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INNOVATION AS AN ELEMENT OF THE DEVELOPMENT OF HEALTHCARE AND EDUCATION IN ISRAEL

ІННОВАЦІЇ ЯК ЕЛЕМЕНТ РОЗВИТКУ ОХОРОНИ ЗДОРОВ'Я ТА ОСВІТИ ІЗРАЇЛЮ

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Abstract. *In a rapidly changing world, new needs are constantly emerging. Changes in different areas of life affect all areas of human activity. Israel's health and education systems are no exception. One of the possible ways of their development is innovation. The development of innovations can help solve many problems both in the field of medicine and in the field of education. In this article, the authors examine various aspects of creating innovations in the field of medicine and education for the development of israel's innovation ecosystem.*

Keywords*: innovation ecosystem, innovations, health care system, education system, pandemic.*

Introduction. The choice of an innovative path of development affects many essential aspects and requires the formation of an appropriate innovation environment, which is a set of functioning institutions - economic, regulatory, social and spiritual, as well as the development of the infrastructure necessary for the implementation of innovative activities.

In the socially significant sphere of life of modern society, which is health care and education, it is impossible to support development without relying on innovation and continuous improvement of all its structural elements. The COVID-19 pandemic has exposed challenges in the provision of both medical and educational services. In this regard, the development and implementation of modern innovations in these areas are becoming relevant.

Literature review. Various authors interpret the concept of innovation depending on the object and subject of their research. Having analyzed the economic literature on the problem of research, it can be noted that there are different approaches to the interpretation of the term "innovation" as: change in order to introduce and use new types of goods / services, a tool / method / means of using changes [1, 2], the process in various modifications (action, set of activities, activities, investment of funds) [3], the result of the process [4] and others. According to the Oslo Manual, innovation is considered as the result of the implementation of new ideas and knowledge with the aim of their practical use to meet certain consumer needs [5]. Innovations in healthcare are defined as the promotion of new ideas, concepts, services, processes and products aimed at a qualitative change in the diagnosis and method of treatment, as well as the prevention of diseases and research

in this area with the long-term goals of improving quality, safety [6].

Despite the growing volume of literature devoted to innovations in higher education, there is no clear and unambiguous definition of it. Susan C. White, Theodore S. Glickman see innovation as a new way of doing things that lead to change that improves administrative or scientific efficiency, or to a transformational experience based on a new way of thinking [7]. Despite the growing volume of literature devoted to innovations in higher education, there is no clear and unambiguous definition of it. Susan C. White, Theodore S. Glickman see innovation as a new way of doing things that lead to change that improves administrative or scientific efficiency, or to a transformational experience based on a new way of thinking [7]. The COVID-19 pandemic has affected health systems around the world. In the context of COVID-19, a new healthcare system has formed - pandemic. This new phenomenon has a lot of features, the main one is the focus not just on treatment, but on saving lives. The Deloitte report [8] identified health problems in the context of COVID-19 and made a forecast for trends in the future development of medicine. The impact of the COVID-19 pandemic on higher education has been the subject of a number of studies: a report from QS on how COVID-19 affects international students in the world [9], a study by the International Association of Universities (IAU) on the impact of COVID-19 on higher education in the world [10] and others.

Aims. The purpose of the study is to identify the main aspects of the creation and implementation of innovations as an element of the development of the Israeli health and education systems, taking into account the characteristics, needs and opportunities.

Results. The formation of a national innovation ecosystem is one of the main challenges for the Israeli economy. The degree of innovative development of Israel can be characterized by various international indices presented in Table 1.

Table 1. Israel's Rank in International Innovation Indices

Years	The Global Innovation Index (GII)	World Competitiveness Index (GCI)	Bloomberg Innovation Index (BII)
2017	17	22	10
2018	11	21	10
2019	10	24	5
2020	13	26	6
2021	15	27	7

Source: developed by the author on the basis of [11,12,13]

The table data shows that Israel's rankings in international indices between 2017 and 2021 do not have a steady increase or decline. For example, the rank of Israel in the GII ranking until 2019 had a tendency to grow, but since 2018 this indicator has begun a slight decline.

Israel ranks first in the world in the coherence of the innovation ecosystem and second in the University-industry R&D collaboration, according to the Global Innovation Index [14]. In the country, there is practically no mental barrier between venture funds, corporations, startup companies, universities, government agencies and even the army. All these structures work at different paces, but obey the same laws.

One of the major players in Israel's technological and innovation ecosystem is the Israel Innovation Authority (formerly the Office of the Chief Scientist). It is the central government agency responsible for stimulating innovation in various industries. The Israel Innovation Authority, through the Research and Development Foundation, supports or shares up to 50% of the costs of research and development of projects in various sectors of the economy [15].

Israel's innovation ecosystem is based on the same principles as the innovation systems of other world leaders: priority state funding of basic research; assistance from the state to transfer the results of research work to industry, legislative stimulation of scientific, technical and innovative activities.

In practice, this is implemented in the format of a wide range of mechanisms for state support of medical institutions and universities, research institutes and laboratories, large national corporations, small and medium-sized businesses. On the one hand, this is budget support in the form of financing expenditures, as well as allocating targeted grants and placing state orders for R&D, investing in the capital of venture funds, as well as carrying out targeted public procurement of innovative products and services, financing business incubators, technology parks, etc. On the other hand, it is the provision of various tax incentives to enterprises engaged in R&D, as well as the allocation of innovative activity to innovative entities preferential state loans and credit guarantees.

The main factors in the development of Israel's innovation ecosystem are strong relationships between its people, which contribute to cooperation and the exchange of ideas, the geographical concentration of universities, the presence of transnational corporations and startups [16].

A feature of the Israeli market are startups. Startups and venture investments have received the greatest development in such sectors of the country's economy as: information and communication technologies; medicine and pharmaceutics; agriculture and biotechnology; natural resources and energy; defense and aerospace. The approach that Israel applies to the development of the innovation ecosystem is laid down by the state and has been developing for many years. The Israeli public sector supports: interaction between R&D in the military and civilian sectors; programmes of cooperation with the private sector; incentives for foreign R&D centres of transnational corporations in Israel; The industrial sector benefits from access to advanced knowledge and technologies developed by research universities. For many years, the country has had a system of government grants and subsidies for innovative startups in various sectors of the economy.

Innovative technologies from cell biology to space technology are examples of Israeli medical startups. CorNeat Vision is developing an artificial corneal implant using advanced cellular technology to integrate artificial optics into living ocular tissue. PixCell Medical develops a low-cost, portable hematology analyzer that performs a complete blood count (CBC). The Swiss-Israeli company SpacePharma will democratize the process of conducting experiments in space. There are many more startup companies that develop new products or services. Research, development and experimentation in the field of medicine is an important tool for many pharmaceutical and research companies.

In Israel, there are already more than 100 startups in the field of educational technology. Every year there are new projects and educational programs in which augmented and virtual reality technologies are used to improve the educational process. Examples of startups include Bonim B'Yachad, which provides online courses in real time at 35 schools in Israel, To Be Education allows students from different countries to participate in joint debates and research; The Islands, a virtual reality lab for the study of civil law; Gamify is an interactive platform that teaches technical and applied sciences, entrepreneurship and coding, and many other programs and applications. Modern educational technologies help children and students to study better, and adults to raise their qualifications and become a highly paid specialist.

Israel in 2020 ranked 21st (among 171 countries) in the ranking of patent activity of the countries of the world with a total number of applications equal to 7738 [17].

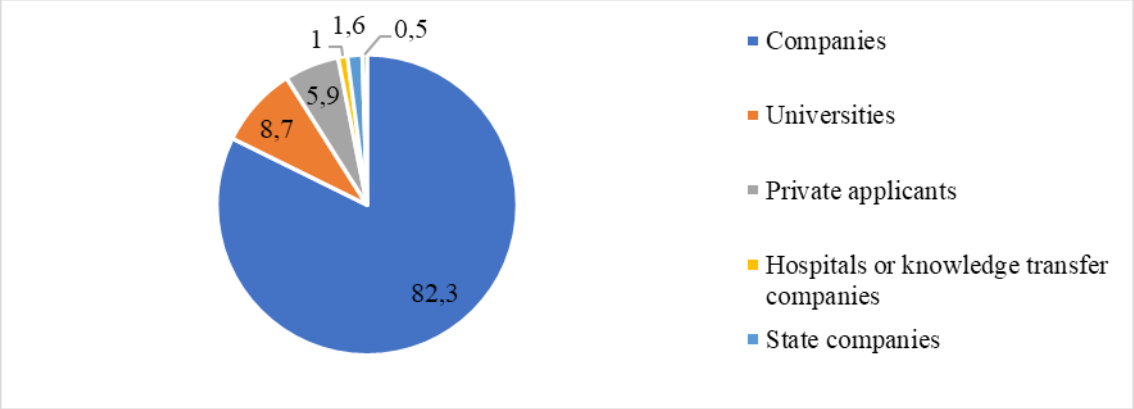

Figure 1. Structure of registered patents for applicants in Israel in 2020
Source: developed by the author on the basis of [18]

In Israel, registered patents in 2020 were filed: 82.3% by companies, about 8.7% by universities, 5.9% by private applicants, about 1% by hospitals or knowledge transfer companies, about 1.6% by state-owned companies and about 0.5% by public research bodies. The segmentation of Israel's patents by application sector shows the involvement of universities and medical institutions in the development of the country's innovations. This is due to the importance of innovation as an integral part of ensuring the competitiveness of Israeli organizations in both the health and education sectors.

Innovation in the Israeli Healthcare System

The target focus of the medical services in Israel is related to the preservation and strengthening of patients' health. Therefore, there is a constant search for more effective methods of treatment, prevention, diagnosis and control of diseases, new drugs and the most high-precision equipment for diagnosis and new protocols for the treatment of various diseases are being developed and introduced.

The high quality of medical services in Israel is ensured by the development of the following areas:

- active state funding - annually the government of the country allocates about $

28 billion for the purchase of new medical equipment, clinical trials and advanced medical training courses;

- medical innovation - broadening the knowledge base and transforming current technological and business models to better meet changing needs and expectations. High level of training of doctors - each of the Israeli specialists, before starting medical practice, studies at the university for at least 7 years and additionally undergoes internships both in the country and abroad;

- prompt introduction of all modern medical technologies - Israeli doctors not only adopt the best practices of foreign colleagues, but also develop innovative methods of diagnosis and therapy;

- individual approach to everyone - turning to Israeli clinics, patients can count on the fact that the treatment plan will be developed taking into account not only all the features of the clinical picture of the disease, but also their personal opinion;

- high performance indicators - in almost 100% of cases, Israeli doctors manage to achieve the onset of pronounced positive dynamics, stable remission and even complete recovery;

- impeccable level of service - on the basis of all leading clinics of the country there are international departments, whose employees help patients from abroad to solve all organizational and everyday issues;

- digitalization of health care - in Israel, information technology accumulates medical information about its patients, which today is a valuable database for assessing the state of health, analyzing the characteristics of diseases and determining the causes of diseases.

The COVID-19 pandemic has accelerated the digital transformation in Israel's healthcare. Israel leads the way in digital health and medical devices and serves as a kind of global laboratory for innovative technological developments. The quality of medical services provided with the help of modern technologies depends not only on the technological, but also on the digital literacy of industry workers. Therefore, one of the main tasks for the state is to maintain its position and improve the methods of personnel training for the introduction of digital technologies in medical institutions. Innovative technologies, rich experience of doctors and comfortable conditions of medical centers make Israel a leading country in conducting complex surgical interventions and successful treatment of oncology. In the coming years, it is necessary to invest in artificial intelligence technologies to optimize operational efficiency, integrated diagnostics or predict treatment outcomes. Participants in the medical services market need to pay special attention to remote patient care, including telemedicine.

The COVID-19 pandemic has caused and continues to cause many social changes and transformations. These include negative economic consequences, problems of the health and medical system, the education system, psychological problems generated by a sharp restriction of social contacts. But COVID-19 has also dramatically accelerated healthcare innovation. The pandemic has forced the medical community to reconsider its attitude towards modern technologies. Before that, doctors were very conservative in terms of the use of new technology, especially when it came to remote diagnosis, telemedicine, remote control of equipment. In the

future, innovation will contribute to the development of the healthcare industry in many countries, and it will change through such areas as: scientific breakthrough, data exchange, interoperability, equitable access, empowerment and changing consumer behavior. The COVID-19 pandemic has forced medical institutions to change their activities in favor of virtual visits and remote monitoring of patients in the shortest possible time, and has given a powerful impetus to the development of the skills of medical personnel.

Innovation in the Israeli Education System

Universities are one of the main participants in Israel's innovation ecosystem. In Israel, eight universities and five companies associated with research institutes and colleges are directly involved in advanced technologies. Their role is to recruit, sell and develop the knowledge accumulated in institutions, obtain patents for commercial products and help launch startups. Israel's best educational institutions have helped create a nation of scientists, engineers, doctors, and professors who aspire to be leaders in their field. As a result, the number of Nobel laureates per capita in Israel is very high for such a small country.

Recognition of the importance of scientific research, the use of the results of intellectual activity (registration of patents, know-how and licensing agreements) and innovation activities (participation in grants, support programs of various levels, etc.) characterizes the development of the scientific potential of Israeli universities. The criteria for evaluation can be the number of scientific publications of Israeli researchers increased more than 2 times in 2000-2020 [19]. University authors make up about 92% of Israeli publications. On average, about a quarter of the scientific publications of Israeli researchers are carried out in cooperation with other foreign researchers [20].

Applied research is carried out in universities, research institutions, hospitals, and industry. A distinctive feature of the innovation system of Israel is that in Israel they have learned to bring the developments of scientists to the state of a market product. Technology Transfer Company (TTC) is engaged in the transfer of knowledge and technologies (commercialization of R&D) developed in universities [21]. But these companies and the universities themselves do not become shareholders of innovative enterprises, although their leaders are commercially experienced people. Universities strictly limit themselves to the sale or transfer of patents. The reluctance to enter into entrepreneurship themselves is understandable: in addition to conflicts of interest, universities are well aware of the limitations of their own experience and opportunities. Israeli universities are a source of creative, talented talent that enable innovation. In Israel, there are more than 145 scientists for every 10,000 workers, which is one of the highest rates in the world [22]. In Israeli universities, training is conducted in parallel with scientific research in various areas and the profile of a higher education institution.

The level of use of the results of intellectual activity of universities in the form of applications for intellectual property (IP) is presented in Figure 2.

Figure 2 data shows the leadership of the Technion-Israel Institute of Technology (Technion) in the number of applications for intellectual property among other Israeli universities for 2018-2020.

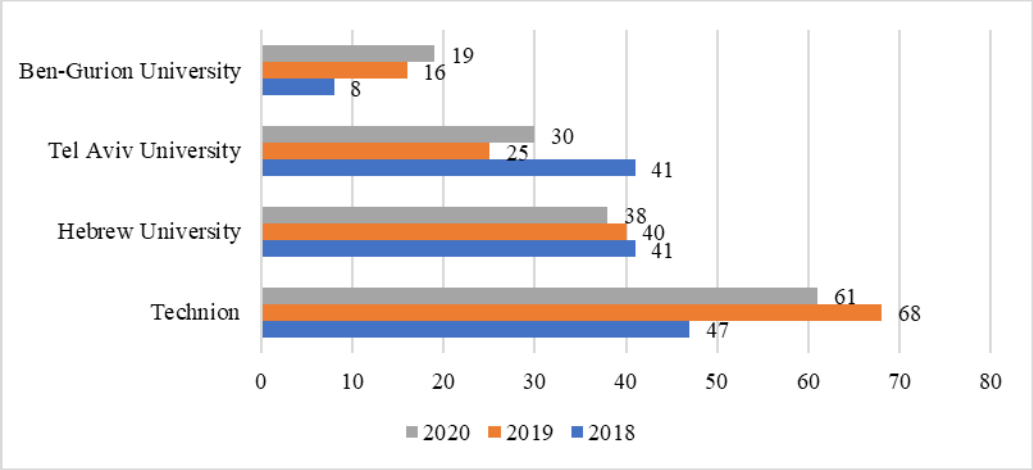

Figure 2. Number of IP applications of Israeli universities in 2018-2020
Source: developed on the basis of [23]

Israeli universities have a sufficient number of subjects of innovative infrastructure that provide research and development: scientific and research centers, entrepreneurship centers, university laboratories, technology transfer centers, business incubators and technology parks.

The COVID-19 pandemic has affected the education system primarily from the angle of its transition to a remote format and the problems that arise in this regard among students and teachers. Universities are forced to revise the system of organization of research works, scientific research and conferences, moved to a virtual format. Many began to search for new forms of interaction in the digital environment to maintain constant communication, solve common problems and problems, and search for optimal solutions for all parties. To solve these problems, it is necessary, according to the authors, to remain open and share developments and research, acting on the method of keep sharing, stay open. This could mark the beginning of new forms of international cooperation.

Findings: Israel is an innovatively developed country. Every year, scientists develop and master new technologies. Intellectual property policies and practices in universities and research institutes are the main ways to develop Israel's latest technologies. The introduction of innovative technologies that provide a modern solution to specific clinical problems will not only improve the quality of life of patients, reach a new level of therapy, spend money more efficiently, but also significantly improve the skills of medical personnel. Thanks to the successful combination of high technology and medicine, Israel has accumulated valuable knowledge and experience in these areas that can be useful for medical institutions and health services in other countries.

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Аннотация. *В стремительно меняющемся мире, постоянно возникают новые потребности. Изменения в разных областях жизни сказываются на всех областях человеческой деятельности. Не является исключением израильские системы здравоохранения и образования. Одним из возможных путей их развития являются инновации. Развитие инноваций может помочь решить многие проблемы как в области медицины, так и в сфере образования. В этой статье авторы рассматривают различные аспекты создания инноваций в области медицины и образования для развития инновационной экосистемы Израиля.*

Ключевые слова: *инновационная экосистема, инновации, система здравоохранения, система образования, пандемия.*