



Review

# Knowledge Mapping and Sustainable Development of eSports Research: A Bibliometric and Visualized Analysis

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**Abstract:** The rapid expansion of the eSports industry has attracted scholars' attention in recent years. However, little research has investigated the evolution of the extant eSports literature. This study aimed to explore the existing knowledge base of eSports and its research networks across authors, journals, institutions, and countries by performing a bibliometric analysis. A total of 260 studies published between 2010 and 2021 were extracted from the Scopus database, which is one of the largest abstract and citation databases. Then, they were analyzed using VOSviewer. Specifically, a series of analyses were conducted: (1) citation analysis, (2) co-occurrence analysis of keywords, and (3) co-citation analysis. The findings revealed that the existing eSports literature mainly revolves around eSports games and activities closely related to eSports. Moreover, the most influential authors and publications were identified. In addition, the studies have been published in journals of various disciplines (e.g., technology and psychology), and the concepts and theories in sport-related fields (e.g., sports management) have been extensively applied in eSports research. This study's findings contribute to a better understanding of eSports research, which can further provide directions for the sustainable development of eSports research.

**Keywords:** eSports; competitive gaming; bibliometric analysis; Scopus; VOSviewer



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## 1. Introduction

eSports has been defined as sports competitions conducted with an electronic system and technological immersion in an organized and structured environment [1–3]. In general, eSports is organized around specific game genres, such as multiplayer online battle arena (MOBA; e.g., League of Legends or Dota 2), player versus player (PvP; e.g., Street Fighter), real-time strategy (RTS; e.g., Warcraft or StarCraft), first-person shooter (FPS; e.g., Counter-Strike), or sports games (e.g., the NBA 2K series) [2,4,5]. Like other traditional sports, the main goal of eSports games is to defeat one's opponent to achieve victory [3]. eSports games require solid and stable cognitive responses during decision making and strategic planning [1–3]. Therefore, practice is vital for eSports players to advance their performance. Moreover, to fully occupy the functions of the mouse and keyboard, eSports games involve numerous fine motor skills that require the control of small muscle groups, especially the fingers [3]. However, scholars have argued against eSports as a form of sport due to its perceived lack of physicality for a long time [6]. More recently, scholars have gradually considered eSports to be a form of sport, as it is a highly structured activity that requires physical execution to determine a competitive outcome [5,7,8]. It should be noted that eSports and traditional sports are primarily different in two main aspects: equipment and environment [2,5]. The equipment of eSports is primarily a human–computer interface, and eSports happens within electronic systems instead of the real world [2].

The eSports industry has become one of the fastest-growing industries globally in the past decade due to the increased prevalence of various online games and improved live streaming technology [2,9,10]. According to an eSports market report [11], the value of the global eSports market surpassed USD 1 billion in 2021 and is projected to grow to over USD 1.6 billion by 2024. The rapid development of eSports has been fueled by its numerous participants, various tournaments, increasing audience, and high media coverage. For example, the largest eSports game, League of Legends, has over 100 million active players every month [12]. Meanwhile, recently there have been more than 9000 eSports tournaments worldwide [11]. Moreover, the global eSports audience is expected to increase from 593.2 million in 2019 to 920.3 million in 2024, representing a 9.2% compound annual growth rate (CAGR) [11]. In addition, the increasing media exposure of eSports generates revenue from advertising and sponsorships. A 2019 report projected that spending on sponsorships and advertising in the eSports market in North America would increase from USD 124 million in 2017 to over USD 634 million in 2023, reflecting a CAGR of 31.3% [13]. This indicates that the eSports industry has been expanding and developing rapidly in recent years. Recently, eSports has been officially accepted as a form of sport in over 60 countries [9]. This has attracted many prestigious international sports clubs (e.g., F.C. Barcelona) to branch out into eSports by sponsoring and sending their teams to play in various virtual sports tournaments, such as the Pro Evolution Soccer 2018 gaming championship [9]. Furthermore, eSports will be introduced as an official sports event at the Asian Games 2022, which will serve to energize eSports development in Asia [9].

Given the rapid development and expansion of the eSports industry, scholars from various disciplines have started to pay increasing attention to eSports research [7,14,15]. For example, scholars in the fields of informatics have explored human–computer interactions as well as users' motivations to view and participate in eSports competitions [16,17]. Moreover, psychologists have investigated the impact of eSports on individuals' psychological and behavioral outcomes, such as mental health or addiction [18,19]. In addition, sports management scholars have discussed and debated the role of eSports in the discipline of sports management and provided research opportunities and directions [5,7,20]. These examples indicate that eSports is a multidisciplinary topic that attracts the interest of many scholars from different disciplines. Moreover, it should be noted that these scholars applied the knowledge in their research fields (e.g., informatics, psychology, or sports management) to explore eSports from various perspectives.

Due to the increasing interest in eSports from scholars, it is not surprising to see a surge of publications relevant to eSports in recent years [14]. Specifically, scholars have gradually recognized eSports as a new and emerging topic and invested increasing efforts into eSports research [14,21]. Although the number of publications in eSports continues to grow rapidly, little is known about the comprehensive and quantitative reviews that exclusively focus on eSports research. To ensure the sustainable development of eSports research, it is necessary to understand its status quo, evolution, and theoretical advancement. Many scholars have used bibliometric analysis to evaluate the growing number of publications and provide a comprehensive profile and research network of a given field [22–33]. This technique is often used to examine performance metrics related to authors, journals, institutions, and countries as well as to map the structure of a research field and unpack the relationships between its subfields [34–36]. Ultimately, the findings of bibliometric analysis can advance theoretical development and provide directions for the sustainable development of research in a specific field [34,37].

Accordingly, the present study aimed to help scholars understand the existing knowledge base of eSports and its research networks across authors, journals, institutions, and countries. To achieve this aim, this study performed bibliometric analysis, which is the most optimal method for depicting the characteristics and development of published studies within a specific field of research [34–36]. The findings of this study may contribute to a comprehensive understanding of the status quo, development, and the most influential authors, institutions, journals, and references in eSports research. They may also help

researchers to understand its evolution, recognize new research directions, and accurately search for papers, journals, and authors.

This paper is divided into five sections, the remainder of which are organized as follows. Section 2 presents the materials and methods that were employed in this study, including an introduction to bibliometric analysis, the data source and collection, and data analysis. Section 3 reports the results of the bibliometric analysis, which consisted of a descriptive analysis, co-occurrence analysis of keywords, citation analysis, and co-citation analysis. The discussion is presented in Section 4, which includes the main findings, recommendations for future research, and limitations. Finally, Section 5 provides the conclusion to the study.

## 2. Materials and Methods

### 2.1. Bibliometric Analysis

Bibliometric analysis was conducted to achieve the research purposes. The term “bibliometrics” was originally defined by Pritchard [38] as the “*application of mathematics and statistical methods to books and other media of communication*” (p. 349). More recently, bibliometric analysis has been used as a statistical approach for investigating the academic literature in a focal field by quantitatively assessing publications’ bibliographic information, such as the author name, title, source title, and affiliation, and this technique has been widely used to understand the structure, evolution, and trend of a given scientific domain [35,36,39,40]. Due to the objective and quantitative nature of the bibliographic information of publications acquired in digital databases, this technique allows researchers to generate a highly reliable and quality review through its systematic, transparent, and reproducible analytic process [40–42].

According to Noyons et al. [43], there are two primary procedures in bibliometric analysis: performance analysis and science mapping. First, performance analysis is used to assess performance by calculating the number of publications by authors, institutions, universities, and countries [44]. Moreover, performance analysis involves examining the contributions of the authors, publications, countries, and affiliations involved (e.g., [30,39,45]). More specifically, this technique, which is descriptive in nature, is regarded as the standard practice of bibliometric studies for presenting the performance of various features in different fields [40]. In this study, the average citations per publication were also calculated as an indicator to reflect the relative importance of publications, authors, journals, institutions, and countries [45]. In addition, the Citescore values provided by Scopus were used to indicate the quality of the journals [46].

Second, science mapping is a graphical representation of research fields and sub-fields [34,37,39,47]. This technique can map the evolution and structure of a research field as well as visualize its thematic networks and relationships between its subfields. In particular, this technique focuses on the intellectual interactions and structural linkages between research constituents (e.g., authors, institutions, countries, and journals) [40]. In this study, three types of co-citation analysis were conducted. First, a co-citation analysis on cited references was performed to understand the structure of the cited references in the focal field. Second, a co-citation analysis on cited authors was performed to identify influential authors by estimating the citation records. Third, a co-citation analysis on cited journals was conducted to understand the relationships between scientific journals in a specific area [34,37]. These co-citation analyses assume that publications frequently cited together are similar thematically [48], and the results of a series of co-citation analyses can reflect how researchers attach to specific references, authors, and journals, indicating the development and trend of a given scientific area [34,37]. In addition, co-occurrence analysis was conducted to analyze the words that frequently co-occur in the publications to understand the thematic relationships [34,37]. This technique is useful for supplementing co-citation analysis and forecasting future research in the field [40].

In recent years, bibliometric analysis has been widely employed to investigate the development of a given scientific area, such as tourism and sustainability [22–24], green

innovation [25,26], risk management [27,28], entrepreneurship [29,30], and COVID-19 research [31–33]. Although Zhang [49] conducted a bibliometric analysis in 2012, it should be noted that the study was conducted in the early stages of eSports research [7,14], and the scope was limited to a Chinese digital database (China National Knowledge Infrastructure (CNKI)). Therefore, to address the gap and limitations in the extant literature and gain a comprehensive understanding of eSports research, the present study adopted bibliometric analysis to investigate the up-to-date knowledge of eSports research and the sustainable development of future eSports research.

## 2.2. Data Source and Collection

Data were collected in June 2021 from Scopus, which is developed by Elsevier. Scopus is one of the largest abstract and citation databases, covering more than 24,600 active titles (peer-reviewed journals, book, trade publications, and articles in process) and over 5000 publishers. It has been regarded as one of the most widely recognized and reliable databases [50–53]. Compared with the Web of Science databases, Scopus is known for covering more categories and articles [52–54]. Various studies have used the Scopus database as the main source for conducting bibliometric analysis [55–58]. Moreover, it should be noted that using a single database is recommended, as this can minimize the likelihood of potential human errors [40]. Therefore, the Scopus database was deemed to be adequate for bibliometric analysis.

As a next step, the literature search was conducted using the keyword “eSport” to search within the “Article title, Abstract, Keywords.” The initial search generated 647 publications. Following the guidelines of previous studies [45,59], the initially generated studies were limited to articles or reviews and those published in English, leading to a total of 305 studies being extracted. After screening the studies, those for which the source was “Apunts Medicina De L’Esport” (Apunts Sports Medicine in English) were excluded from the list as they were not relevant to eSports. As a result, the literature search finally identified 260 studies published between 2010 and 2021, which were included for bibliometric analysis using VOSviewer.

## 2.3. Data Analysis

Prior to the data analysis, the 260 eSports articles extracted from Scopus were saved in a CSV document that contained the authors’ names, document titles, years, source titles, citation counts, document types, abstracts, keywords, and reference lists, which are valuable for bibliometric analysis [40,53]. Notably, the sample size of this study ( $N = 260$ ) fulfilled the minimum sample size for bibliometric analysis for generating an appreciable degree of differentiation [60]. As a next step, the CSV document was imported into VOSviewer 1.6.16 [61]. VOSviewer has been widely used in bibliometric analyses [24,62] and can be used to analyze various bibliometric networks, publications, authors, journals, organizations, and countries [63,64]. In this study, performance analysis was conducted by descriptive analysis and citation analysis; science mapping was performed by co-occurrence analysis of the keywords, and co-citation analysis. The results and output were useful for exploring the research streams of eSports studies.

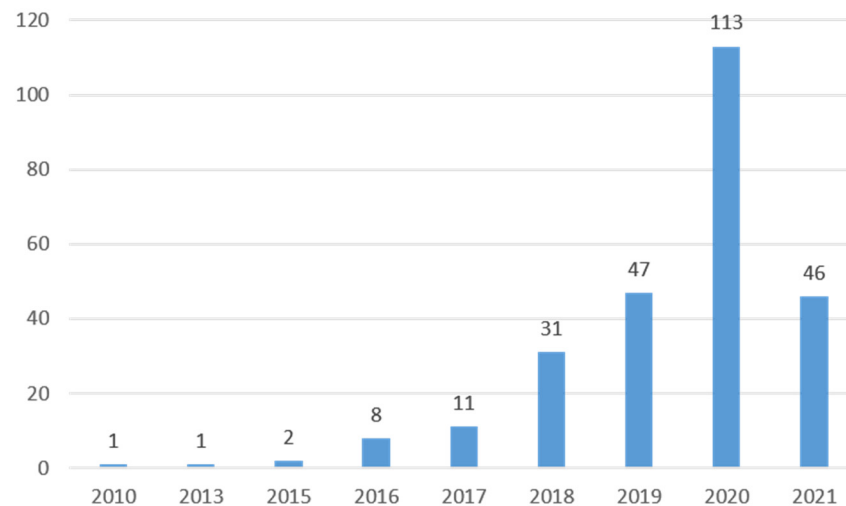
## 3. Results

This section presents the results of the descriptive analysis and citation analysis of publications, authors, journals, institutions, and countries in eSports research. Moreover, the results of the co-occurrence analysis of keywords are demonstrated. In addition, the results of the co-citation analysis on cited references, cited authors, and cited journals are interpreted.

### 3.1. Descriptive Analysis

The final sample ( $N = 260$ ) of this study consisted of 237 articles (91.2%) and 23 reviews (8.8%). More specifically, the final sample included 150 sources by 629 authors affiliated

with 522 institutions in 45 countries and a total of 12,945 cited references. Figure 1 presents the chronological distribution of the publications in the field of eSports research. In the Scopus database, the first traceable article was published in 2010, and the number of publications significantly increased from 2018, indicating the rapid development of eSports research.



**Figure 1.** Distribution of publications.

### 3.2. Citation Analysis of Publications and Authors

The citation analysis performed with VOSviewer uncovered the 10 most cited publications in the Scopus database. As reported in Table 1, the most cited article was an artificial intelligence study that explored reinforcement learning in eSports games [65]. The second, third, and fourth most cited articles primarily explored individuals' motivations for watching eSports competitions [2,66,67]. The fifth and seventh most cited studies provided definitions of eSports and compared the differences between eSports and traditional sports [5,15]. The sixth most cited article demonstrated the new marketing opportunities in the eSports landscape [16]. The eighth most cited article illustrated suggestions for and the direction of eSports research in the field of sport management [7]. Finally, the ninth and tenth most cited articles addressed eSports consumption behavior and problematic behaviors in eSports [18,68]. Among these 10 most influential publications, except for the most cited publication, which explored eSports athletes' reinforcement learning in eSports games [65], the remainder could be classified into two categories. The first category focused on individuals' motivations for and behaviors when watching eSports games [2,66–68], whereas the second category addressed the new phenomenon and development of eSports [5,7,15,16]. As listed in Table 2, the top 10 most cited publications reflect the most important and influential studies in the field of eSports research.

Table 2 displays the top 10 authors' names, publications, and research interests. Juho Hamari is the most productive author, having published nine articles according to our search, and his research interests include gamification, game design, and game-based learning. Mark Campbell, the second most productive scholar, has published six studies, and his research interests are focused on sports psychology. Mark Griffiths published six articles during our search period, and his research interests include game addiction and gambling addiction. Joseph Macey has published six articles and is interested in eSports and digital media research. Adam Toth has also published six papers related to eSports, and his research interests are neuroscience and eSports science. Table 3 also reports the h-index provided by Scopus databases to indicate the authors' productivity and the impact of their published work. Said index revealed that Griffiths, M.D., Demetrovics, Z., and Hamari, J. were the three most productive and impactful scholars.

**Table 1.** Top 10 most influential publications in eSports research.

Rank	Authors	Title	Journal	Year	Citations
1	Vinyals, et al. [65]	Grandmaster level in StarCraft II using multi-agent reinforcement learning	<i>Nature</i>	2019	284
2	Hamari and Sjöblom [2]	What is eSports and why do people watch it?	<i>Internet Research</i>	2017	207
3	Sjöblom and Hamari [66]	Why do people watch others play video games? An empirical study on the motivations of Twitch users	<i>Computers in Human Behavior</i>	2017	148
4	Hilvert-Bruce, et al. [67]	Social motivations of live-streaming viewer engagement on Twitch	<i>Computers in Human Behavior</i>	2018	120
5	Jenny, et al. [15]	Virtual(ly) athletes: Where eSports fit within the definition of “Sport”	<i>Quest</i>	2017	106
6	Seo [16]	Electronic sports: A new marketing landscape of the experience economy	<i>Journal of Marketing Management</i>	2013	76
7	Hallmann and Giel [5]	eSports—Competitive sports or recreational activity?	<i>Sport Management Review</i>	2018	75
8	Funk, et al. [7]	eSport management: Embracing eSport education and research opportunities	<i>Sport Management Review</i>	2018	74
9	Seo and Jung [68]	Beyond solitary play in computer games: The social practices of eSports	<i>Journal of Consumer Culture</i>	2016	72
10	Macey and Hamari [18]	eSports, skins and loot boxes: Participants, practices and problematic behaviour associated with emergent forms of gambling	<i>New Media and Society</i>	2019	60

**Table 2.** Top 10 most important authors in eSports research.

Rank	Authors	Affiliations	Country	Publications	Research Interests	H-Index
1	Hamari, J.	University of Tampere	Finland	9	Gamification; game design; game-based learning	41
2	Campbell, M.J.	University of Limerick	Ireland	6	Sports psychology	16
3	Griffiths, M.D.	Nottingham Trent University	UK	6	Psychology; online video games; video game addiction	94
4	Macey, J.	University of Tampere	Finland	6	eSports; digital media	6
5	Toth, A.J.	University of Limerick	Ireland	6	Sensory-motor learning; eSports science	6
6	Byon, K.K.	Indiana University	USA	5	Sports management; sports marketing	12
7	Parshakov, P.	National Research University of Higher School of Economics	Russia	5	Sports economics; eSports	7
8	Bonnar, D.	Finders University	Australia	4	Sleep problems	5
9	Bányai, F.	Eötvös Loránd University	Hungary	4	Psychology; online video games; video game addiction	4
10	Demetrovics, Z.	Eötvös Loránd University	Hungary	4	Psychology; behavioral addiction	48

**Table 3.** Top 10 journals in eSports research.

Rank	Journal	Publications	Citations	Average Citations/Publication	Citescore
1	<i>Frontiers in Psychology</i>	15	51	3.4	3.5
2	<i>International Journal of Gaming and Computer-Mediated Simulations</i>	12	118	9.83	1.8
3	<i>Games and Culture</i>	9	73	8.11	4.0
4	<i>Computers in Human Behavior</i>	8	348	43.5	13.8
5	<i>International Journal of Environmental Research and Public Health</i>	8	22	2.75	3.4
6	<i>Communication and Sport</i>	7	43	6.14	3.6
7	<i>Sport Management Review</i>	5	233	46.6	6.5
8	<i>Sport, Ethics and Philosophy</i>	5	66	13.2	1.4
9	<i>Sport, Business and Management</i>	4	7	1.75	1.8
10	<i>European Sport Management Quarterly</i>	4	19	4.75	4.1

### 3.3. Citation of Journals

The impact of a journal in a research field is determined by the number of articles published in it and the number of citations it possesses [45,69]. Therefore, this study calculated the number of articles and citations as well as the average citations per publication for all journals to determine the top 10 most important journals in eSports research.

As displayed in Table 3, the top five journals with the most articles published were *Frontiers in Psychology* (15 publications), the *International Journal of Gaming and Computer-Mediated Simulations* (12 publications), *Games and Cultures* (nine publications), *Computers in Human Behavior* (eight publications), and the *International Journal of Environmental Research and Public Health* (eight publications). This indicates that these five journals were more interested in studies on eSports topics. By contrast, according to the indicators of citations and average citations per journal, the first journal was *Computers in Human Behavior* (348 citations and 43.5 citations/publication), followed by *Sport Management Review* (233 citations and 46.6 citations/publication), *Sport, Ethics and Philosophy* (66 citations and 13.2 citations/publication), the *International Journal of Gaming and Computer-Mediated Simulations* (118 citations and 9.83 citations/publication), and *Games and Cultures* (73 citations and 8.11 citations/publication). This reflects that these five journals received more attention in eSports research. In addition, the Citescores of the journals indicated adequate levels of journal quality, ranging from 1.4 to 13.8, and *Computers in Human Behavior* had the highest Citescore among these journals.

### 3.4. Citation Analysis of Institutions and Countries

The studies included in this study involved a total of 522 institutions from 45 countries. In a similar vein, the number of publications and citations as well as the average citations per year of each institution reflected the impact of an institution on eSports research. As presented in Table 4, many universities in Finland (e.g., the University of Tampere, University of Turku, and Tampere University of Technology) exhibited a significant impact on eSports research due to the high number of publications, citations, and average citations per publication. The results are detailed in Table 4.

Moreover, to explore which country excelled the most in the field of eSports research, this study further conducted an analysis of the countries. As reported in Table 5, the USA was the most impactful country in the field of eSports research, with 90 publications, 709 citations, and 7.88 citations per publication. Moreover, although Finland ranked fifth in terms of the number of publications, it had the highest average number of citations per publication (45.79), indicating that eSports studies in Finland received significant attention. This shows that many European countries (e.g., the UK, Germany, Spain, Finland, and

Ireland) and North American countries (e.g., USA and Canada) contributed to eSports research. However, only two countries (i.e., Korea and China) were located in Asia.

**Table 4.** Top 10 most influential institutions in the field of eSports research.

Rank	Affiliation	Country	Publications	Citations	Average Citations/Publication
1	University of Tampere	Finland	9	598	66.44
2	University of Turku	Finland	8	471	58.88
3	Nottingham Trent University	UK	6	69	11.5
4	University of Limerick	Ireland	6	18	3
5	National Research University of Higher School of Economics	Russia	6	26	4.33
6	Flinders University	Australia	6	22	3.67
7	Indiana University	USA	6	21	3.5
8	University of Georgia	USA	6	26	4.33
9	Tampere University of Technology	Finland	5	476	95.2
10	German Sport University Cologne	Germany	5	150	30

**Table 5.** Top 10 countries in the field of eSports research.

Rank	Country	Publications	Citations	Average Citations/Publication
1	USA	90	709	7.88
2	UK	28	487	17.39
3	Australia	26	238	9.15
4	Germany	17	172	10.11
4	Spain	17	51	3
5	Finland	14	641	45.79
6	South Korea	13	152	11.69
7	Canada	12	106	8.83
8	Russia	11	55	5
9	China	9	13	1.44
10	Ireland	8	25	3.13

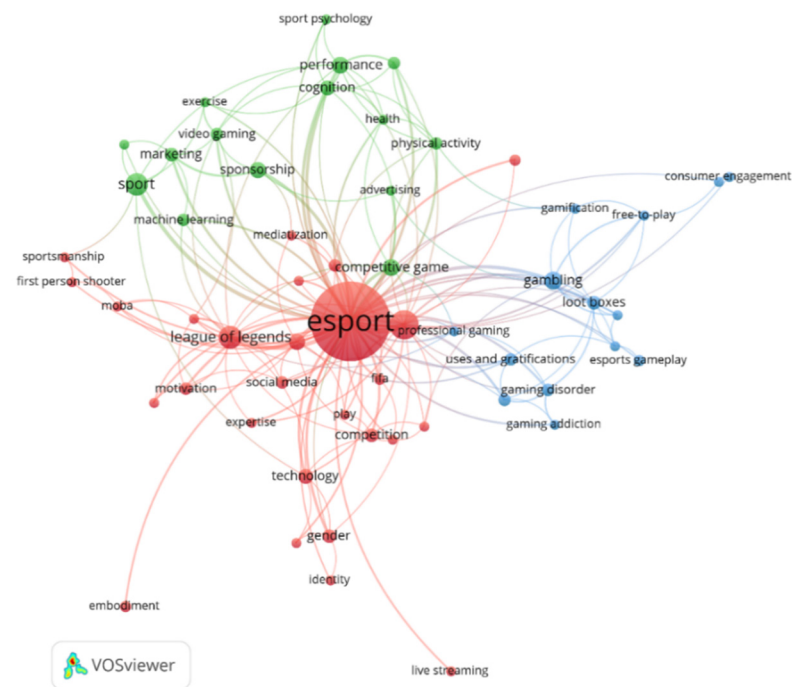
### 3.5. Co-Occurrence Analysis

To identify the emerging themes related to eSports in 260 studies, co-occurrence analysis of the keywords was conducted using VOSviewer. This technique applies a text-mining algorithm to the titles, abstracts, and keywords of articles to construct maps of the keywords [40,63]. The links between keywords were established based on the co-occurrence of keywords in the selected articles. To avoid repeated keywords, a customized VOSviewer thesaurus file was used to merge variants with the same meaning (e.g., “esport”, “esports”, “electronic sport”, and “e-sport”). From a total of 806 keywords, the co-occurrence analysis identified 56 keywords with a minimum of three co-occurrences. Table 6 presents the frequently co-occurring keywords in eSports research. In Figure 2, the nodes indicate the frequently occurring keywords, and the links indicate the relationships between themes. Moreover, the nodes closely connect to each other to form a theme with the same color [61]. VOSviewer identified three clusters consisting of nodes with the same color: (1) eSports games (red), (2) development of eSports (green), and (3) eSports user perception and behavior (blue). Specifically, the first cluster (red) included the characteristics of eSports games and activities close to eSports (e.g., [2,66,67]). The second cluster (green) consisted of comparisons between eSports and traditional sports (i.e., physical activity) and marketing opportunities in eSports (e.g., [13,66]). Finally, the last cluster (blue) captured different perceptive and behavioral aspects of users within the context of eSports, such as competitive behavior, gaming addiction, gaming disorders, gambling, and consumer engagement (e.g., [67,68]).



**Table 6.** Highly co-occurring keywords in eSports research.

Keywords	Frequency	Keywords	Frequency
eSport	190	Performance	9
Game	26	Cognition	7
League of Legends	16	Competitive game	9
Sport	15	Streaming	8
Gambling	10	Sponsorship	8

**Figure 2.** Co-occurrence analysis.

### 3.6. Co-Citation Analysis on Cited References

Following previous bibliometric analysis studies [45,69], we performed a co-citation analysis on the cited references to understand their structure in the field of eSports research. From the 12,945 cited references, the co-citation analysis generated a set of 30 references by employing the threshold 6 times, which means the minimum number of citations of a cited reference was 6. As depicted in Figure 3, two clusters emerged in the co-citation analysis on cited references. Specifically, the first cluster (red color) focused on the perspective of eSports consumer behaviors. For example, many cited references are relevant to sports consumers' motivations and needs [2,66,67,70–72] as well as consumption behaviors [68,73,74]. The second cluster (green) focused on the emerging phenomenon of eSports [75,76] and directions for future research [5,7,20,21].

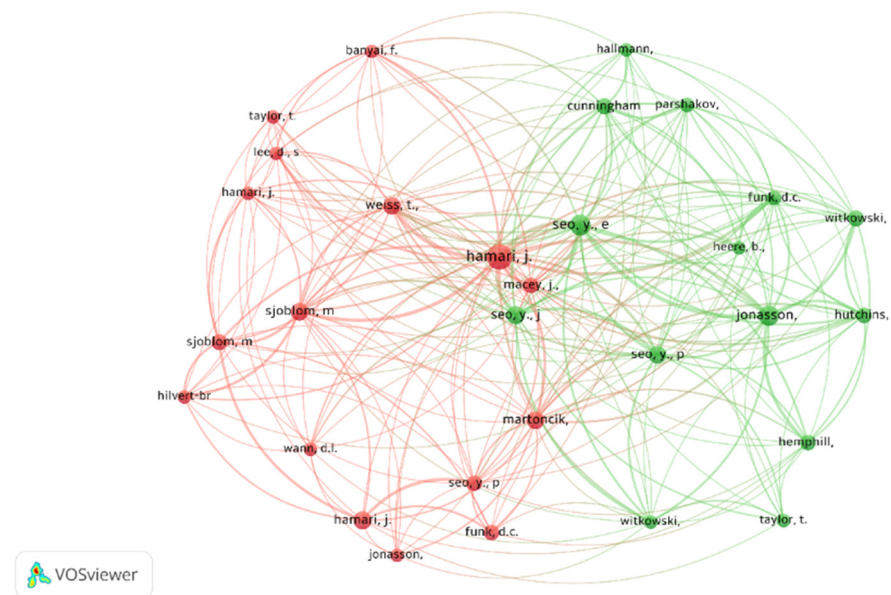


Figure 3. Co-citation of cited references.

### 3.7. Co-Citation Analysis on Cited Authors

As a next step, to explore the most cited authors in the field of eSports research, a co-citation analysis was conducted on a sample of 15,309 authors cited in our 260 publications. A list of 75 authors was extracted with a minimum of 25 citations. As portrayed in Figure 4, the co-citation analysis on cited authors generated a map of 75 authors consisting of three clusters. The top three cited authors were Hamari, J. (207 citations), Griffiths, M. D. (147 citations), and *Sjöblom, M.* (145 citations). More specifically, the first cluster (red) primarily consisted of authors from the fields of gaming and video games (e.g., Freeman, G., Hamari, J., *Sjöblom, M.*, Taylor, T. L., and Witkowski, E.) and digital consumption (e.g., Seo, Y.), indicating that the publications of these authors have been extensively co-cited by other studies.

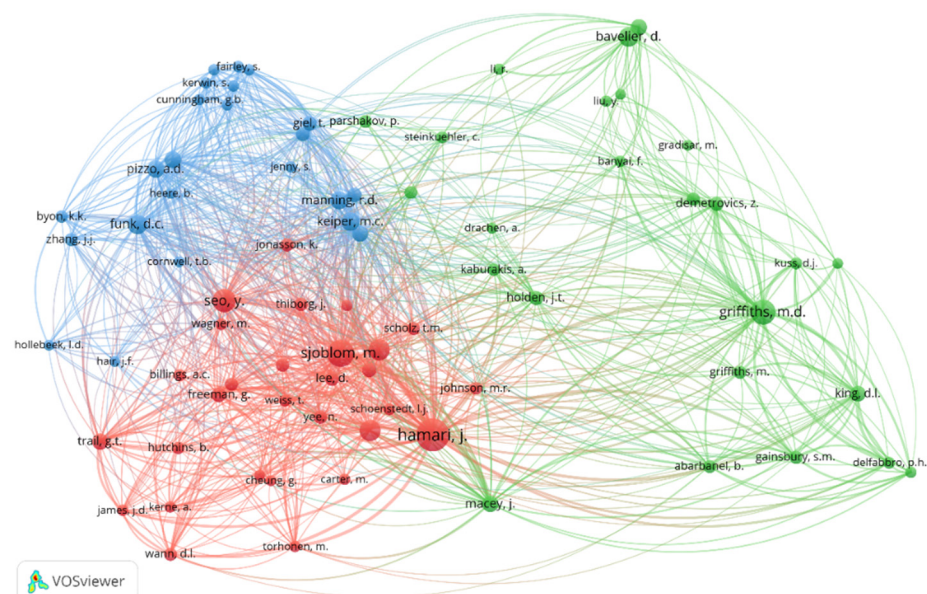


Figure 4. Co-citations of cited authors.

Moreover, the second cluster (green) included authors from various disciplines, such as psychology and eSports (e.g., Griffiths, M.D. and Demetrovics, Z.), cognitive neuroscience

(Bavelier, D. and Green, C. S.), gaming disorders (King, D. L.), digital media and gambling (e.g., Macey, J.), and sports law and policy (Holden, J. T.). These authors from different disciplines represent the diverse aspects of eSports research.

Finally, the third cluster (blue) mainly comprised authors from the fields of sports management (e.g., Baker, B. J., Byon, K. K., Cunningham, G. B., Funk, D. C., Giel, T., Hallmann, K., Pizzo, A. D., Manning, R. D., Olrich, T. W., and Trail, G. T.). It is noteworthy that eSports has been regarded as a hot topic in the field of sports management, and an increasing number of sports management scholars are investing growing efforts into eSports research.

### 3.8. Co-Citation Analysis of Cited Journals

Of the 260 publications, a total of 6,412 cited resources were obtained. A co-citation analysis on the cited journals was conducted by employing a threshold of 25 citations. Consequently, the results generated a set of 37 journals and a map consisting of 3 clusters. It should be noted that these three clusters were closely connected. The top 3 cited journals were *Computers in Human Behavior* (247 citations), *Sport Management Review* (169 citations), and *Games and Culture* (172 citations). In particular, as shown in Figure 5, the first cluster (red) consisted of journals focused on culture and society (e.g., the *Journal of Consumer Culture*, *Games and Culture*, *New Media & Society*, and *Information, Communication & Society*) and some sports-related journals (e.g., *Sport Management Review*, *Communication & Sport*, *Sport*, the *Journal of the Philosophy of Sport*, *Leisure Studies*, and *Sport in Society*). The cluster indicated that eSports studies have been widely accepted by culture and society-related journals, indicating the emerging phenomenon of eSports.

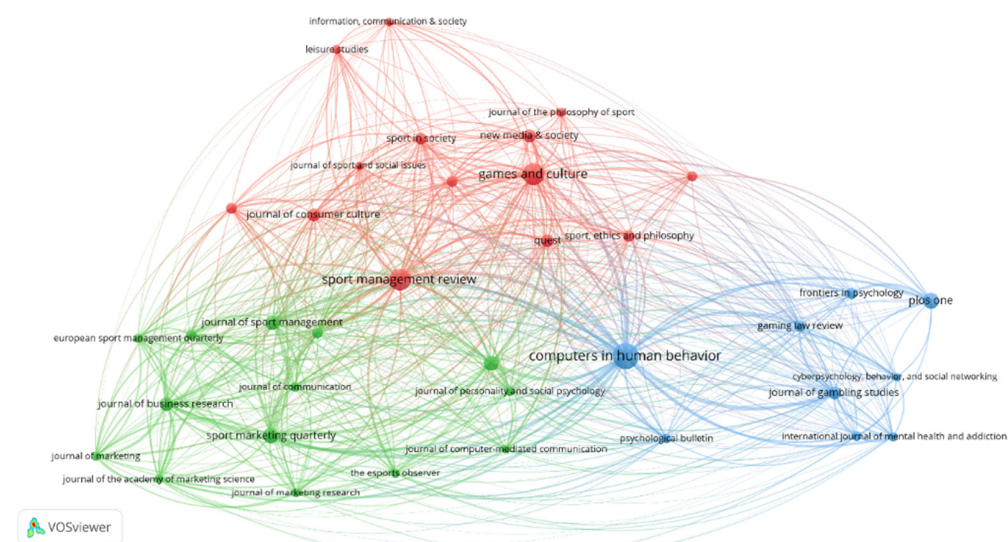


Figure 5. Co-citation of cited journals.

The second cluster (green) primarily included journals that concentrate on marketing (e.g., the *Journal of Business Research*, *Journal of Consumer Research*, *Journal of Marketing*, *Journal of Marketing Research*, *Journal of Marketing and Management*, and *Journal of the Academy of Marketing*) as well as sports management and marketing (e.g., *European Sport Management Quarterly* and *Sport Marketing Quarterly*). The cluster indicated that it is not only sport management journals but also marketing journals that are interested in eSports studies.

Finally, the third cluster (blue) basically contained journals that emphasize behavior research (e.g., *Computers in Human Behavior*, *Cyberpsychology, Behavior, and Social Network*), gambling and addiction (e.g., the *Journal of Behavioral Addictions*, the *Journal of Mental Health and Addiction, Review*, and the *Journal of Gambling Studies*), and psychology (*Psychology Bulletin* and *Frontier in Psychology*). The cluster indicated that these journals are interested in behavior-related studies in the context of eSports.

#### 4. Discussion

Following the emergence of eSports, knowledge of eSports has rapidly developed in recent years. However, the understanding of this knowledge development and current research on eSports still remain unclear, which limits the sustainable development of eSports research. To gain an enhanced understanding of eSports research, this study collected bibliographic data from the Scopus database and performed a bibliometric analysis using the VOSviewer software package to uncover the development of eSports research. According to 260 articles published from 2010 to 2021, this study mapped the primary themes of eSports research; identified the most influential publications, authors, journals, institutions, and countries; and analyzed the co-citation network of eSports research. The findings of this study not only provide an enhanced understanding of state-of-the-art eSports research but also insightful implications for the sustainable development of future eSports research.

First, the three identified clusters in Figure 2 revealed that eSports research is primarily focused on eSports games themselves (e.g., “League of Legends”, “first-person shooter”, “video gaming”, “competitive game”, and “human–computer interaction”). It should be noted that many co-occurring keywords are relevant to other activities closely related to eSports, such as “social media” (e.g., “streaming”, “live streaming”, and “online games”) and business (e.g., “marketing”, “sponsorship”, and “advertising”). Moreover, Figure 2 revealed that many studies have compared eSports with traditional sports (i.e., physical activity) and discussed the future development of eSports. Finally, the last theme of eSports research is relevant to the different perceptions and behaviors of eSports users, including competitive behavior, gambling, addiction, mental health, and cognition. The map of eSports research implies the various aspects of the extant literature on eSports, including not only eSports games and activities but also consumers’ perceptions and behaviors.

Moreover, this study identified the most influential publications, journals, authors, institutions, and countries. In particular, it found that the 10 most cited papers accounted for more than 1200 citations in less than 10 years. Among these studies, most explored motivations to watch eSports games [2,66,67] and compared eSports with traditional sports [5,15]. These findings indicate that scholars are more interested in understanding why people participate in eSports games as well as in defining eSports, which is similar to but different from traditional sports. Furthermore, several prolific authors have significantly contributed to eSports research; more specifically, these authors have diverse backgrounds and research interests, which are primarily sports, psychology, and gaming. Furthermore, it was found that studies on eSports were not only published in sports-related journals but also in journals in other disciplines, such as technology, psychology, gaming, and health, demonstrating that eSports studies are widely accepted by journals in different disciplines. In addition, universities in Finland have published a significant proportion of the research and citations. Finally, in terms of documents and citations, the USA is the leading country for eSports research.

Furthermore, the co-citation analysis on cited references indicated that many eSports studies have applied the concepts from traditional sports (e.g., motivation) and compared sports consumers and eSports consumers. Moreover, many cited references were relevant to the emerging phenomenon of eSports, its definition, and directions for future eSports research. This indicates that, to some extent, eSports is regarded as an extension of traditional sports as it fulfills specific defining criteria of sports in general [7,20]; eSports can be defined as a type of sports entertainment product in the sports industry [20].

The co-citation analysis on authors revealed that many authors had backgrounds in technology, gaming, and video games. Moreover, due to the multi-disciplinary nature of eSports, it is not surprising that there are many cited authors from various fields, such as psychology, cognitive neuroscience, law and policy, and mental health. In addition, because many scholars view eSports as an extension of traditional sports, many sports management scholars have been co-cited in eSports research. Finally, this study uncovered the patterns of various sports-related journals being co-cited by eSports research. Furthermore, journals in the field of business, gaming, and behavior were revealed to be the primary sources of

citations. This again implies that knowledge in different disciplines put together contributes to the development of eSports research.

#### *4.1. Recommendations for the Sustainable Development of eSports Research*

The findings of this study provide various implications for the sustainable future development of eSports research. First, the findings revealed a lack of collaboration across various fields. Therefore, collaboration across disciplines such as technology and sports management is necessary for the advancement of eSports research, since eSports is a multi-disciplinary topic. That is, to gain more comprehensive knowledge of eSports, scholars must collaborate with scholars from different fields. The integration of different perspectives will help scholars to gain new insights into eSports research. On the other hand, studying eSports from a single perspective may limit the sustainable development and advancement of eSports research.

Second, applying the existing theories and concepts in closely relevant fields, such as sports management, technology, and mental health, to eSports research may be useful for explaining individuals' perceptions and behaviors as well as the impact of eSports on individuals. For example, sport fans' motivations for watching sports games have been found to be helpful for explaining eSports fans' motivations and behaviors [77,78]. Moreover, it would be helpful to apply technology-related models, such as the technology acceptance model of Davis [79] or the unified theory of acceptance and use of technology of Venkatesh et al. [80] to explore individuals' behavior toward playing eSports games. Therefore, to establish a sustainable research plan for eSports, future research may consider using applicable theories and concepts to advance the sustainable development of eSports research.

Finally, the findings of this study identified the "dark side" of eSports. Many individuals, especially teenagers and young people, are overly obsessed with eSports, resulting in problematic behaviors (e.g., gambling) and mental disorders (e.g., game addiction) [73,81]. However, how eSports can benefit individuals in different ways is still unclear. For the sustainable development of eSports research, it is critical to identify the benefits of eSports. Therefore, it is necessary for future research to better understand not only the harm but also the potential benefits caused by eSports participation and consumption.

#### *4.2. Limitations*

This study is not without its limitations. First, as the data were collected in June 2021, the overview of scientific production in 2021 is limited. Moreover, the sample of this study was captured in only one database (i.e., Scopus). Although the Scopus database encompasses various articles and journals, it might not cover all eSports studies. Furthermore, like many bibliometric studies, the literature search may not include all relevant studies, and some eSports studies may not be included in this bibliometric analysis. Third, in this study, the document type was restricted to articles and reviews to ensure the intellectuality and high quality of the publications. Future research may consider other document types such as conference papers and working papers to gain more insights and the latest findings in eSports research. Finally, due to the limitations of the bibliometric software and the authors' knowledge, only English articles and reviews were included; therefore, the trends and patterns of non-English articles and reviews remain unknown.

### **5. Conclusions**

To understand the evolution and trend of eSports research and provide directions for the sustainable development of eSports research, this study systematically reviewed and collected studies published from 2010 to 2021. A bibliometric analysis was conducted to uncover the development of eSports research. The present study contributes to the extant research by providing state-of-the-art information and identifying patterns, trends, research opportunities, and directions through analyzing the most recent and relevant eSports studies. It has evidenced that the rapid advancement of eSports is fueled by

scholars in different fields (e.g., technology, sports management, and psychology) and applications of relevant knowledge (e.g., sports management). This implies that eSports has emerged as a unique research topic that requires more collaborations across disciplines as well as explorations of the research gap in the extant literature on eSports to better comprehend the sustainable development of eSports knowledge.

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