Svitlana PIATYSOTSKA[a]
https://orcid.org/0000-0002-2246-1444

Leonid PODRIGALO[b]
https://orcid.org/0000-0002-7893-524X

Oleh OLKHOVYI[c]
https://orcid.org/0000-0002-5223-5229

Andrii YEFREMENKO[d]
https://orcid.org/0000-0003-0924-0281

Volodymyr ASHANIN[e]
https://orcid.org/0000-0002-4705-9339

Priority areas of scientific research in the field of esports: an analytical review based on publications in the scientometric database

[a] Assistant Professor, PhD, Department of Computer Science and Biomechanics, Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine; e-mail: piatsvit25@gmail.com (corresponding author)

[b] Doctor of Science (Medicine), Professor, Department of medical and biological foundations of sport and physical culture, Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

[c] Doctor of Science, Professor, Department of Theory and Methods of Physical Education, Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine; e-mail: olkhovoleh@gmail.com

[d] Assistant Professor, PhD, Department of Athletics, Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

[e] Assistant Professor, PhD, Department of Computer Science and Biomechanics, Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine

Priorytetowe kierunki badań naukowych w obszarze e-sportu: przegląd analityczny na podstawie materiałów publikacji w naukowych i metrycznych bazach danych

Streszczenie

Cybersport jest złożonym, wieloskładnikowym zjawiskiem, o czym świadczy obecność dużej liczby prac naukowych z różnych obszarów tematycznych. Celem artykułu jest analityczna analiza publikacji poświęconych e-sportowi w bazach bibliometrycznych Scopus oraz ustalenie priorytetowych kierunków badań naukowych w tej dziedzinie (w okresie od 2005 do 2022 roku). Zastosowaliśmy bibliometryczne metody przetwarzania otrzymanych informacji w kontekście e-sportu. Wykorzystano program VOSviewer 1.6.18. Skonstruowane mapy bibliometryczne pozwoliły określić wiodące obszary tematyczne badań, najpopularniejsze obszary badań w tej dziedzinie: fenomen e-sportu jako fenomen wieloaspektowy, proces uczenia się i treningu w e-sporcie, poprawa jakości grania i zwiększanie wydolności fizycznej dla pomyślnego udziału w zawodach, problemy zdrowotne zawodników i e-sportowców, przygotowanie fizyczne e-sportowców, badanie wpływu gier komputerowych wykorzystywanych w trakcie zajęć na zdolności psychomotoryczne człowieka, charakterystyka aktywności e-sportowej ze względu na płeć i wiek, sieci społecznościowe i media pełniące funkcje komunikacyjne i informacyjne, psychologiczne aspekty e-sportu.

Podkreśla się niedostatek badań poświęconych specyfice budowania procesu treningowego z e-sportowcami, problematyce przewidywania sukcesu w e-sporcie, określania cech zawodowych ważnych dla zawodników, badania wpływu obciążeń treningowych i startowych na stan funkcjonalny sportowców e-sportowych.

Słowa kluczowe: e-sport, gry video, mapy bibliometryczne, VOSviewer.

Abstract

Esports is a complex multi-component phenomenon, which is confirmed by the presence of a large number of scientific works devoted to various subject areas. The purpose of the article is an analytical analysis of publications devoted to esports in the Scopus bibliometric database and the establishment of priority scientific research areas in this field (for the period from 2005 to 2022). We used bibliometric methods for processing the information received in the context of esports with the program VOSviewer 1.6.18. The constructed bibliometric maps made it possible to identify the leading thematic research areas, i.e. the most popular areas of research in this field: the phenomenon of esports as a multi-faceted phenomenon, the process of learning and training in esports, increasing gaming and physical performance for successful participation in competitions, health problems of players and esportspeople, physical training of esportspeople, study of the influence of computer games on human psychomotor abilities, gender and age characteristics of esports activities, psychological aspects of esports.

There is lack of research on the specifics of building a training process with esportspeople, the issue of predicting success in e-sports, definition of professionally important qualities for players, study of the influence of training and competitive loads on the functional state of esports participants.

Keywords: esports, video games, bibliometric mapping, VOSviewer.

Introduction

The rapid development of multimedia technologies and their growing availability for various contingents, in particular children and adolescents, lead to the emergence of new popular forms of human activity associated with the constant use of multimedia applications. The use of mobile phones, computers, tablets, TVs, DVD players and game consoles is associated with many applications – from professional to consumer and entertainment ones. At the same time, it cannot be denied that the intensification of technological progress has a significant impact on the physical and mental health of the population (Podrigalo et al., 2020). Video games are a separate phenomenon associated with the spread of computer applications and the global Internet. Those that have a pronounced competitive component, and whose success depends mainly on the skills of the players, subsequently transformed into computer sports or esports.

The term "esports" was first used in a 1999 press release from the Online Gaming Association, defining it as a set of activities in which people participate, exercise and develop mental and physical skills through information or communication technology (Wagner, 2006). More recently, esports has come to be defined as a competitive sport in which gamers use their physical and mental abilities to participate in various games in a virtual electronic environment (International Esports Federation, 2021). The study of the phenomenon of esports and its various facets is becoming more common among scientists around the world, although an academic interest in it and the number of publications about esports have been increasing significantly only since 2016 (Yamanaka et al., 2021). At the same time, it is necessary to distinguish between the concepts of gaming and esports, where the fundamental difference lies in the ultimate goal of the activity. The gamer is trying to get the most out of the game process, and the esports player is trying to win the competition with a reward. However, a common feature of these two activities is that players spend a large amount of time on the game, although their reasons and motives differ significantly.

Scientists note that the rapid development of esports is accompanied by a number of prerequisites. One of the most important factors in the promotion of esports is the development and dissemination of technology around the world. This led to the emergence of new, more advanced computer games and gave impetus to the mass enthusiasm for them among young people (Shynkaruk et al., 2018; Heere, 2018).

Since esports is a multi-faceted phenomenon in its specificity, the works on its research are conducted in various subject areas, namely management, physical and mental well-being, productivity, psychology, legal regulations pertaining to the activities of esports players, etc. A separate direction is treating esports activities like a separate sports discipline. This requires the study of factors and

indicators that determine the effectiveness of this competitive activity, training programs and methods for improving the players' performance. At the same time, this is associated with certain risk factors for the physical and mental health of esports players, which also occupies an important place in modern research (Xie Y, et al., 2022).

The constantly growing number of scientific studies in this area requires a balanced approach to their analysis in order to systematize and identify promising areas. Some authors have begun work on identifying and creating a list of areas for studying the phenomenon of esports by the world's leading scientists. In particular, (Yamanaka et al., 2021), whose work was carried out in June 2021, conducted a bibliometric analysis using the SciMAT software based on the materials of the Web of Science scientometric database for the keywords eSport and electronic sport. The authors selected 246 articles about eSports for the period from 2006 to 2020 and established the statistical information on these works, namely: the categories of the database which comprise the majority of articles, the journals containing the largest number of articles on this topic, the most cited articles and authors from the given field of their research. However, the content of the found publications has not been analyzed in detail and the priority directions of publications have not been determined. It should be noted that the SciMAT software is significantly inferior to the VOSviewer program in terms of the range of functionality.

The study (Cranmer et al., 2021) proposes an esports matrix representing three different areas of esports: representation of current physical sports (digitalization of sports), a traditional gaming experience (computer games as competitions, multiplayer), and esports using new technologies such as virtual and augmented reality (immersive reality sports). The esports matrix was developed based on the industry's experience, which confirmed its suitability and relevance to deepen its conceptual and empirical understanding and, more importantly, would contribute to a more structured approach to exploring the potential of esports.

A systematic review (Xie Y et al., 2022) provides an estimate of the prevalence of musculoskeletal risk factors associated with the use of mobile handheld devices. Searches were made in Pubmed, Medline, Web of Science, CINAHL and Embase. The review shows that the prevalence of musculoskeletal complaints among mobile device users ranges from 1.0 to 67.8%, while neck complaints have a high prevalence ranging from 17.3 to 67.8%. This study also finds some evidence that neck flexion, frequency of phone calls, texting, and gaming are associated with musculoskeletal complaints among mobile device users. Evidence is inconclusive for other risk factors, such as duration of use and methods of human interaction with the device, due to conflicting results or limited research.

Kelly, S., & Leung, J. (Kelly & Leung, 2021). conducted a meta-review based on 10 reviews that reported any health effects (physical, lifestyle, cognitive,

mental, or social) of esports, online competition, or participation in video games for both the player and the viewer. While past reviews have explored the impact of video games on health, few have focused on the newly developed context of gaming, including both playing and streaming, recognition as a professional sport, and potential careers for gamers. Most of the preliminary reviews have focused on the impact of video games on the physical health of adolescents and young adults, but none of them has explored the impact of different forms of gaming participation in the new gaming era and their potential differential impact on health.

A separate area of research in the field of esports is the search for effective ways to develop the esports ecosystem and bring it into the framework of the traditional system for other sports. Murray et al. (Murray et al. 2022) in their article state that there is currently no collective diplomatic strategy in place to counter existing problems in the esports industry, or to assist in realising any core policy objectives for the common good. However, if esports is to be successful, sustainable and beneficial for society, then a new way of harnessing its power – in the form of esports diplomacy – should be adopted. As the authors note, its application could produce reciprocal outcomes and turn esports from a threat into an opportunity.

However, in the identified works, articles from one scientometric database or databases of a separate thematic area were mainly analyzed, which significantly reduces their number. The proposed criteria for dividing the esports sector into separate areas need to be expanded, also taking into account current trends in recent scientific publications. This is what determined the relevance of the chosen direction of work, the purpose of which was the analytical analysis of publications devoted to esports in the Scopus bibliometric database and the establishment of priority scientific directions in this area.

Methods

To identify the leaders in research on the problems of our study, we used bibliometric methods (He Q., 1999, Smith LC, 1981) for processing the information received in the context of esports. To do this, we used VOSviewer 1.6.18, a software tool for building and visualizing bibliometric networks. (VOSviewer version 1.6.18., 2021). The most important for the study was the implementation of the method of keyword analysis (He Q., 1999) and direct citation (Smith LC, 1981). The most frequently cited references were used to identify promising areas of research in this category. Moreover, we also used distance-based bibliometric maps, in case of which the distance between two elements reflects the

strength of the relationship between the elements. The smallest distance usually indicates a stronger connection.

The search for literature sources was carried out in the bibliometric database Scopus (for the period from 2005 to 2022) using the keywords: esport*, cybersport*, electronic sport*.

As of 10/01/2022, 1010 articles were found in the Scopus database in the following thematic areas (number of publications): Computer Science (336), Medicine (287), Social Sciences (261), Health Professions Business (252), Management and Accounting (128), Psychology (119), Engineering (106), Arts and Humanities (78), Mathematics (54), Decision Sciences (38).

The most popular categories of publications were determined by quantitative index as well as authors and journals with the largest number of publications on the subject under study in the database (Table 1).

Table 1

Results analysis table for Scopus categories, autors and countries fields

Scopus (N=1010)
TOP-10 categories by number of publications, n; percentage of the total number of publications
Computer Science (336), Medicine (287), Social Sciences (261), Health Professions Business (252), Management and Accounting (128), Psychology (119), Engineering (106), Arts and Humanities (78), Mathematics (54), Decision Sciences (38).
TOP-10 authors by number of publications, n
Drachen, A. (15), Burnaev, E. (14), Hamari, J. (14), Somov, A. (14), Macey, J. (11), Campbell, M.J. (10), Toth, A.J. (10), Block, F. (9) Demediuk, S. (9), Byon, K.K. (8)
TOP-10 journals by number of publications, n
Apunts Medicina De L Esport (165), Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics (26), Frontiers In Psychology (26), Conference On Human Factors In Computing Systems Proceedings (21), Lecture Notes In Networks And Systems (21), ACM International Conference Proceeding Series (14), Ceur Workshop Proceedings (14), International Journal Of Environmental Research And Public Health (14), Computers In Human Behavior (13), Frontiers In Sports And Active Living (12)
TOP-10 countries/regions by number of publications, n
United States (230), Spain (193), Australia (78), United Kingdom (76), Germany (73), Russian Federation (48), Canada (38), Finland (36), China (30), Japan (29)

According to the total indicator of the number of works defined in the country/region, the largest number of them belongs to the USA (230), Spain (193) and Australia (78) (Figure 1).
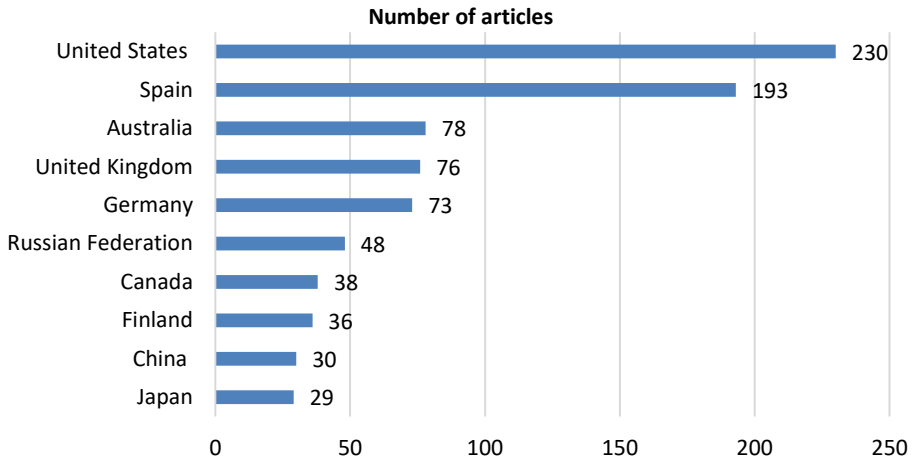
Number of articles

United States	230
Spain	193
Australia	78
United Kingdom	76
Germany	73
Russian Federation	48
Canada	38
Finland	36
China	30
Japan	29

Figure 1
TOP-10 countries/regions by number of publications, n

Results

Analyzing the number of publications by year of publication, it was found that interest in esports is constantly increasing. The periods 2005–2013, 2014–2015 are highlighted separately due to a relatively small number of publications currently available. Since 2018, the number of publications in the database we have studied has shown a steady upward trend (Figure 2).
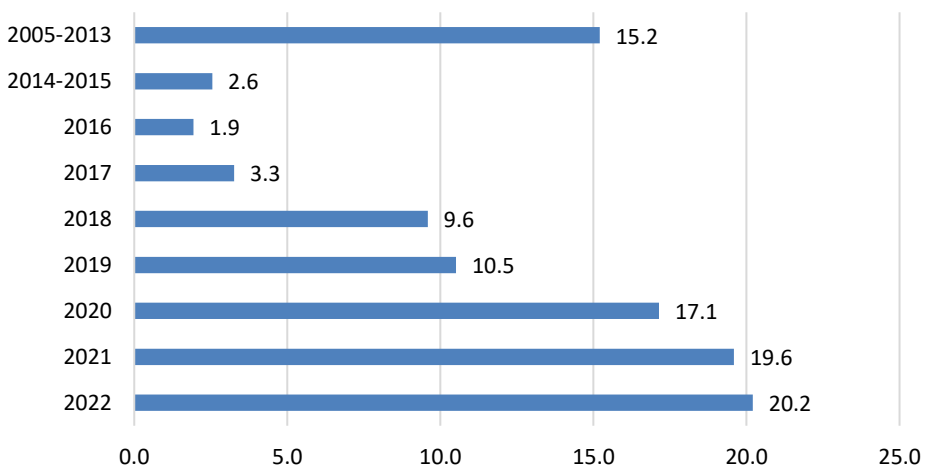
2005-2013	15.2
2014-2015	2.6
2016	1.9
2017	3.3
2018	9.6
2019	10.5
2020	17.1
2021	19.6
2022	20.2

Figure 2
Number of publications (%) on the keywords "e-sports", "cybersport" from 2005 to 2022, in the Scopus database

The analysis carried out allowed us to create the corresponding visualization maps. Network visualization of the results obtained from the Scopus database is shown in Figure 3.
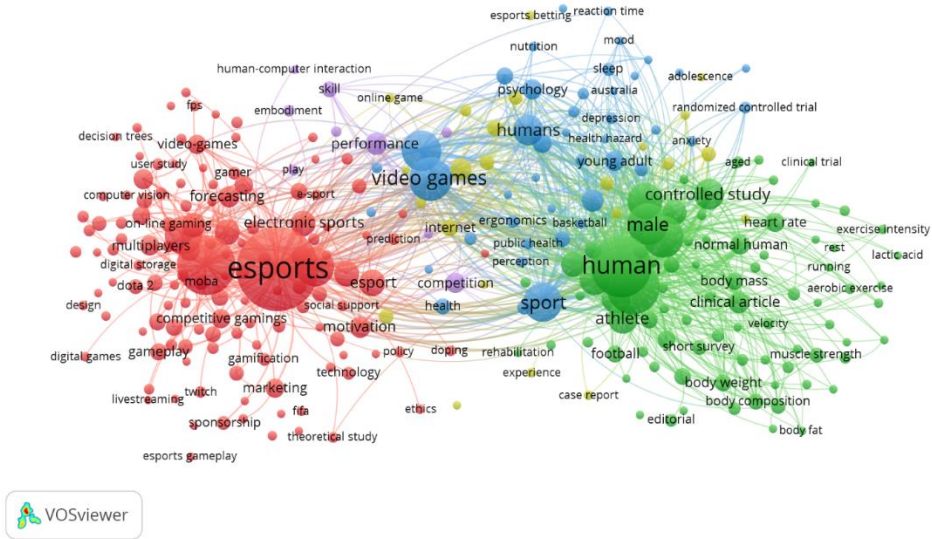

Figure 3
Main keywords in publications on the subject of esports. Source: Own research based on data obtained from the Scopus database (10/01/2022)

The network is based on 259 elements – keywords. They are grouped into 5 clusters. The size of the keywords corresponds to the number of links received, and the spatial proximity reflects the strength of the relationship between subjects. According to Figure 2, the most popular studies can be identified. They are centered around the keywords "esports", "human", "video games", "sport", "controlled study", "electronic sport", "performance", "psychology".

The first cluster is the largest, contains 131 keywords and is marked in red on the map. The cluster received the code name "esports" for the most significant keyword. This keyword is characterized by the presence of 239 links with other map words. The keywords of the cluster publications are centered around the very concept of "esports" with variants of its name such as "esports" (184), "electronic sport" (112), "video games", "gaming" (109), "e-sport" (93), "computer games" (87), "video gaming" (81), "online gaming" (60), which indicates a significant number of publications devoted to the study of the very phenomenon of cybersport as a phenomenon examined from various angles, i.e. sports, social, economic, legal, psychological. Also, the keywords sports (167) and human computer interaction (148) have a significant weight in this cluster, which

can also be associated with consideration of human-computer interaction in the context of sports activities.

The second cluster contains 83 elements, the keyword "human" has the highest weight – 224, it is marked in green on the map. The most important keywords in this cluster are "male" (199), "female" (191), "athlete" (163), "controlled study" (161), "human experiment" (154), "physical activity" (139), "exercise" (118), "risk factor" (98), "training" (91). The cluster contains publications on the subject of targeted education and training in eSports, focuses on gender issues as well as athletes' and players' physical activity as a method of combating risk factors for their health.

The third cluster is formed around the keyword "video game" (198), it is marked in blue on the map and contains 43 elements. The keywords with the highest weight are "sport" (173), "adolescent" (128), "young adult" (125), "mental health" (102), "psychology" (101), "cognition" (87), "child" (79), "public health" (71), "sedentary behavior" (68), "health" (67). This cluster contains works devoted to the age characteristics of players in esports, issues of physical and mental health of both an individual and the population as a whole. Also, a significant number of publications are devoted to the psychological aspects of esports activities.

In the fourth cluster, the keyword "Internet" (91) has the highest weight, it is marked in yellow on the map and contains 23 elements. The following keywords have the highest weight in this cluster: "game addiction" (78), "cross-sectional study" (77), "gambling" (74), "addiction" (71), "behavior, addictive" (64), "prevalence" (63), "epidemiology" (62), "online game" (62), "social interaction" (54), "experience" (42), "gaming disorder" (42). These keywords clearly indicate that the publications are devoted to the study of various kinds of addictions and the negative impact of video and gambling on the behavior and socialization of people of all ages caused by interaction with gaming products on the Internet.

The fifth cluster is marked in purple on the map and contains 9 elements. It includes such keywords as "performance" (106), "competition" (105), "skill" (66), "emotion" (58), "motor performance" (41), "human-computer interaction" (30), "videogames" (21), "play" (19), "embodiment" (11). The publications included in this cluster are focused on the problem of achievements, increasing gaming and physical performance for successful participation in competitions.

Discussion

An analytical review of literary sources is the most important component of scientific research. It allows you to identify priority areas for the topic under consideration, to find out the main connections between its chief components.

The use of bibliometric methods for processing the received information takes such an analysis to a qualitatively new level (He Q., 1999; Smith LC, 1981). This is due to the possibility of creating and visualizing bibliometric networks. This is exactly what VOSviewer 1.6.18 is used for – a software tool for building and visualizing such networks (VOSviewer version 1.6.18., 2021). The legitimacy and effectiveness of using this program have been proven in the analysis of priority scientific areas in the study of sports dances (Podrihalo O. et al., 2022), kickboxing (Podrigalo L. et al., 2022), the use of physical rights and physical activity in patients with Alzheimer's disease (Iermakov et al., 2022) and NPP operation safety analysis (Khakymova et al., 2020).

The scientometric database Scopus was chosen due to the fact that it is one of the most authoritative tools in the scientific world. This significantly improves the quality of the information on the analyzed articles.

The analysis of articles from three scientometric databases made it possible to identify the most popular and promising areas of research in the field of esports. Articles from the categories "Sport Sciences", "Hospitality Leisure Sport Tourism", "Communication", "Psychology Multidisciplinary" were of the greatest interest to our study. According to clustering data, they can be divided into certain groups: 1) the study of the phenomenon of esports as a multi-faceted phenomenon; 2) the process of learning and training in esports, increasing gaming and physical performance for successful participation in competitions; 3) health problems of players and esportsmen; 4) physical training of esportsmen; 5) study of the influence of computer games on one's psychomotor abilities; 6) gender and age characteristics of esports activities; 7) social networks and media performing a communication and information function; 8) psychological aspects of esports.

Study of the esports phenomenon as a multi-faceted phenomenon

An analysis of the keywords that had the highest weight in search queries in all three scientometric databases indicates a variety of options for the existence of the very concept of "esports" or "e-sport", namely "video games", "electronic sport", "computer games", "online gaming". At the same time, in a number of cases, scientists regard the esports and competitive aspect of esports as an object of study, and players as athletes. Another category of research concerns the study of social, psychological, and economic characteristics of activities performed by the players who devote a significant part of their time to gaming activities with different motivations: pleasure, communication, financial rewards, etc., but are not members of any professional esports society. Also, at the same time, the concepts of an esports athlete and a gamer are formulated and justified as fundamentally different categories, since for esports athletes esports is

a professional activity, and gamers are positioned as amateur, not professional players. The proof of this statement is the work that studies the changes in physiological parameters of esports athletes and amateur players (Zimmer et al., 2022).

Cranmer et al. (Cranmer et al., 2022) proposed an esports matrix of four different areas that distinguish esports: esports as a representation of current physical sports (sports digitalization), esports as a traditional (multiplayer) gaming experience (competitive multiplayer), computer changing existing sports, rules and player customization through digital augmentations (enhanced digital sports), as well as new types of esports using new technologies such as virtual and augmented reality (immersive sports). The esports matrix has been developed on the basis of industry experience to validate its suitability and relevance to improve its conceptual and empirical understanding and, importantly, to promote a more structured approach to enable businesses to realize the potential of esports.

A significant amount of research, especially from the earlier period, focused on the issue of the legitimacy of classifying the video game player activity as a sports category (Adamus, 2012; Hilvoorde, 2022; Jenny et al., 2017; Hallmann & Giel, 2018). The work of Pase et al., Pack & Hedlund (Pase, 2020; Pack & Hedlund, 2020) analyzes the possibilities and legitimacy of including esports in the program of the Olympic Games.

The authors propose to classify games according to the features of game mechanics, genres, methods of interaction between players and their number, while highlighting those that meet the requirements of esports – the competitive component, the dependence of the result on the skills and abilities of the players, the minimum amount of randomness in the competition process (Imas, 2021).

This category includes articles devoted to the historical processes of development and formation of esports, both in general and individual game genres and products (Adamus, 2012; Hamari & Sjöblom, 2017).

While digital games provide a very compelling experience, the nature of this interaction is not clear enough. A descriptive review (Connolly et al., 2012) explores aspects related to digital game engagement. A number of studies have been identified that have examined various aspects of game involvement, including subjective experience while playing, physiological concomitant experiences, motives for playing, game use and time spent playing, and the impact of playing on life satisfaction. A study of work over the past 10 years has revealed the complex, multifactorial nature of participation in digital entertainment games. The range of games and gaming platforms available is ever-expanding, and like many other enjoyable activities, gaming can easily backfire as attraction becomes habitual or even addictive. The authors urge to maintain a delicate balance between positive and negative experiences, emotions and motives for attracting players to games.

In their article, Murray et al. (Murray et al. 2022) introduced and built the term 'esports diplomacy', its definition and benefits. Esports diplomacy can be defined as conscious, strategic and regular use of diplomatic techniques, skills and functions to inform and create a favourable image among the general public, states, and organisations so as to shape their perceptions in a way that is (more) conducive to the esports industry's desired goals. According to the authors, the use of such an approach will help to deal with such negative aspects of esports as illegitimacy, breaches of integrity, lack of diversity, cheating, corruption, and the encroachment of more powerful players into the esports realm.

Process of learning and training in esports, increasing game and physical productivity for successful participation in competitions

Research on ways to improve the gaming skills and efficiency of esports players leads to the need of studying the factors that determine them. These factors include primarily psychomotor abilities, cognitive functions, sensorimotor reactions of players. Researchers argue that there is a connection between individual manifestations of these abilities and the ability to solve game problems with maximum speed and efficiency.

Previous research has shown that experienced video game players outperform amateurs in a variety of cognitive and perceptual tasks, including visual selective attention (Green & Bavelier, 2003, 2006; Dye et al., 2009; Spence & Feng, 2012; Leg; Belchior et al. , 2013; Achtman et al., 2008), visual search performance (Castel et al., 2005), contrast sensitivity (Lee & Schoenstedt, 2011) (Green et al., 2010), cognitive flexibility (Colzato et al. 2006, 2010; Leigh & Clark, 2023), visual short-term memory (Boot et al. Bavelier, 2006; Spencer-Smith & Klingberg, 2017) and multisensory integration (Di Luzio et al., 2021).

Esports players must anticipate the opponent's stimulus and respond to it as quickly and accurately as possible by manipulating the human-computer interface. Developed perceptual-motor abilities are essential for success in esports, since successful keyboard and mouse control is one of the most important winning factors (Piatysotska et.al., 2023). Playing computer games requires higher skills in perception, attention, cognitive functions and fine motor skills (Pluss et al., 2020).

According to the authors (Toth et al., 2021), among many perceptual-motor skills, waiting time, eye-hand coordination and peripheral perception (field of vision) are of crucial importance for e-sportsmen. Since esports requires more precise and faster movements, professional players often spend significant time training and competing in order to get the best results. Studies have shown that perceptual-motor skills can be improved through experience and practice, which is proportional to the time spent on purposeful practice (Toth et al., 2021; Dylan R Poulus et al., 2022).

The study (Kim H. et al., 2022) was aimed at exploring the differences between professional and amateur esports athletes in perceptual-motor abilities. In particular, perceptual-motor skills were assessed in relation to waiting time, eye-hand coordination and peripheral perception, which are closely related to the results of esports. Professional esports players demonstrated better latency and peripheral perception (wider field of view in degrees) than amateurs.

A study by Kim & Thomas (Kim & Thomas, 2015) found that professional esports athletes practice at least 10 hours a day, including game plans, strategy, and individual performances. In addition to training cognitive skills, physical demands should not be underestimated (Railsback & Caporusso, 2019).

In their study, Neri et al. (Neri et al., 2021) determined that video games can have a beneficial effect on cognitive functioning and demonstrated how a personalized/adaptive first-person shooter (FPS) experience can greatly accelerate the learning process of video game players. The authors also present a training program to improve shooting skills in CS:GO, expanding the understanding of the means and methods of sports training in esports.

The scientists' attention is also attracted by technical equipment in esports. In their research, Conroy et al. (Conroy et al., 2021) studied the impact of changing the characteristics of esports equipment on the performance of players. It has been found that, in combination, using a lighter mouse with lower sensitivity can improve in-game target acquisition performance.

A study by Pradhan & Abdourazakou (Pradhan & Abdourazakou, 2020) aimed to create a power rating model for seasonal performance in the popular MOBA video game, Dota 2. The hybrid analysis results are consistent with other forms of performance evaluation such as Elo and Glicko ratings. Regarding the best teams, the proposed rating system allows to more accurately reflect the actual situation in the season compared to other methods.

In their study, Pluss et. al. (Pluss et al., 2022) found differences in the training behavior of professional and semi-professional esportsmen in Counter-Strike: Global Offensive (males aged 23,76±2,88 years). Professional and semi-professional esportsmen performed on average 30,9±8,2 and 24,7±3,6 hours of general game practice per week, respectively, 19,6±6,9 and 15,0±2,7 hours of competitive practice, respectively. In particular, professional esportsmen trained 6,6 (SE=2,2) hours more per week than semi-professional players, out of which 4,8 (SE=1,8) hours were spent on competition practice.

Seya & Shinoda (Seya & Shinoda, 2016) investigated the effects of first-person shooter (FPS) experience and training on cognitive performance. Participants completed tasks to determine the useful field of view (UFOV), working visual memory (VWM), and reaction time (RT). The experiment showed that FPS players performed better in all cognitive tasks than players of other genres. The

results obtained indicate that FPS play experience and/or training can improve cognitive performance for at least UFOV, VMW and RT.

Physical preparation of esportsmen

The content of esportsmen's physical readiness is determined by the nature of their training and competitive activities. During the competition, the athlete is in a forced sitting position, and purposeful motor actions are performed only with the fingers of the hand. A long stay in a sitting position requires the development of general endurance and static strength endurance of the muscles of the back and neck, as well as coordination abilities, which act as an integrating element. Controlling a virtual object (game character) with the help of a keyboard and a computer mouse requires the manifestation of accuracy of movements and speed of decision-making. Effective interaction with the keyboard and mouse is achieved due to the formed motor memory, proprioceptive and muscle sensitivity, accuracy of movements (Toth et. al., 2021).

Forced posture is characteristic of all cyberdisciplines, yet the optimal degree of development of reaction speed, motor memory, proprioceptive and muscle sensitivity may not be needed in some cyberdisciplines (Schary et al., 2022). For example, in Hearthstone: Heroes of Warcraft the control of the game is carried out mainly with the mouse at a low speed of the gameplay. In the Counter-Strike: Global Offensive discipline, on the contrary, the requirements for speed and accuracy of movements are very high. Therefore, the development of general and static strength endurance is the basis of general physical training (GPT), and the development of reaction speed, movement accuracy, motor memory, proprioceptive and muscle sensitivity, movement accuracy – special physical training (SPT) (Baumann et. al., 2022).

Separate studies provide a body of empirical data on the training routines of elite esports athletes, with a particular focus on their physical performance. Kari & Karhulahti (Kari & Karhulahti, 2014, 2016) present a study of the training system of elite esports athletes, with a particular focus on exercise programs. The study is based on a sample of 115 elite esports players. According to the survey data, esports athletes train approximately 5.28 hours daily throughout the year at a high level. Approximately 1.08 hours of this workout is exercise. Over half (55.6%) of elite esports athletes believe that integrating exercise into their training programs has a positive impact on esports performance, however, at least 47% of elite esports athletes engage in physical activity primarily to maintain overall health. Accordingly, the study indicates that elite esports athletes are also active athletes, individuals aged 18 and over who exercise almost three times as much as the daily recommendation of 21 minutes of activity provided by the World Health Organization.

The only work in the aforesaid area comes from the research by Hebbel-Seeger (Hebbel-Seeger, 2012). He cites a study by the esports organization ESL (Electronic Sports League), which apparently released an unpublished German thesis written by Luttmann in 2007. According to Hebbel-Seeger's study (Hebbel-Seeger, 2012), it is found that esports players are more active than the average population, and at least 95% of them are also involved in traditional sports.

The work by Emara (Emara et al., 2020) proposes a three-pronged framework for sports medicine professionals and coaches to provide a holistic approach to caring for an esports player. This esports framework includes awareness and management of common musculoskeletal and health hazards, health promotion opportunities, and recommendations for optimizing performance.

Esports has a huge potential for the development of physical activity programs and health promotion efforts. Ketelhut et al. (Ketelhut et al., 2021) presented the potential of esports to increase the physical activity, health and well-being of gamers and esports players, strategic and preventive solutions to mitigate possible adverse health effects of esports, the use of esports technologies (platforms, exergames, etc.) as an innovative health promotion tool, especially attracting gamers and esports players with engaging and interactive activities.

Study of the influence of computer games on the psychomotor abilities of a person

Computerized virtual reality scenarios are created in the context of training in various professional areas, such as airline pilots using flight simulators that reproduce real scenarios (Haslbeck et al., 2014), drones, or virtual training for surgeons (Carbone & Thomas, 2018). In this context, personalization of an exercise regimen tailored to the individual is critical and can be used to enhance specific cognitive performance in both healthy individuals and patients, with favorable outcomes in daily life (Klingberg et al., 2005; Jaeggi et al., 2008; Shinaver et al., 2014; Spencer-Smith and Klingberg, 2017).

In Stark et al. (Stark et al., 2021) it has been proven that at least some classes of games can improve memory function. In particular, playing immersive 3D games that provide a rich experience and novelty improves memory in hippocampal-dependent tasks. The study was conducted with the participation of middle-aged adults using the game Minecraft.

Carbone & Thomas present studies of the psychomotor skills of esports players with differentiation according to the way they interact with the computer interface and input means (mouse, keyboard or joystick). Analog controller use has been found to be highly correlated with gamers' developing psychomotor skills, indicating that repeating gameplay with analog controllers develops psychomotor skills to a greater extent than the same game time with a mouse/key-

board. A set of methods has been proposed for determining the visual-motor reaction time, tremor, keystroke frequency, measuring hand coordination using the Purdue Pegboard and Grooved Pegboard methods (Carbone & Thomas, 2018).

Carbone et al. (Carbone et al., 2016) found that the hand position when using a game controller is the same as during laparoscopic surgery, suggesting that experienced gamers may have psychomotor skills easily transferable to those of laparoscopic surgery. Robotic laparoscopic surgery involves a computer-controlled mechanical device that manipulates laparoscopic instruments. Unlike traditional laparoscopic surgery, the surgeon controls the robot and the robot manipulates the instruments. This is advantageous because the articulation possible with a mechanical robot is far superior to that of a human surgeon, resulting in finer and finer motion control. In particular, the thumb and forefinger of each hand are often used by the interaction control participant in both interface paradigms. Greater dexterity in the movements of these particular fingers gained through play may lead to an increased initial ability to successfully use the robotic laparoscopic interface. D. Stefanidis et al. showed that gross psychomotor skills account for the rate at which new surgeons acquire laparoscopic skills (Stefanidis et al., 2006). Miskry has shown that performance in the racing game Diddy Donkey Kong Racing on the Nintendo64 game console is highly correlated with performance in time trials on the Laparoscopic Skills Station (Miskry et al., 2002).

Previous research (Green & Bavelier, 2003, 2012) shows that action video games improve attentional resources, allowing gamers to better distribute their attention both in space and in time. To further characterize the plastic changes resulting from playing these video games, the authors (Dye et al., 2009) performed an Attention Network Test (ANT) on action game players and non-gamers. Its findings suggest that action video game players of all ages have improved attention skills, allowing them to respond to targets more quickly.

In the work of Green et al. (Green et al., 2010) action games have been shown to improve behavioral performance in a wide range of perceptual tasks, from those that require efficient allocation of attentional resources across a visual scene to those that require successful identification of fleeting stimuli. Importantly, these effects have not only been shown in experienced video game players, but a causal relationship has been established between playing video games and improved information processing through learning.

Understanding the neurological changes that occur as experiences develop is a central theme in both cognitive psychology and cognitive neuroscience. The authors (Campbell et al., 2018) argue that video games, despite previous misconceptions, are an excellent model environment allowing us to explore the development of neurocognitive experience., In their opinion, the area of esports is particularly relevant as it covers video / computer games at a competitive and

increasingly professional level. The sheer scale of participation, controlled environments, structured skill rankings, pervasive social nature, and large databases make esports a potentially very fertile research field to improve our understanding of the new era of athlete cognition.

Based on the results of the analysis of scientific sources, it was found that as far as the formation of psychomotor skills is concerned, scientists note a predominantly positive aspect of interaction with computer gaming devices. The negative consequences of such interaction are mainly in the medical and hygienic aspects associated with insufficient physical activity of esports activities, as well as the harmful effects of computer devices, especially with the systematic violation of the ergonomic conditions for their use. The negative consequences of esports activity are presented in the following subsection "Health problems of players and esportsmen".

Health problems of players and esportsmen

At a professional level, esports has been proven to have a high potential for stress and is sometimes considered equivalent to traditional sports. While traditional sports promote health through muscle activity and increased energy expenditure, esports can be a purely sedentary activity that can have potentially harmful consequences if practiced regularly.

A significant number of works are devoted to the problem of health maintenance and prevention. The researchers note that, according to the specifics of their professional activities, esportsmen and gamers share similar categories of health risks with people whose professional activities are associated with long-term work at the computer.

The following main categories of diseases and injuries are distinguished (Emara et al., 2020): musculoskeletal pain in the back, neck, upper limbs, headache, cardiovascular diseases (Zimmer et al., 2022), dry eye syndrome, diseases of the gastrointestinal tract, obesity, chronic inflammatory diseases of the pelvic organs, diseases of the respiratory system, diseases of the veins of the lower extremities. Among professional esportsmen injuries, there are those that are associated with the functioning of the radiocarpal (hand, wrist) and elbow joints – tendinitis, carpal tunnel syndrome, tenosynovitis, de Quervain's tenosinitis and cross syndrome, systematic microtraumas of tendons and ligaments (McGee C & Ho K, 2021). Among various risk factors one can identify physical inactivity, prolonged sitting, irregular meals and / or malnutrition, unventilated rooms and / or air-conditioned rooms, large crowds in a limited area, allergens (plastic, dust), irregular working hours, lack of sleep (Sanz-Milone et al., 2021), psychological and psycho-social factors, incorrect position of the legs when working at a computer ("foot to foot"), bad habits.

A number of occupational factors have been identified as contributing to an increased risk of upper limb tendinopathies, including repetitive or continued bending of the wrist, repeated twisting or absorbing movements, non-neutral wrist positions during work, and repetitive forceful movements (DiFrancisco-Donoghue et. al., 2019; Zwibel et. al., 2019).

Lam et. al. (Lam et al., 2022) analyzed the features of the work of mobile games players, also related to esports disciplines, but having a specific biomechanical structure. They found that the highest rates of symptom prevalence among professional mobile gamers were associated with pain in the neck (40%), fingers (38%), and head (32%), slightly different from those in computer gamers, i.e. neck (42%), back (42%), wrists (36%) and hand (32%) (Yin et al., 2020) and in sedentary office workers, i.e. the lower back (72%) and neck (55,2 %) (Rudolf et. al., 2020). Differences in rates of injury prevalence and localization may be related to the unique work environment and task intensity of mobile esports, which affect the fine tuning of postural control and postural adaptation and thus lead to the development of chronic injuries (Truong et. al., 2020).

In a study by Podrigalo L. et al. (Podrigalo, L. et al., 2020) it was found that excessive communication with computer games leads to endocrine system disorders, increased oxidative stress and the gradual formation of a prenosological state in children and adolescents, which was proven by the results of determining 10 biochemical parameters of saliva. Significant differences were established between the group of active players and children who did not have contact with games as far as DC, catalase activity, concentrations of SH groups, concentrations of glutathione, secretory IgA, adrenaline and serotonin were concerned. The concentration of DC in the group of active players was higher by 75.8%, catalase activity was 2.23 times lower, the concentration of SH groups was reduced by 32%, the concentration of glutathione was reduced by 73%, the level of secretory IgA was 40% lower, whereas the concentration adrenaline 2.3 times higher, and the concentration of serotonin 35.5% higher. Children-gamblers are also characterized by a decrease in nonspecific immunity due to a decrease in the concentration of secretory immunoglobulin A. The results of the study confirmed that a prenosological state of health is gradually forming in the group of active players. Characteristic manifestations of this condition are an imbalance in the LPO-AOS system, gradual depletion and disruption of protective antioxidant mechanisms, a decrease in the level of resistance, and an imbalance in the endocrine system. All these factors significantly reduce the reliability of body functioning and increase its vulnerability to adverse factors.

Influence of computer games on the psychological characteristics of players

A study by Garcia-Lanzo et. al. (García-Lanzo et al., 2020) has shown that competitiveness in esports is associated with different demands/stressors, psy-

chological and physiological stress responses, and the use of different coping strategies.

In their work, Poulus et. al. (Poulus et al., 2022) determined the psychological similarity between professional esportsmen and athletes of traditional sports, mainly team sports. It was found that the players used the same strategies to improve team cohesion, and interpersonal disputes were cited as one of the main problems.

Hong et. al. (Hong et. al., 2022) studied the relationship between satisfaction of basic needs that determine motivation and burnout among esports athletes. The results show that player competence has a negative relationship with self-determined motivation. It has been established that players do not associate an increased level of competence with their motivation. The results show that intrinsic motivation is negatively associated with elevation, especially exhaustion and decreased feelings of accomplishment. It should be noted that a high level of players' competence can lead to a decrease in self-motivation, which can lead to burnout.

An article by Bányai et. al. (Bányai et al., 2019), which is a systematic review, covers the main psychological aspects of esports as well as explores the similarities between esports and professional gambling. The authors singled out eight studies that explored three topics: the process of becoming an esports player, the characteristics of esports athletes such as intelligence, and motivation of esports viewers. These results draw attention to a new area of professional video game research and provide some insight into the psychology of esports athletes. The article also explores the similarities between esports athletes and professional players (and poker players in particular) in terms of the psychological vulnerability of esports athletes.

The basis of training in esports is the development of cognitive and physical skills, which an athlete combines to achieve complex strategic results. According to research, esports contributes to the development of player skills such as teamwork skills, systematic and strategic thinking, skills of orienting in virtual space, adaptation in situations of psychological stress, stress resistance, communication and language competencies.

Along with the problem of psychological dependence on games and their connection with aggression, the specifics of gamers' cognitive sphere are widely studied. Interaction with virtual images during the game involves a wide range of cognitive processes and can affect such cognitive characteristics of gamers as attention, memory, spatial perception, thinking, control and planning (Leis & Lautenbach, 2020).

It should be noted that in relation to the nervous system properties, the researchers did not reveal any similarities between the typological portraits of representatives of esports games and the portraits of representatives of traditional

sports. According to the research of F. Genov, the volitional qualities associated with the participants' performance in different classes of esports games also do not correlate with the leading qualities of athletes. All this points to the highest originality and originality of the considered types of virtual sports, asking for further research on the individual typological features of esports players.

In his work, Bonilla (Bonilla, 2022) studies the key psychological skills that affect the performance of esports players. It has been established that there are three main parameters that structure the players' optimal performance, namely: technical-tactical skills, psychological skills and healthy habits. Among psychological abilities, 8 components were identified: attention control, emotion control, activation control, communication, team cohesion, thought control, goal control and behavior control.

In the course of a study of gaming disorders among esports players as a potential risk of their activity, it was found (Bonkalo et al., 2022) that players who prefer the strategy genre are the least likely to escape from reality and take on a game role to express their emotions through the game, and in general have the lowest level of addiction to games. The risk of computer gaming disorders among esportsmen is largely determined by their sporting achievements, the type of sports activity (individual or team), and the genre of the computer game.

The limitations of this study are related to the fact that the analysis of articles focused on areas related to sports and its manifestations. At the same time, the number of publications found does not allow an analysis of other areas in this article.

Summary

An analytical analysis of publications devoted to esports in the Scopus bibliometric database was carried out. A fairly large number of works devoted to this problem has been selected. The largest number of works belongs to the following headings: Hospitality Leisure Sport Tourism, Sport Sciences, Computer Science, Medicine, Social Sciences, Communication Health Professions Business, Management and Accounting, Psychology Multidisciplinary, Engineering, Arts and Humanities, Law, Mathematics, Decision Sciences. The vast majority of authors come from countries such as the United States, Spain, Australia, United Kingdom, Germany, the Russian Federation, Canada, China, Finland, Japan. Priority scientific directions in this area have been established and they include the phenomenon of e-sports as a multi-faceted phenomenon, the process of learning and training in esports, increasing gaming and physical performance for successful participation in competitions, health problems of players and esportsmen, physical training of esportsmen, study of the influence of playing computer

games on the psychomotor abilities of a person, gender and age characteristics of esports activities, social networks and media that perform a communication and information function, psychological aspects of esports. The analysis made it possible to identify a number of unsolved scientific problems in esports, which include: determination of the training features in esports and optimizing the training process, development of a methodology for predicting performance in esports, determination of professionally important qualities for players, building an esports professiogram, determination of esports players' skill levels according to a set of indicators of gaming efficiency and competitive activity, study of the influence of training and competitive loads on the functional state of esports athletes, study of possible ways of using esports in the training of military specialists in camera work. The very solution of these problems should become a priority scientific direction in further research.

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