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У журналі відображено результати актуальних досліджень з проблем загальної педагогіки, історії педагогіки, педагогіки вищої школи, спеціальної освіти, а також мистецької освіти.

*Співпраця між двома середовищами – сім'єю та школою – має бути зорієнтована на підтримку, взаєморозуміння й активну участь батьків у в освітньому процесі. Зміна активності батьків означає зміну принципів співпраці та всієї діяльності школи. Освітнє партнерство в школі полягає у створенні простору для співпраці, метою якої є добробут дитини.*

**Ключові слова:** співпраця батьків зі школою, освітні труднощі молодших школярів.

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## **THEORETICAL ASPECTS OF INNOVATION MODELS AND THEIR PRACTICAL IMPLEMENTATION IN MODERN MEDICAL EDUCATION**

*The article deals with theoretical aspects of innovation models and their implementation in modern medical education. The author focuses on the first innovation model, proposed by J. Schumpeter during the first half of the 20<sup>th</sup> century. This model considers the so-called “triad” in the innovation process, namely invention, innovation, diffusion. Besides, in this context, J. Schumpeter described the concept of “creative destruction”. As for the last quarter of the 20<sup>th</sup> century, there were such innovation models as (i) induced innovation model, (ii) evolutionary models, and (iii) models that characterize the way of innovation. The end of the 20<sup>th</sup> century represented the development of the model of national innovation systems and the model of technological innovation systems.*

**Key words:** innovation, innovation models, innovation process, research and development, linear model of innovation, induced innovation model, evolutionary models, model of national innovation systems, model of technological innovation systems, medical education.

**Introduction.** During the 20<sup>th</sup> century, medical education has undergone many changes. They are mostly related to innovations in teaching, research, and management of higher education institutions. P. González-Flores and L. Luna argue that “some innovations are still being implemented and have even been adapted to other contexts (i.e. problem-based learning), while others have been discarded” (González-Flores & Luna, 2019). The matter is that the authorities of each country chose the appropriate development strategy for education within the certain innovation model.

**Analysis of relevant research.** The issue of innovation models is applicable in the economy, management, and technology. K. Arrow, C. Freeman, B. Lundvall, R. Nelson, C. Perez, J. Schumpeter, R. Solow, S. Winter, and others dedicated their studies to this point in different years of the 20<sup>th</sup>

century. T. Foxon, M. Hekkert, S. Negro, G. Nemet, P. Pearson, V. Ruttan, J. Speirs, T. Stenzel were highlighting this question within the first 20 years of the 21<sup>st</sup> century. L. Kozak, E. Luzik, S. Semenyuk, A. Tsymbalaru, O. Usenko, and others consider innovation models in Ukrainian education in general aspect.

During the last decades, innovation models have become crucial in medical education. However, we should mention that the Ukrainian pedagogical space reveals the problem partially in this aspect. So, the question of theoretical standpoints of innovation models and their practical implementation in modern medical education needs more attention.

**The study aims** to focus on innovation models and highlight their theoretical aspects which are practically implemented in modern medical education.

**Research methods.** To achieve the aim of the study we have used such general scientific methods as analysis and synthesis of references, generalization, and systematization, comparison of innovation models. Moreover, the study applies a chronological method – to determine the time of innovative models introduction.

**Results.** J. Schumpeter made the initial attempt to theoretically substantiate the innovation process in the first half of the 20<sup>th</sup> century. According to the researcher, there were three stages of this process, namely invention, innovation, diffusion. J. Schumpeter believed that an invention was the first demonstration of an idea, innovation was the first use of an invention on the market, while diffusion was the spread of a technology or process on the market. Typically, an S-shaped curve represented the diffusion process, where the starting point of the innovation process or technology coincided with the appearance on the market, then the curve went up rapidly, symbolizing the diffusion process, gradually slowed down to a certain level of saturation, which in turn implied the need to improve the innovative product or reduce its value (Schumpeter, 1911/1934).

This three-stage way of slow start-up, set of turnovers, and, finally, reduction of return characterizes the linear model of innovations, which illustrates a relatively continuous path of three successive stages such as basic research – applied research – development and diffusion of technologies. The model assumes that scientific advances determine the speed and direction of innovation, and the best way to increase the production of new technologies is to intensify new inventions by enhancing the share of resources invested in innovation activity (Nemet, 2007).

In his early works on the analysis of innovation drivers, J. Schumpeter emphasized the crucial role of an individual entrepreneur in the innovation process. Later work proved the importance of large firms that had the resources to conduct large-scale research and support new technologies. Accordingly, the concept of “creative destruction”, proposed by J. Schumpeter, which deals with the process of replacing old firms and old goods with new firms and products, allows us to rethink the essence of the innovation process. However, according to W. Ruttan, J. Schumpeter was more interested in the consequences of innovations than their causes, and none of his works “contains anything that can be identified as a theory of innovation” (Ruttan, 2001).

During the 50-60s of the 20<sup>th</sup> century, theoretical research on the problems of innovations and innovation activity was focused on the sources of innovation. Besides, researches highlighted the process of promoting innovation in organizations through the effective management of research departments and innovation. Also, the macroeconomic aspect of innovation was studied by R. Solow and other authors who considered the relative importance of various factors for the growth of national economies (Solow, 1957).

Using a linear model of innovation, R. Nelson (1959) and K. Arrow (1962) examined whether the level of investment in innovations was sufficient to meet national economic needs (Nelson, 1959; Arrow, 1962). They concluded that the social return on investment exceeded the private return of an individual firm, arguing that an innovation process or technology created by a firm or an entrepreneur could be easy and cheap (or free) to copy, i.e. the firm often could not fully appropriate the fruits of their investments, as new knowledge “flowed” to other firms and consumers. This, in turn, could critically reduce the number of private initiatives required for a socially optimal level of innovations (Nelson, 1959; Arrow, 1962).

During the last quarter of the 20<sup>th</sup> century in the development of innovation theory, there were the following three approaches that helped to understand technological change: induced innovation models, evolutionary models, and models that characterized the way of innovation. If evolutionary theories and models that characterize the way of innovation emphasize the importance of past decisions that may constrain modern innovation, the induced innovation models focus on the importance of changes in relative prices in the movement to technical changes (Foxon, 2003).

*The induced innovation model* is aimed at studying the impact of changes in the economic environment on the speed and direction of technical change. The model focuses on market drivers, and therefore, mechanisms to increase

demand are also considered important. The key idea of this model is that the change in the relative prices of factors of production stimulates innovations intended to save the use of a factor that has become relatively expensive. For example, if labor becomes more expensive than capital, innovations will focus on more cost-effective technologies (Foxon, 2003).

Evolutionary theories of innovation explain the essence of technological change, which is slow and gradual, resulting from the interaction of several variables belonging to the economic, social, institutional, and technological spheres. Changes in one dimension create tension with others, causing further changes and continuous feedback loops between different dimensions (Stenzel, 2007). According to scientists, in this context technological changes can be viewed through the prism of the ideas of “limited rationality” and “uncertainty”.

The idea of limited rationality implies that decision-makers (both individuals and firms) have limited ability to collect and process the information. Instead of being completely rational profit maximizers, they make decisions that meet certain criteria, sacrificing others, that is, they “satisfy” rather than optimize. In this case, the mentioned way of quickly achieving fixed minimum criteria, rather than trying to find the best possible solution, becomes “routine” (according to R. Nelson and S. Winter), i.e. any technical, procedural, organizational or strategic process, or technology, used by the firm as part of its normal business activities, such as its research and development (R&D) strategy (Nelson, Winter, 1982).

“Routine” is gradually changing in the process of finding better technology. Since firms have limited rationality, such search processes will usually focus on gradual improvements (perhaps following the practice of other firms) and will be discontinued when firms reach a given level of pursuit. Thus, any achieved equilibrium cannot be considered optimal or most effective.

An important consequence of limited rationality is that firms’ expectations of the future have a fundamental impact on current decision-making. Innovation is inevitably characterized by uncertainty concerning future markets, technological potential, and the regulatory environment. Firms’ expectations of these factors will influence the direction of their innovation pursuits, and because expectations are often implicitly or explicitly shared between firms in the same industry, it helps to explain why technologies evolve along defined trajectories (Foxon, 2003).

According to scientists (Meijer et al., 2007), the internally uncertain nature of innovative solutions is mainly related to innovative solutions for new technologies, i.e. those that are still in the early stages of development. On the

one hand, a high level of uncertainty describes the wide range of possibilities offered by new technologies. On the other hand, such uncertainty does not allow the firms to accurately predict the success or failure of the technological trajectory.

We would like to mention that uncertainty may arise not only about the technology itself but also about the social and institutional environment where the new technology will be applied. In the early stages, technology developers will perceive uncertainty concerning the user needs and market demand, while potential users will perceive uncertainty concerning what new technology can offer. Accordingly, researchers distinguish the following types of uncertainty in the development and implementation of new technologies: technological, resource, competitive, supply, consumer, and political ones (Meijer et al., 2007).

In the 70-80s of the 20<sup>th</sup> century, R. Nelson and S. Winter attempted to construct a more general theory of innovation based on the evolutionary model. It contained the following propositions:

- the main characteristic of innovation is uncertainty, especially in the early stages, when there are many options for solving a technological problem or user needs;
- institutional structure plays an important role in stimulating or creating barriers to innovation (Nelson & Winter, 1982).

Based on this, R&D is described as a process of finding solutions that are guided by both technological capabilities (proposal – impetus) and user needs (demand – attraction), creating many opportunities. They are tested in an environment that consists of both market and non-market elements. The non-market element arises from existing institutional structures, such as regulations and codes of conduct. The dominant set of technologies and institutions collectively form the technological regime. This directs innovation activities along certain trajectories, which usually contribute to the gradual introduction of innovative products or processes.

The end of the 20<sup>th</sup> century dealt with an attempt to create theoretical concepts that would reflect the complexity and interdependence of the innovation process. In particular, within the framework of our study, the “Innovation System Frame” deserves attention.

The OECD document, also known as the Oslo Guidelines (OECD, 2005), first proposed the outlined model to denote innovative technological products and processes at the firm or enterprise level. In this context, the conceptual framework of the so-called “Innovation System Framework” is used to classify system conditions into four separate domains related to innovation potential, namely:

– *framework conditions* mean the external area where the firm is located:

- basic educational system;
- communication infrastructure;
- financial institutions that determine access to capital;
- legislative and macroeconomic regulators;
- market availability, including market size and ease of access;
- sectoral structure, including the existence of supplier firms in additional sectoral sectors;

– *scientific and technical base* means scientific and technical establishments that support business innovators;

– *transfer factors* are those that affect the transfer of information to firms and training of firms;

– *innovation dynamo* is a complex system of factors that shape the innovation potential of a firm or entrepreneur, i.e. the propensity to innovate (Speirs et al., 2008).

The OECD research on the characteristics that make firms innovative and the peculiarities of generating innovation in companies has shown that the firm propensity to innovate depends on the technological capabilities it faces. Besides, firms are distinguished by their ability to recognize and use technological capabilities. To innovate, a firm must find out what the opportunities are, develop an appropriate strategy, and be able to turn those resources into real innovation and do everything faster than its competitors (OECD, 1997).

The model of national innovation systems focuses on individual and comparative analysis of innovation systems in different countries around the world using many technologies. In particular, the main idea is that the key institutional drivers are at the national level. The concept of the national innovation systems was first developed in the late 80s of the 20<sup>th</sup> century during a study of the Japanese economy. C. Freeman and C. Perez (1988) defined the national innovation system as “a network of establishments in the public and private sectors, which activities and interactions initiate, import, modify and disseminate new technologies” (Freeman & Perez, 1988). The study emphasized the positive role of government, which, working closely with industry and science, should ensure:

- the direction and support of development, as well as the market of advanced technologies;
- an integrated approach to R&D, design, procurement, production, and marketing within large firms;



- high level of education and scientific culture combined with practical training and constant renewal of industry (Freeman & Perez, 1988).

In turn, B.-A. Lundvall stated that the role of interaction between users and manufacturers, which facilitated the flow of information and knowledge, connected technological capabilities with the needs of users. Due to the fundamental uncertainty of innovation, such interaction went beyond purely market mechanisms and was based on mutual trust and mutually recognized codes of conduct (Lundvall, 1988).

R. Nelson (1993) further developed the idea of national innovation systems. The researcher conducted an empirical study and compared national innovation systems of 15 countries. As a result, the author concluded that “to a large extent, differences in innovation systems reflect differences in economic and political contexts and country priorities” (Nelson, 1993). These differences have reflected the peculiarities of the institutional structures of different countries, including the system of training and research in higher education, innovations of enterprises, financial establishments, government, public infrastructure, which determine the national monetary, fiscal, and trade policy (Foxon, 2006).

Later, the OECD improved the model of national innovation systems, which was widely implemented within this model, the innovation process means the presence of various entities and establishments (small and large firms, users, government and regulatory bodies, universities, etc.), interaction and knowledge flows, funding and influence between them, as well as incentives for innovations created by the institutional structure (OECD, 1997).

The report “Dynamization of National Innovation Systems” considers that the mentioned model is based on an interactive model of the innovation process, which focuses on the exchange of the market and non-market knowledge between firms, establishments, and human resources (Remoe & Guinet, 2002).

Moreover, S. Remoe and J. Guinet summarized the theoretical provisions of the model of national innovation systems and pointed out that:

- the basis of innovation is an innovative firm, but its innovative capabilities are limited due to the market and system failures;
- the innovative potential of a firm is related to its ability to combine knowledge from external and internal sources. Besides, the development of connections and transition management becomes urgent;
- firms can choose certain innovation from many others, so it is important to choose the one that best describes their needs;

- technological innovations play a crucial role, but non-technological forms of innovation need more attention;
- any innovation deals with the innovation process or product, but the innovative behavior involves updating the firm itself (Remoe & Guinet, 2002).

If the model of national innovation systems focuses on the regional aspect of innovation due to public policy and area features of institutional structures, the starting point of the *model of technological innovation systems* is technological change.

Moreover, critics of the model of national innovation systems argue that such models do not sufficiently reveal the essence of the innovation process, because due to a numerous participants, relationships and establishments it is difficult to trace the dynamics of this process. That is why the supporters of the model of national innovation systems focus on the structure, rather than the emergence of innovation systems and the dynamics of their development (Hekkert et al., 2006).

In contrast, in the model of technological innovation systems, the number of participants, networks, and relevant establishments is usually smaller, which reduces its complexity. This is especially true of technological innovation systems that are in the process of formation. As a rule, an innovation system consists of a relatively small number of participants. Only a few institutions meet the needs of new technology. Thus, the application of the model of technological innovation systems allows us to trace the dynamics and better understand the essence of innovation systems (Hekkert & Negro, 2009). At the same time, the proponents of the model of technological innovation systems do not deny the fact that interaction of participants within this model takes place in regional and national contexts (see Fig. 1).

S. Jacobson and E. Bergek identify the following main elements of technological innovation systems:

- participants (and their competencies), including firms, users, suppliers, investors, and other organizations;
- networks that are channels for the transfer of hidden and explicit knowledge (as opposed to the idea of transfer factors or connections);
- establishments that are subjects of governance and which create an environment where all participants interact (as opposed to framework conditions or innovation infrastructure) (Jacobsson & Bergek, 2004).

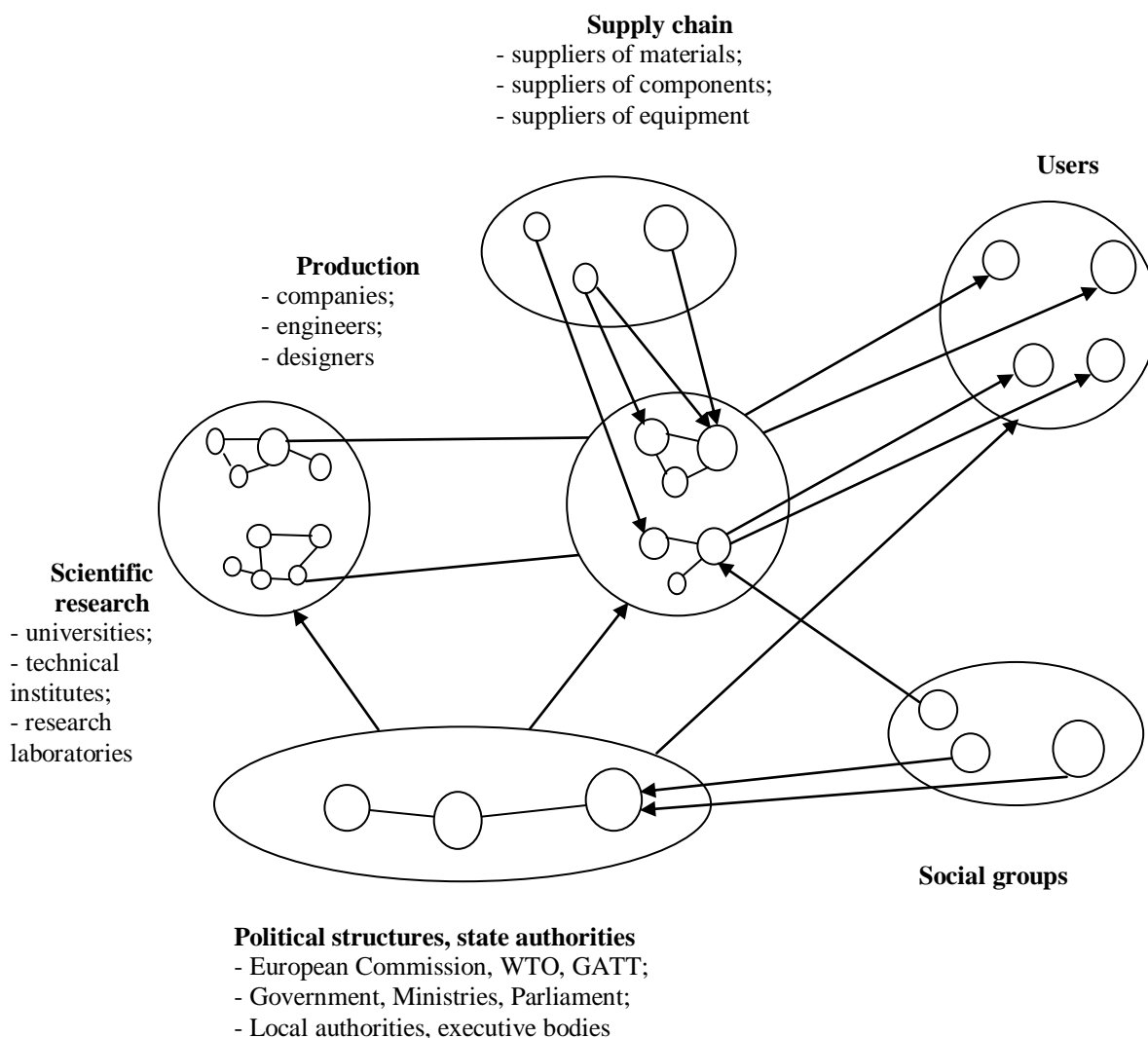


Fig. 1. Interaction of participants within technological innovation systems

Note that, in general, the framework of the innovation system usually provides a broad definition of establishments, including not only formal rules in marketing, regulation, and planning but also informal “norms, rules and values” in organizations and society, which determine different ways of cooperation and competition of participants. Informal establishments also play a significant role in the innovation processes (Winkel & Moran, 2008).

We emphasize that theorists of the model of technological innovation systems attach great importance to the analysis of the functions of the innovation system (Speirs et al., 2008), which are essential for the success of the innovation system. In this context, the study (Jacobsson & Bergek, 2004) deserves attention, the authors of which proposed the analysis of technological system processes through the prism of several core functions that directly affect the development, dissemination, and use of new technology and thus the efficiency of innovation. There are such functions as

- business activities;
- knowledge development, including “learning by searching” and “learning by doing”, and disseminating knowledge;
- search guide;
- market formation (identification of market niches or manipulation of market conditions with the help of economic instruments, such as favorable tax regimes or minimum consumption quotas);
- resource mobilization: resources, both financial and human, are the main contribution to all activities within the innovation system;
- creating legitimacy/resistance to changes. To develop well, new technology must become a part of the current regime or even overcome it;
- development of positive externalities (Jacobsson & Bergek, 2004).

Scientists argue that the more of these system functions are performed, the better is the efficiency of the innovation system, which will lead to greater chances for successful development, dissemination, and implementation of innovations/new technologies. Both the individual performance of each system function and the dynamics of interaction between the functions are crucial. Well-established interaction between functions will enhance the dynamics of the system, while imperfect mechanisms of interaction can cause its collapse (Negro et al., 2008).

**Conclusions.** Thus, we can state that the considered models of innovative activity make it possible to trace the genesis of scientific discourse on the essence of innovative activity, its participants, as well as the mechanisms and conditions for ensuring its effectiveness. Although most of the outlined models originate in the field of economy, numerous studies prove their effectiveness in other areas of public life, including medical education. In this regard, scientific innovation activity in American medical colleges is one of the prospects for further studies.

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## АНОТАЦІЯ

**Куліченко Алла.** Теоретичні аспекти моделей інновацій та їх практична реалізація в сучасній медичній освіті.

*Упродовж ХХ ст. медична освіта зазнала багатьох змін. Здебільшого вони пов'язані з інноваціями в навчанні, дослідженні та управлінні закладами вищої освіти. Оскільки влада кожної країни обирає стратегію розвитку освіти відповідно до певної моделі інновацій, то розгляд теоретичних аспектів наявних моделей інновацій є актуальним для української медичної освіти.*

*Досягнення мети дослідження уможливили такі загальнонаукові методи, як аналіз та синтез наукових джерел, узагальнення та систематизація, порівняння інноваційних моделей. Крім того, у розвідці застосовано хронологічний метод – для з'ясування часу появи моделей інновацій.*

*Авторка зосереджує увагу на першій моделі інновацій, запропонованій Дж. Шумпетером у першій половині ХХ ст. Зазначена модель пояснює так звану «триаду» в інноваційному процесі, а саме винахідництво, інновацію, розповсюдження. У цьому контексті Дж. Шумпетер описав концепцію «творчої деструкції». У дослідженні також розглянуто лінійну модель інновацій, що унаочнює відносно безперервний шлях проходження трьох послідовних етапів: базові дослідження – прикладні дослідження – розвиток та дифузія технологій.*

*Що стосується останньої чверті ХХ ст., у цей період з'явилися такі моделі інновацій, як модель індукованих інновацій, еволюційні моделі та моделі, що характеризують шлях інновацій. На засадах еволюційної моделі в 70–80-х рр. ХХ ст. здійснено спробу побудувати більш загальну теорію інновацій. Кінець ХХ ст. ознаменував розвиток моделі національних інноваційних систем та моделі технологічних інноваційних систем.*

*Розглянуті в дослідженні моделі інноваційної діяльності дають змогу прослідкувати генезу наукового дискурсу щодо сутності інноваційної діяльності, її учасників, а також механізмів та умов забезпечення її ефективності. Попри той факт, що більшість із окреслених моделей беруть свій початок у сфері економіки, численні дослідження науковців доводять їх ефективність в інших сферах суспільного життя, зокрема в медичній освіті. У цьому річизці наукова інноваційна діяльність медичних коледжів університетів США є однією з перспектив подальших розвідок.*

**Ключові слова:** *інновації, моделі інновацій, інноваційний процес, інноваційна діяльність, лінійна модель інновацій, модель індукованих інновацій, еволюційні моделі, модель національних інноваційних систем, модель технологічних інноваційних систем, медична освіта.*

## РЕЗЮМЕ

**Куличенко Алла.** Теоретические аспекты моделей инноваций и их практическая реализация в современном медицинском образовании.

*В статье рассмотрены теоретические аспекты моделей инноваций и их внедрение в современное медицинское образование. Автор делает акцент на первой модели инноваций, предложенной Дж. Шумпетером в первой половине ХХ века. Эта модель связана с так называемой «триадой» инновационного процесса: изобретение, инновация, распространение. Кроме того, в этом контексте*

*Дж. Шумпетер описал концепцию «творческого разрушения». На протяжении последней четверти XX века существовали такие модели инноваций, как модель индуцированных инноваций, эволюционные модели и модели, которые описывают путь инноваций. Конец XX века ознаменовал развитие модели национальных инновационных систем и модели технологических инновационных систем.*

**Ключевые слова:** *инновации, модели инноваций, инновационный процесс, инновационная деятельность, линейная модель инноваций, модель индуцированных инноваций, эволюционные модели, модель национальных инновационных систем, модель технологических инновационных систем, медицинское образование.*

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## **ЕПІСТЕМОЛОГІЯ ЯВИЩА «ТРАНСГЕНДЕР» У СУЧАСНОМУ ОЛІМПІЙСЬКОМУ СПОРТІ**

*Мета статті – вивчити питання онтології трансгендеру в сучасному олімпійському спорті та напрями вирішення зазначеної проблеми. Методи дослідження – аналіз, порівняння й узагальнення історичної інформації та її систематизація відповідно до діалектики розвитку зазначеної проблеми. У статті показано, що Міжнародний Олімпійський Комітет вирішив очистити сучасний олімпійський спорт від цього ганебного явища, адже мирні олімпійські суперництва – це демонстрація індивідуальних якостей спортсмена, а не суперництво сучасних надбань медицини і фармакології. Ця боротьба продемонструвала принципову позицію МОК до спортсменів, команд та національних збірних, які заради високих спортивних результатів, у підготовці до офіційних змагань, використовували заборонені фармакологічні препарати, здійснювали заборонені маніпуляції з допінг-пробами тощо, та відсторонення зазначених суб'єктів від участі в Олімпійських іграх 2021 року. Автори статті спробували дослідити діалектику явища «трансгендер» у сучасному олімпійському спорті й визначити аспекти політики МОК щодо допуску атлетів-трансгендерів до участі в літніх Олімпійських іграх 2021 року.*

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