Original Article

eSport: a state-of-the-art review based on bibliometric analysis

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Abstract:
Introduction: eSports is a recent phenomenon that has been garnering interest, mostly among young people. At first, electronic games (which today make up eSports) were considered simply a game, a pastime close to the concept of leisure. Given the dizzying growth of this industry and the emergence of championships with a significant audience, however, eSports began to be related to Sports, besides the possible 'sporting' processes present therein. Currently, eSport comprises a set of activities in which people participate, train and develop mental and physical skills through information or communication technologies. Despite this, the impacts of this phenomenon are little explored by scientific literature. **Objective:** This study seeks to develop a co-word analysis of the eSports research field to highlight the topics addressed in the 21st century. **Methods:** This bibliometric research analyzed 246 articles retrieved from the Web of Science (Thomson Reuters, New York, USA) database. Letters, editorials, book reviews, conference abstracts/papers, and news were excluded. Discovery and analysis of the main research topics in eSports was performed using the SciMAT software tool. **Results & Discussion:** Since eSports is a recent phenomenon, the field covers several research topics such as sport, video-game, play, game, motivations and gambling. Academic interest and publications on eSports increased significantly only since 2016, with a significant number of studies within humanities. **Conclusion:** Despite the few studies, eSports is not just a research topic, but an area of knowledge that encompasses several themes from different areas. In fact, it is a modern human phenomenon that uses information or communication technologies.
Keywords: eSports, Bibliometric Analysis, Science Mapping Analysis, electronic sports, e-Sports, video-game, SciMAT, Cybersports.

Introduction

Sport is a global phenomenon, following all the characteristics and changes of our human society (Giddens, 2001). Its practice involves different behaviors, rules, and goals, as well as a variety of contexts and environments. While much has been said on the introduction of technology in sport over the past years on the grounds of inclusion, fairness, or protection of athletes (Caine et al., 2012; Møller, 2015), the 21st century has witnessed how technology in the form of digitalization can also reshape the way sport is practiced in the "traditional" way (Hemphill, 2005, 2014). The indisputable establishment of the so-called eSports as a new social practice renders some enthusiastic views to place this practice as the future (Miah, 2019). Nevertheless, the debate on the boundaries and similarities between sports and eSports remain open.

One of the most debated questions in the last decade is whether eSport is, in fact, a sport. At first, electronic games (which today make up eSports) were considered just a game, a pastime close to the concept of leisure (van Hilvoorde, 2016). Given the dizzying growth of this industry and the emergence of championships with a significant audience, however, eSport began to be related to Sports, besides the possible 'sporting' processes present therein. Currently, eSport comprises a set of activities in which people participate, train and develop mental and physical skills through information or communication technologies (Wagner, 2006). eSports is a recent cultural, social, and economic phenomenon, originating from the technological evolution inherent in today's human society, and which has attracted more organizations (companies, media, sports club, governments) and people (especially an 'younger audience') (Elasri-Ejjaberi et al., 2020) can be reflected by the vertiginous growth of this industry, the emergence of professional competitions, or the significant following audience defy this paradigm from the lens of the 'sporting' processes (Bourdieu, 1989). As a recent research topic, the term eSports is often replaced by or related to the terms cybersports, programming, electronic sports, cyber athletes, cyberathletics, esports, E-sports and competitive games (Martončik, 2015).

eSports' popularity has recently made its communities reconcile with the IOC[1], which shows its acceptance in the future Olympic agendas[2]. After its growth in the pandemic[3], eSport has presented itself as a

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lucrative alternative to traditional sports competitions and their demands. This acknowledged growth has also been followed by the academic literature, which has debated the legitimacy of such incorporation (Edgar, 2019; Hemphill, 2005, 2014; Jonasson & Thiborg, 2010a; Karhulahti, 2017; Thiel & John, 2019; van Hilvoorde, 2016).

The wide range of topics presented in the literature – from the nature of eSports to its moral implications – determines a complex knowledge matrix responsible for legitimizing the activity itself, determining its public and private funding, or declaring the emergence of a new research field (Edgar, 2019; Thiel & John, 2019). But what is being researched and published about eSports? Are the issues involving its comparison with traditional sports or its possible 'sporting' already overcome in academia? This article consists of a systematic review of publications on eSports, electronic sports, or e-Sports since the 21st century, investigating the areas of knowledge have been dedicated to research, study and understand this phenomenon. Such endeavor can help other scholars explore the emerging topics and provide general suggestion for future research based on published results.

Understanding and synthesizing previous research allows for expansion of scientific knowledge. Qualitative review and quantitative analysis approaches can be complemented with the use of scientific mapping methods, based on quantitative analysis and bibliometric methods, thus making the state-of-the-art review more accurate and assertive (Zupic & Čater, 2014). The article contributes to the research on eSport by pointing to emerging topics for exploration, as well as it suggests future research based on published results.

Material & methods

Based on literature analysis, bibliometric mapping is a spatial representation of how fields, disciplines, journals, articles or authors are presented in academia and to society (Small, 1999), used in different research fields to discover its main themes, approaches and gaps (Cobo et al., 2012, 2018; Moral-Munoz et al., 2018; Murgado-Armenteros et al., 2014).

Data collection

This study included per reviewed and published articles retrieved from the Web of Science database. The search was performed on June 27, 2021using the following terms: "eSport*" or "electronic sport*" or "e-sport*." Letters, editorials, book reviews, conference abstracts/papers and news were excluded. Keywords considered meaningless in this context, such as stop-words or words with a too broad and general meaning, e.g., "SPORTS" or "DISPLAY MONITOR", were removed. After checking for duplicates and other possible errors, we reached a total of 246 articles published between 2006 and 2020.

Data analysis

Bibliometric analysis was performed using the SciMAT software. For each research paper, raw data was downloaded from Web of Science as plain text, stored on hard disk and entered into SciMAT to build the knowledge base for the science mapping analysis. To improve data quality, we applied a de-duplicating process (author keywords and the Keywords Plus were used as the unit of analysis). Words representing the same concept were grouped together.

SciMAT is an open source software that integrates several key features designed for science mapping analysis, for it combines mapping tools with performance analysis within its assessment (Cobo, López-Herrera, Herrera-Viedma, et al., 2011). SciMAT was used here to develop a longitudinal conceptual mapping analysis, based on bibliographic co-words networks derived from research topics (Batagelj & Cerinšek, 2013; Michel Callon et al., 2016).

The analysis was carried out in three stages. First, we detected the research topics and established co-words networks according to the corresponding themes and period of time (Callon et al., 2016). A topic/theme keyword clustering, which locates keyword networks that correspond to centers of interest, constitutes the raw data(Coulter et al., 1998). Similarity between keywords was assessed using the equivalence index (M. Callon et al., 1991).

Second, we visualized research themes and thematic networks detected by means of a strategic diagram (Cobo, López-Herrera, Herrera-Vidms, et al., 2011). The instrument consists of two variables that can be characterized by each theme: centrality, which measures the degree of interaction of a network with other networks; and density, which assesses the internal strength of the network (M. Callon et al., 1991).

Finally, we carried out a performance analysis to: a) measure the relative contribution of research topics to the entire research field (quantitatively and qualitatively); and b) establish the most prominent, most productive, and highest-impact subfields. Some of the bibliometric indicators used were: number of publications, number of citations, and different types of h-indexes (Alonso et al., 2009; Hirsch, 2005; Martínez et al., 2013). For each topic, performance measure is computed considering the publications associated with it, so that the h-index is computed using the citations of papers in a given topic. A key point in our analysis concerned the main research, authors, references, topics and authors' references, thus verifying and understanding the current research landscape on eSports.

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[2] Available at: https://www.insidethegames.biz/articles/1104558/ioc-to-encourage-virtual-sports
[3] Available at: https://www.economist.com/international/2020/06/27/the-pandemic-has-accelerated-the-growth-of-e-sports

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Results

This study identified a total of 246 papers on eSports published from 2006 to 2020, averaging 1.5 articles per year. A more in-depth analysis of such period, however, shows a significant increase in publications on this topic (Figure 1).
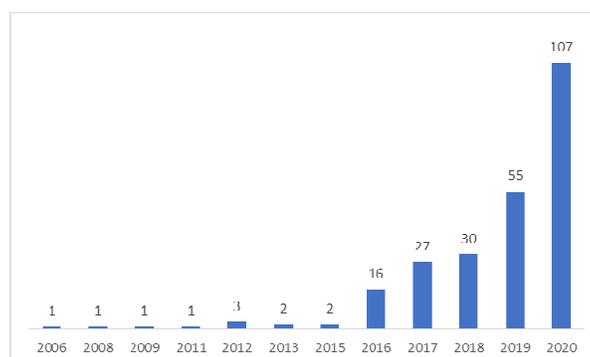

Figure 1. Numbers of articles published per year between 2006-2020

Web of Science (WoS) has its own way of categorizing the subject area of each article published over the entire period. Interestingly, of the 246 articles found, 154 could be classified as humanities-related (Table 1). Importantly, the "Author Categories" column in the table was a classification we created to group the WoS categories into a larger knowledge area.

Table 1. Knowledge categories of papers 2006-2020

WoS Categories	Author Categories	Nº Article
Communication	Human Science	35
Computer Science, Interdisciplinary Applications	Interdisciplinary	31
Hospitality, Leisure, Sport Sciences	Interdisciplinary	34
Psychology, Multidisciplinary; Experimental; Substance Abuse	Human Science	33
Cultural Studies; Economics; Sociology; Sport & Tourism	Human Science	32
Law	Human Science	24
Others	Others	27
Education & Educational Research; Sport Sciences	Human Science	10
Ethics	Human Science	10
Business	Human Science	10

An important piece of information for those who want to research eSports is to know which are the most productive journals in the field (Završnik et al., 2015). Looking at the overview of journals that published four or more articles between 2006-2020 (Table 2), we observe only four journals published ten or more articles within this entire period. Being a recent research field, publications on eSports are made in publications from different fields of knowledge, with many journals having published at least one article on this topic.

Table 2. The most productive journals between 2006-2020

Journal	Scope	Nº Articles
Gaming Law Review-Economics Regulation Compliance And Policy	Presents the latest developments in legislation, regulation, market performance, emerging technologies, and judicial decisions affecting gaming around the world.	15
International Journal Of Gaming And Computer-Mediated Simulations	One main goal of this peer-reviewed, international journal is to promote a deep conceptual and empirical understanding of the roles of electronic games and computer-mediated simulations across multiple disciplines.	15
Games and Culture	The journal's scope includes the sociocultural, political, and economic dimensions of gaming from a wide variety of perspectives, including textual analysis, political economy, cultural studies, ethnography, critical race studies, gender studies, media studies, public policy, international relations, and communication studies.	15
Sport Ethics And Philosophy	The journal is particularly open to essays of applied philosophy that engage with issues or practice, policy and scholarship concerning the nature and values of sports.	10

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Frontiers In Psychology	The largest journal in its field, publishing rigorously peer-reviewed research across the psychological sciences, from clinical research to cognitive science, from perception to consciousness, from imaging studies to human factors, and from animal cognition to social psychology.	9
Computers In Human Behavior	The journal addresses both the use of computers in psychology, psychiatry and related disciplines as well as the psychological impact of computer use on individuals, groups and society.	9
Communication & Sport	Publishes research and critical analysis from diverse disciplinary and theoretical perspectives to advance understanding of communication phenomena in the varied contexts through which sport touches individuals, society, and culture.	7
New Media & Society	Publishes peer-reviewed content from both the social sciences and the humanities and includes contributions from communication, media and cultural studies, as well as sociology, geography, anthropology, economics and the political and information sciences.	5
Sport Business And Management-An International Journal	Promotes the development of a coherent, high-quality body of work that examines both the business and management of sport, as well as the actors and stakeholders that align with sport to further their strategic objectives.	4
International Gambling Studies	It's a peer-reviewed interdisciplinary journal in gambling studies.	4
International Journal Of Environmental Research And Public Health	It focuses on the publication of scientific and technical information on the impacts of natural phenomena and anthropogenic factors on the quality of our environment, the interrelationships between environmental health and the quality of life, as well as the socio-cultural, political, economic, and legal considerations related to environmental stewardship, environmental medicine, and public health.	4

Table 3 summarizes the most cited authors within the period (2006-2020), the journal that published the article, and the purpose of the study.

Table 3. The 10 most cited authors in the collected sample (2006-2020)

Cited Authors	Main Goal	Journal	Nº Citations
Trepte et al., 2012	In the present study, we proposed that the online game players' physical and social proximity as well as their mutual familiarity influence bridging and bonding social capital.	Computers in Human Behavior	178
Vinyals et al., 2019	The authors evaluated the agent, AlphaStar, in the full game of StarCraft II, through a series of online games against human players.	Nature	172
Hamari & Sjöblom, 2017	In this study the authors investigate why do people spectate eSports on the internet.	Internet Research	170
Sjöblom & Hamari, 2017	This study investigates why people choose to watch others play video games, on services such as Twitch	Computers in Human Behavior	112
Hilvert-Bruce et al., 2018	This study trialled an eight-factor socio-motivational model, based on Uses and Gratifications Theory, to explain four aspects of live-stream viewer engagement.	Computers in Human Behavior	92
Jenny et al., 2017	The purpose of this article is to provoke thought on the academically accepted definitions of sport and debate whether eSports should be considered a sport.	Quest	87
Witkowski, 2012	In asking is there a "sport" in e-sports, this study questions the legitimacy of a traditional sports ontology and simultaneously tackles the notion of engagement with computer game play as a legitimate sporting endeavor.	Games and Culture	84
Seo & Jung, 2014	This article adopts the theory of social practices as a critical lens for understanding computer game consumption as multiple 'nexuses of doings and sayings', which represent the elements of and are situated within the broader context of consumer culture.	Journal of Consumer Culture	68
Hutchins, 2008	This article analyses the transformation of the relationship between computer gaming, media and sport in the global age of 'second modernity'.	New Media & Society	57
Macey & Hamari, 2018	This study assesses participation rates and demographic characteristics of eSports spectators who gamble via an international online survey (N = 582).	New Media & Society	56

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Table 4 presents the ten most referenced authors, the purpose and type of the research, the journal that published the study, and the number of citations over the entire period (2006-2020). Interestingly, the second most used reference by the collected articles is a book.

Table 4. The 10 most cited authors in the references by the collected sample

Cited Authors	Main Goal	Type	Journal	Nº Citations
Hamari & Sjöblom, 2017	In this study the authors investigate why do people spectate eSports on the internet.	Article	Internet Research	73
Taylor, 2012	In the book "Raising the Stakes", T. L. Taylor explores the emerging scene of professional computer gaming and the accompanying efforts to make a sport out of this form of play.	Book	N/A	60
Jenny et al., 2017	The purpose of this article is to provoke thought on the academically accepted definitions of sport and debate whether eSports should be considered a sport.	Article	Quest	44
Witkowski, 2012	In asking is there a "sport" in e-sports, this study questions the legitimacy of a traditional sports ontology and simultaneously tackles the notion of engagement with computer game play as a legitimate sporting endeavor.	Article	Games and Culture	44
Jonasson & Thiborg, 2010	The basic aim of this essay is to discuss and analyse the 'sporting qualities' of competitive computer gaming in relation to the definition of sport.	Article	Sport in Society	34
Seo & Jung, 2014	This article adopts the theory of social practices as a critical lens for understanding computer game consumption as multiple 'nexuses of doings and sayings', which represent the elements of and are situated within the broader context of consumer culture.	Article	Journal of Consumer Culture	31
Seo, 2013	This paper advances the concept of eSports consumption in marketing by developing the experiential perspective of competitive gaming as an assemblage of multiple interrelated experiential performances, which traverse the virtual and real worlds.	Article	Journal of Marketing Management	31
Hallmann & Giel, 2018	In this paper, the authors reflect on whether eSports can be considered as sport based on evaluating five characteristics of sport and assessing them for eSports.	Article	Sport Management Review	30
Lee & Schoenstedt, 2011	With recognition of the need for studying eSports in this interactive digital communication era, this study explored 14 motivational factors affecting the time spent on eSports gaming.	Article	ICHPER-SD Journal of Research	29
Funk et al., 2018	In this article, the authors argue for the inclusion of organized eSport events and competitions within sport management vis-à-vis eSport's meeting certain defining criteria of sport in general.	Article	Sport Management Review	27

Looking at the "Network eSports Theme Cluster" (Figure 2), we see that its main cluster – "eSports" – is related to several research topics. Interestingly, two other research clusters were formed: one about loot boxes, related to studies on gambling, and another of studies on sports, video games and gaming.
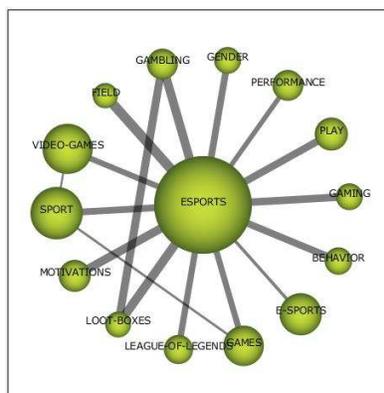

Figure 2. Cluster network eSports theme

Table 5, "Performance of eSports-related themes over the entire period (2006-2020)," shows the number of times a theme was cited by an article in the sample. An article can associate and involve more than one theme.

Table 5. Performance of the themes in the whole period (2006-2020)

Theme	Nº citations
eSports	138
Sport	58
Video-games	54
e-Sports	40
Games	37
Play	24
Motivations	22
Gambling	20
Performance	20
League-Of-Legends	17
Behavior	14

Discussion

The term "e-Sports" was first used in 1999 in a press release by the Online Gamers Association, defining it as a set of activities in which people participate, train, and develop mental and physical skills through information or communication technologies (Wagner, 2006). To understand the "state of the art" of eSports studies, this study collected recent data (2006-2020) by means of a literature search on the Web of Science database. The first article published on eSports found dates back to 2006, focusing on the use of e-Sports to improve fitness (Pan et al., 2006).

Academic interest and publications on eSports increased significantly only since 2016 (Figure 1), however most studies and even the most cited references by the analyzed articles came from the humanities (Table 1) and possible connections with other fields (interdisciplinarity), which seek to understand the space of eSports in contemporary society and its impact on society. The strategic presented only "eSports" as a theme – an unsatisfactory result that stems from the fact that eSports being a recent research field and spread over several topics. This finding indicates that "eSports" became an area of knowledge, thus our discussion was outlined based on the detection of research themes, co-words, and performance analysis.

"Gaming Law Review-Economics Regulation Compliance and Policy," "International Journal of Gaming and Computer-Mediated Simulations," and "Games and Culture" are the three scientific journals with the most publications on eSports, with fifteen articles each published between 2006 and 2020. "Gaming Law Review-Economics Regulation Compliance and Policy" and "International Journal of Gaming and Computer-Mediated Simulations," however, do not have any articles among the ten most cited in the sample (Table 3) or in the references (Table 4). On the other hand, the journal "Games and Culture" has one article among the most cited in the sample (Table 3) and in the references (Table 4).

Given the scope of the journal "Gaming Law Review-Economics Regulation Compliance and Policy," focused on law in eSports, gaming and video games and their implications, we note how recent the topic of eSports is and that most studies focus on the legal issues concerning betting and gambling. The tenth most cited article in the sample (Table 3) involves gambling in eSports (Macey & Hamari, 2018). Despite its broader and more comprehensive scope, with publications on the deep conceptual and empirical understanding of the roles of electronic games and computer-mediated simulations in various disciplines, the journal "International Journal of Gaming and Computer-Mediated Simulations" has no article among the most cited in the collected sample or in the references. The journal "Games and Culture" also has a broader scope and has one published article among the most cited in the sample (Table 3) and one of the most referenced (Table 4). This study focuses on discussing the legitimacy of a traditional sports ontology while addressing the notion of engaging in computer games as a legitimate sport activity (Witkowski, 2012).

A more in-depth analysis showed that the first and eighth most cited articles in the sample sought to understand the behavior and social impacts of eSports (Seo & Jung, 2014; Trepte et al., 2012). When looking at the most referenced article (Table 4), we identified a second research topic: to understand the motivations of those involved with eSports (Hamari & Sjöblom, 2017), which is the main goal of the seventh and ninth most cited articles (Lee & Schoenstedt, 2011; Seo, 2013).

As mentioned above, the themes with more studies are in line with the " Network eSports Theme Cluster" (Figure 2) and the "Performance of eSports-related themes over the entire period (2006-2020)" (Table5). We can identify a diversity of themes under study in the field of eSports and the formation of clusters (Figure 2). Studies on motivation, behavior, performance, league of legends, and gameplay are thus growing areas of research and the main cluster. Additionally, we found two other clusters that seem to be more interconnected and advanced: one concerning the connection between gambling, loot boxes and eSports, which refers to studies in the field of law; and a third cluster that discusses eSports, video games, sport and gaming within the humanities.

Our findings seems to indicate a consensus on eSports being a new form of sport, and thus discussions in this regard are outdated (Egliston, 2018; Jenny et al., 2017), but in essence it is a phenomenon increasingly present in contemporary society.

Besides these studies, other interdisciplinary research focuses on understanding the motivations and behavior of eSports players, covering areas such as psychology, marketing, management, and culture. Such variability of articles that address a wide range of other topics and different areas of knowledge cannot be overlooked.

Conclusions

This bibliometric-based study sought to provide the state of the art of publications on eSports since and within this theme which areas of knowledge are dedicated to researching, studying and understanding this phenomenon. After analyzing the collected data, we formed a better understanding of the studies, authors, and areas that have been most dedicated to researching eSports.

Although the field of eSports research has grown in the last 5 years, most studies have discussed the inclusion of eSports as a sport, its legal implications and impacts, such as betting on eSports teams or players, or behavioral and motivational studies (psychology) in eSports.

As "eSports" appear to be a consolidated human phenomenon in our society, studies about it will likely continue to advance. In this conjecture, we noted important research gaps regarding the technical committees of the sports teams and the impact and influence of technology companies on eSports modalities (games), players, and teams.

Regarding the use of bibliometric analysis in future studies, we advise including additional advanced methods such as data mining and citation analysis, country trend analysis and other similar methods to gain additional insight from different points of view and thus ensure the further development of this important research field.

Conflicts of interest

The authors declare no conflict of interest.

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