announced major anti-crisis intervention at the EU level, under which – as was said at the end of May this year – Poland would receive 63.8 billion EUR in the form of grants and loans (out of a pool of 750 billion EUR for all the Member States), is a significant financial injection and an opportunity to modernise the country, but under the condition that a sensible balance is struck between financing what is to neutralise the effects of the economic slowdown and what should be a long-term, pro-development investment, moving our country to a higher level of international competitiveness. This objective cannot be achieved without strengthening Polish science based on higher education institutions, which should build greater relations with the economic sector and support public administration.

Decision-makers in wealthy Western countries understand this, identifying the impact of the corona crisis on the condition of universities. In Ireland, a popular choice for international students, Trinity College Dublin alone is estimated to lose 40 million EUR this year and 80 million EUR next year. In the UK, the loss of international students in 2021 (the estimate is around 47%) will generate a loss of around 1.5 billion GBP. In its analysis for the University and College Union of the entire group of the UK universities, London Economics predicts a shortfall of 2.6 billion GBP for the following year. The government support packages already planned to offset the harmful effects of the crisis on the UK universities run into hundreds of millions of pounds. In Germany, where it is common for students to combine part-time work with study, the idea of launching interest-free loans for those among them who have lost earning opportunities due to the closure of shops and restaurants has emerged.

Western researchers say the widespread social and political crisis – including growing xenophobia caused by both the pandemic and the economic crisis – will significantly impact patterns of academic migration and which countries are seen

¹⁹ Działalność badawcza i rozwojowa w Polsce w 2018 r. [Research and development activity in Poland in 2018], GUS, <https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/nauka-i-technika/dzialalnosc-badawcza-i-rozwojowa-w-polsce-w-2018-r.,8,8.html> (4.09.2021).

as attractive destinations for students and researchers. The US universities are bracing for a drop in overseas students in the coming autumn semester with a loss of revenue of up to around 4.5 billion USD; in Australia, a 50% decline in international student numbers is predicted by 2021. It is widely believed that China will turn to Europe and Southeast Asia once the pandemic is over. If towards Europe, this could mean that Polish universities might also benefit from this change.

6. CONCLUSIONS

The diagnostic analysis allows to identify factors affecting the functioning of science and higher education during a pandemic based on the case study of Poland, with comparison to other countries. It was found that before the pandemic, science and higher education were underestimated by those in power, especially in terms of their expert role, which was reflected in insufficient outlays on science, depreciation of scientific achievements in the public space and little investment in universal access to the Internet for the poor. The corona crisis pointed to the need to modernise existing criteria and learning outcomes to develop in students the ability to adapt flexibly to changing circumstances and in a changing world. Modern education should, especially now, provide students with the personal development, skills and competencies to cope with the changing socio-economic and cultural conditions they will face. The outcome of the pandemic may be more effective management of the resources available to universities – both in the form of researchers and graduates in the labour market.

Drawing on the experience of developed countries and on a sensible establishment of priorities of the countries aspiring to join this group, we should especially now begin a serious debate on how to build vital scientific and research centres in Poland, making use of national universities for this purpose. It would be worth thinking about how to reward universities that create new solutions, are active in the international arena, and cooperate in an inter-sectoral environment with the business community, state and local government administration, and the non-governmental sector. The later we take up this task, the more difficult it will be for us to catch up with those countries that have already set their sights on strengthening their scientific communities and increasing the competencies of their societies. It is a mistake to treat science like a racing car that gets more petrol and thus goes faster, without technical breaks and always further. This understanding has become more widespread, not least because of the COVID-19 epidemic. The allocation of relatively large sums of money on research into a vaccine for SARS-CoV-2 has had the desired effect, but the cycle of research, verification and implementation into production and then into widespread use

can only be shortened within reason. The same is true in every other field of science, whether we are dealing with research and implementation in the natural and technical sciences or the social sciences. Working under time pressure sometimes produces some results, but all research experience shows that the best motivation for the research is to create the right conditions for researchers' ambition and passion for having free rein. The scientific community knows that before success can be achieved in research and development, it is necessary to build up specialised staff, equip them with technical means and scientific tools – and only under such conditions research a selected issue.

Furthermore, the road to implementation is even longer. Science and development are, after all, long-term activities comparable to building foundations – challenging to accelerate but necessary to ensure the durability of the structure. The Polish State is such a structure for us, scientists. Probably in our environment, there is also the strongest conviction that in the 21st century, we will not build a lasting and robust Polish economy without our science and knowledge resources created at universities and scientific and research centres. Recalling the amounts spent on scientific and research activities and their relation to GDP, we must understand that for the time being, we have little chance for economic competitiveness. Not only in the European backyard.

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