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Visualizing the Evolution of Gaming Disorder Research: A Global Literature Mining Analysis

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Abstract: This research critically explores the trajectory of global gaming disorder research spanning the years 2003 to 2023. The formal recognition of gaming disorder as a legitimate concern by the World Health Organization in 2018 has spurred a discernible upswing in scholarly investigations. Employing a robust methodology, we conducted an exhaustive bibliometric analysis using the Web of Science (WOS) and CiteSpace, delving into diverse facets such as annual publication counts, countries, institutions, journals, keywords, and burst keywords. Our meticulous examination illuminates a substantial surge in publications, particularly noteworthy in the post-2013 period, culminating in a zenith in 2022. China and the United States emerge as pivotal contributors, engaging in collaborative endeavors on a global scale. The dual-map overlay underscores the interdisciplinary character of gaming disorder research, while the burst analysis accentuates the emergence of key keywords such as "depressive symptom" and "sleep quality." Looking forward, this study envisages future research directions, underscoring the significance of multidisciplinary collaborations, longitudinal studies, and cultural considerations within the domain of gaming disorder research. The implications of our findings contribute significantly to a nuanced comprehension of the evolving research landscape, providing valuable insights for shaping future research agendas and guiding interventions in this critical area.

1. Introduction

In recent years, the surge in popularity and accessibility of digital gaming has brought forth a concomitant rise in concerns surrounding the potential adverse effects of excessive gaming on individuals' mental health. As the digital gaming landscape continues to evolve, the scientific community has engaged in a concerted effort to understand and categorize gaming-related disorders.

This paper contributes to this ongoing discourse by presenting a comprehensive visual analysis of global research on gaming disorder spanning the years 2003 to 2023.

The World Health Organization's International Classification of Diseases, 11th Revision (IDC-11), released in 2018, formally recognized gaming disorder as a mental health condition. This inclusion marked a pivotal moment, highlighting the growing acknowledgment of the need to investigate the impact of gaming on mental well-being[1]. To navigate the expansive landscape of gaming disorder research, we employ CiteSpace[2], a powerful bibliometric analysis tool. CiteSpace facilitates the exploration of citation networks, offering visualizations that unravel the intricate web of scholarly communication.

By leveraging CiteSpace, we aim to uncover hidden patterns, emerging trends, and pivotal research nodes within the gaming disorder literature. This approach not only enhances our understanding of the global research landscape but also enables us to identify key contributors, seminal works, and the evolution of research themes over the past two decades.

Our study seeks to provide a nuanced and visually enriched perspective on the state of gaming disorder research. As we delve into the visual narrative woven by the interconnected threads of academic discourse, we aim to contribute valuable insights that can inform future research directions, clinical practices, and policy considerations in the realm of mental health and digital gaming.

2. Materials and Methods

2.1. Data Retrieval

The Web of Science (WOS) stands as a reputable and widely embraced digital publications resource database for conducting bibliometric analyses. On October 31, 2023, we meticulously queried the WOS core database to extract publications about gaming disorder, spanning from January 1, 2003, to October 31, 2023. The search formula utilized for this exploration was as follows: TS= (“gaming disorder” or “gaming addiction” or “game addiction”). Only articles with titles, abstracts, and keywords closely associated with gaming disorder were included in our dataset.

2.2. Screening Process

Inclusive criteria were rigorously applied: (1) Focused on gaming disorder with full-text availability; (2) Written in English; (3) Limited to the publication type "article"; (4) Originating from the Sciences Citation Index Expanded (SCI-E) and Social Sciences Citation Index (SSCI) databases of WOS; (5) Published between 2003 and 2023. Exclusion criteria were as follows: (1) Irrelevant topics unrelated to gaming disorder; (2) Publication types such as conference abstracts, graduation theses, reports, etc.

2.3. Variables and Analysis

Bibliometric methods were employed to amass cutting-edge knowledge and discern trends within gaming disorder research. Variables from the extracted data included annual publication counts, countries, institutions, journals, top 10 keywords, and burst keywords. For analysis and visualization, Citespace (version 6.1.R6 Basic) was employed. The software facilitated the examination of countries, keywords, and more. Burst keyword analysis using CiteSpace was performed to prognosticate emerging trends in the immunotherapy landscape for gaming disorder. Burst intensity, indicating the frequency of a keyword, was visualized, with higher intensity denoting increased prominence. Each node within the visual representation signifies an observation

result, encompassing keywords, institutions, countries, and co-cited references. Node size corresponds to citation or occurrence frequency, and connections between nodes represent collaborative or co-cited relationships. Notably, nodes are color-coded by the respective years, offering a dynamic representation of evolving trends over time.

3. Results

3.1. Annual Growth Trend of Publications on Gaming Disorder

Between January 1, 2003, and October 31, 2023, a comprehensive total of 3049 publications associated with gaming disorder emerged on the Web of Science (WOS), encompassing 2094 articles. These publications spanned 90 countries or regions, involving a diverse array of 192 institutions that contributed five or more publications on gaming disorder. Figure 1 illustrates the dynamic trajectory of publications on gaming disorder during this period. The research trend remained relatively stable until 2013, after which a notable surge in annual publications occurred. The most rapid growth transpired between 2019 and 2021, with 2022 marking the zenith, witnessing the highest number of publications on gaming disorder in the past two decades.

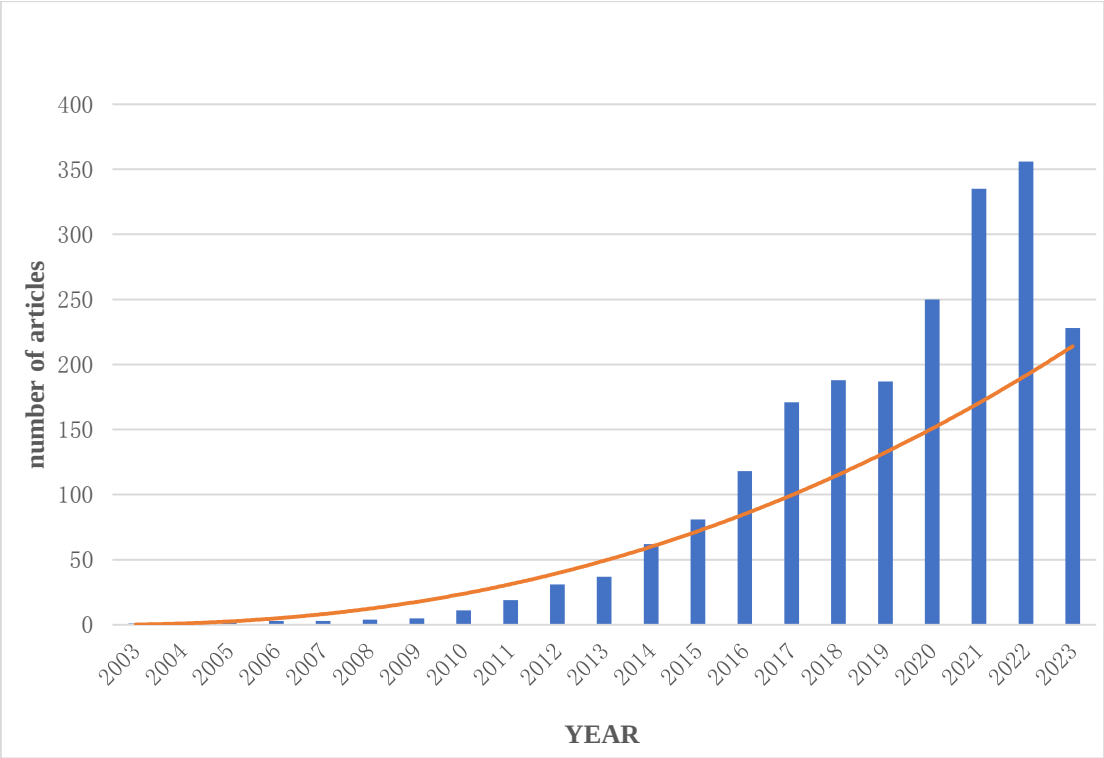

Figure 1. Annual trends in articles published on gaming disorder (2003-2023)

3.2. Analysis of Countries/Regions and Institutions

China emerged as the predominant contributor, boasting 286 publications, followed closely by the United States (245 publications), England (171 publications), Germany (166 publications), and South Korea (162 publications). Figure 2 visually captures the collaborative efforts of China and the United States, the two leading nations in gaming disorder research. Despite their prolific output, the collaboration between these countries remains noteworthy, underscoring the global nature of research in this field. Intriguingly, among the top ten institutions with the highest number of publications, only one hails from China (Figure 3).

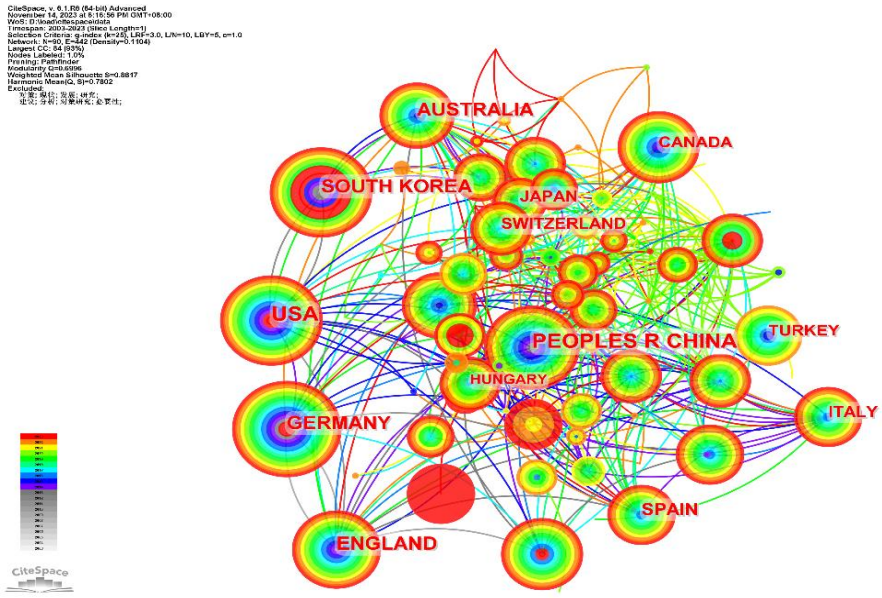

Figure 2. Cooperative network of countries in gaming disorder research

Visualizing the collaborative landscape of countries involved in gaming disorder research, the figure showcases a network of partnerships represented by nodes (countries) and lines (collaborations). The node area corresponds to the volume of publications, with colors transitioning from gray to red over the period 2003 to 2023. This dynamic representation provides insight into the evolving global cooperation in gaming disorder research.

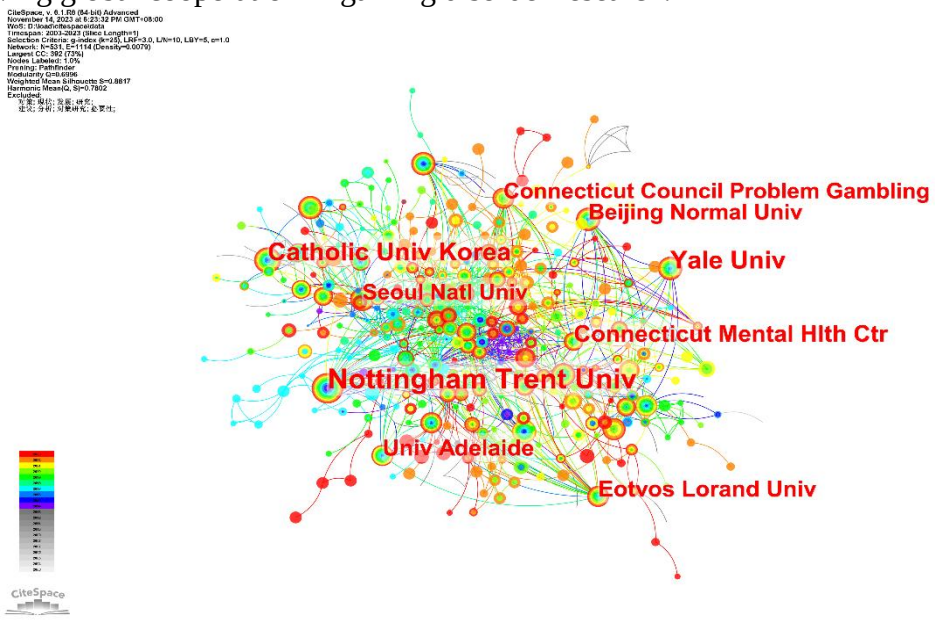

Figure 3. Cooperative network of institutions in gaming disorder research

The cooperative network of institutions engaged in gaming disorder research is depicted. Nodes represent institutions, lines represent partnerships, and the node area corresponds to publication volume. Colors shift from gray to red, symbolizing the evolving collaboration landscape from 2003 to 2023. This visualization offers a comprehensive view of the institutional dynamics within the field.

3.3. Analysis of Journals

The subject distribution of academic journals is depicted through a dual-map overlay, as illustrated in Figure 4. Color lines delineate reference paths, while labels pinpoint the represented disciplines of the journals. The map's coloring serves to highlight the principal citation pathways. A notable light blue citation path underscores the frequent citation of research from Psychology/Education/Health by journals in the Psychology/Education/Social domain. This observation provides valuable insights into the interconnectedness of research disciplines within the realm of gaming disorder.

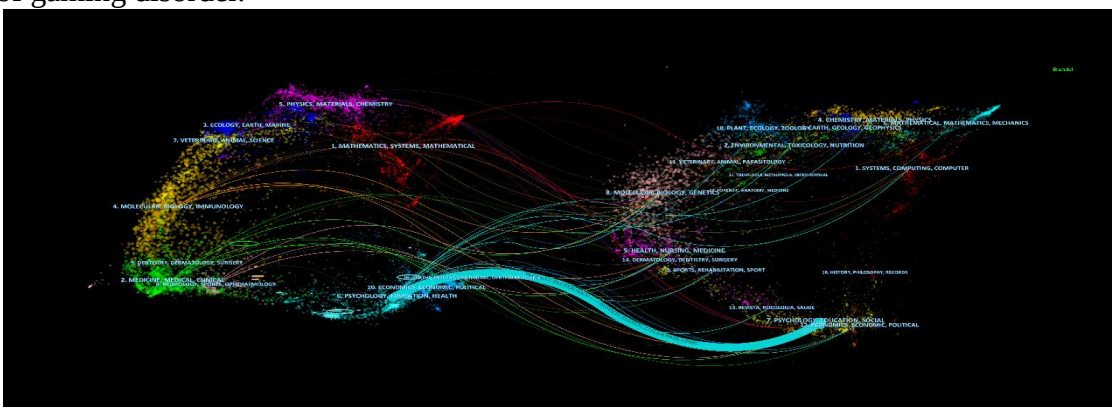

Figure 4. Dual-map overlay of journals in gaming disorder research

A dual-map overlay in this figure illustrates the subject distribution of academic journals related to gaming disorder. Citing journals appear on the left, cited journals on the right, with colored paths indicating citation relationships. This visualization provides a nuanced understanding of the multidisciplinary intersections within the gaming disorder research landscape.

3.4. Analysis of co-cited References and Timezone View

It can be seen that the co-cited references are divided into 10 clusters (Figure 5). Co-cited references refer to those that are frequently cited with other publications, which are considered the basis of research in a field. The smaller the number, the more keywords the cluster contains. “0# functional connective” has the most keywords, indicating that it has been widely studied on gaming disorder.

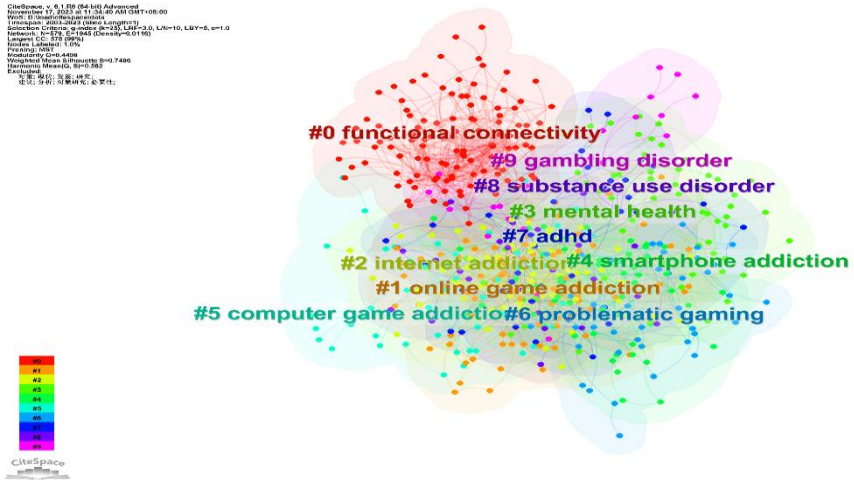

Figure 5. Knowledge map of co-cited references in gaming disorder research

Different colors denote distinct clusters, offering a visual representation of the thematic groupings within the co-cited references. This map enhances our comprehension of the foundational knowledge framework that shapes the discourse on gaming disorder.

Timezone view in the context of bibliometric analysis typically refers to a visual representation that incorporates the temporal dimension of the data. It allows for the examination of the historical evolution or appearance of certain elements over time. In the context of co-cited references or keywords, a timezone view would display how these references or keywords emerged and gained prominence across different periods. In this study, the position of each node along the vertical axis could indicate the year when a particular reference was first cited. This provides a chronological perspective, allowing researchers to observe the temporal patterns and shifts in the importance or influence of specific references over time. The representation often uses colors or shades to highlight the recency of citations, with redder colors indicating closer proximity to the present year. This visualization helps researchers understand the historical context of influential references within a particular field of study. Observing the progression, researchers initially directed their attention towards "children" and "adolescents" in the early stages. Midway through the period, a shift occurred, with a newfound focus on college students (Figure 6). Notably, during the surge of research activity, there was an emphasis on investigating the external manifestations, underlying mechanisms, and potential interventions for game addiction.

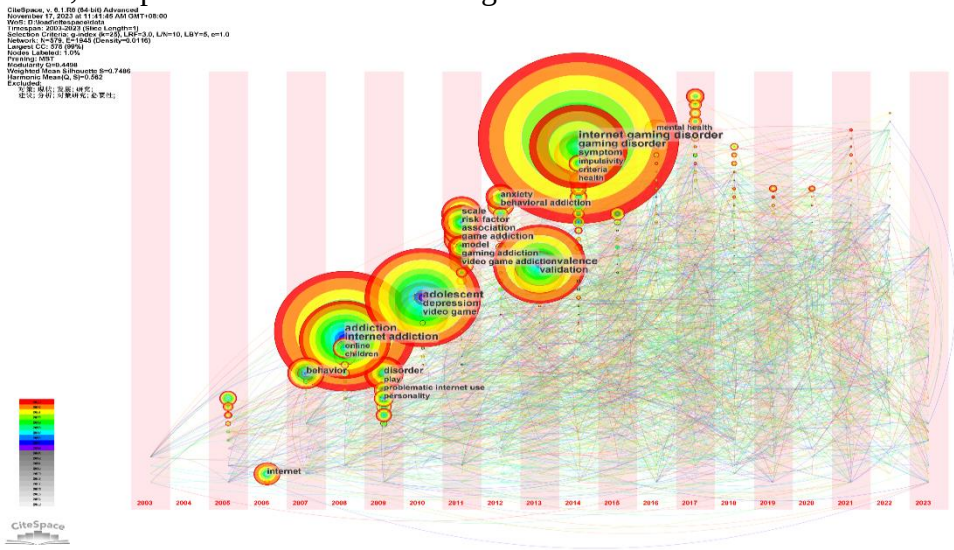

Figure 6. Timezone view of co-cited references in gaming disorder research

The position of each node on the vertical axis signifies the time of the reference's first appearance. The node size correlates with the number of co-citations, while lines between nodes represent co-cited relationships. The redder the color, the closer the association to the year 2023. This visualization provides a chronological perspective on the influential references shaping gaming disorder research.

3.5. Analysis of keyword co-occurrence

Our analysis revealed that keywords such as "internet gaming disorder," "adolescent," "prevalence," and "depression" exhibited the highest frequency (refer to Table 1). Examining the temporal evolution of these keywords provides valuable insights into the progression of cutting-edge knowledge in the field. This dynamic representation serves as a crucial guide for shaping future research directions in the domain.

Table 1. The top 10 most frequent keywords related to gaming disorder

Freq	Burst	BurstBegin	BurstEnd	Degree	Keyword
888	0			10	Internet gaming disorder
531	5.07	2010	2012	25	adolescent
428	0			22	prevalence
425	15.05	2009	2014	25	Internet addiction
254	0			22	depression
249	0			18	validation
240	3.69	2010	2012	29	video game
196	0			21	scale
192	0			25	risk factor
185	0			40	behavior

3.6. Keyword Burst Analysis

Identifying research fronts through burst keyword analysis is instrumental in recognizing topics that have garnered widespread attention over time. The top twenty keywords with the highest burst intensity from January 2003 to October 2023 are highlighted in Figure 7. Examples include “internet addiction” (Strength=15.05), “international consensus” (Strength=11.03), “Fmri” (Strength=7.95), and “depressive symptom” (Strength=7.53). Remarkably, "depressive symptoms" and "sleep quality" emerged as research hotspots from 2021 onward, providing early indications of potential directions for subsequent research endeavors.

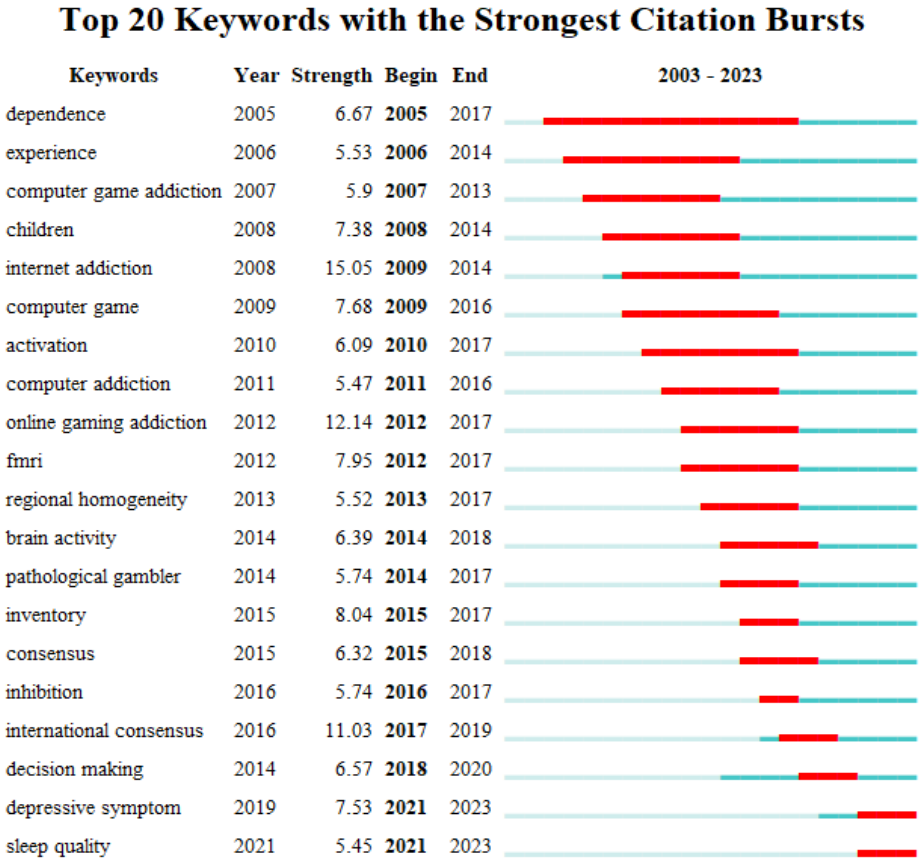

Figure 7. Keywords Exhibiting Robust Citation Bursts in Gaming Disorder Research

The temporal axis is depicted by the blue line, where the red segment denotes the initiation year, culmination year, and duration of the burst.

4. Discussion

The current state of gaming disorder research, as elucidated by the presented visual analysis, reflects a dynamic field in active evolution and expansion. This section will delve deeper into each key aspect contributing to the dynamic nature of the research landscape, expanding on the significance of each element.

4.1. Increasing Scholarly Attention

The surge in annual publications, particularly after 2013 and reaching a zenith in 2022, underscores the heightened scholarly interest in gaming disorder. This increased attention signifies a growing recognition of the importance of understanding the implications of excessive gaming on mental health. Researchers, clinicians, and policymakers are increasingly acknowledging the need to explore the multifaceted aspects of gaming disorder, given its potential impact on individuals and society.

4.2. Global Collaboration

The cooperative network of countries underscores a globally distributed effort in gaming disorder research. China and the United States emerged as prominent leaders, not only in terms of the sheer volume of publications but also in collaborative partnerships. This indicates a global perspective and shared responsibility in addressing the challenges posed by gaming disorder. The collaborative endeavors transcend national boundaries, emphasizing the universality of the issue and the need for a coordinated global response.

4.3. Institutional Contributions and Collaboration Dynamics

The collaborative network of institutions reveals the active engagement of numerous academic and research centers worldwide. The changing network dynamics, shifting from gray to red, highlights the temporal evolution of collaborative efforts. This evolution emphasizes the continuously developing landscape of gaming disorder research, reflecting the evolving dynamics of institutional partnerships and collaborative initiatives.

4.4. Interdisciplinary Nature of Research

The dual-map overlay of journals provides a vivid illustration of the interdisciplinary nature of gaming disorder research. The color-coded paths vividly portray the diverse disciplinary intersections within the field, illustrating the need for collaboration between fields such as psychology, medicine, and education. This interdisciplinary approach is essential for comprehensively understanding the complex interplay of factors contributing to gaming disorder.

4.5. Foundational Knowledge and Thematic Clusters

The knowledge map of co-cited references unveils the foundational literature shaping the discourse on gaming disorder. Distinct thematic clusters suggest the existence of specific domains within the literature, showcasing the multifaceted aspects of gaming disorder. This foundational knowledge provides a basis for further exploration and informs researchers about the key concepts

and theories that have shaped the field.

4.6. Temporal Evolution of References

The timezone view of co-cited references adds a temporal dimension to the analysis, offering a chronological perspective on the historical development of key concepts. Nodes' positions on the vertical axis signify when references first appeared, providing insights into the historical evolution of research themes. This temporal analysis is crucial for understanding how the focus of research has shifted over time.

4.7. Emerging Trends and Focal Points

Keywords with strong citation bursts indicate emerging trends and focal points within gaming disorder research. The burst intensity reflects the sudden and increased attention to specific topics, offering insights into evolving research priorities. Identifying these trends is instrumental for researchers and stakeholders to stay abreast of the latest developments and focus areas within the dynamic landscape of gaming disorder research.

In summary, the current status of gaming disorder research reflects a field characterized by global collaboration, interdisciplinary exploration, and a continual evolution of research priorities. The visual analysis not only captures the present landscape but also provides a foundation for future investigations and a more nuanced understanding of the complexities surrounding gaming disorder. As research in this field progresses, addressing identified gaps and considering emerging trends will be crucial for advancing our comprehension and developing effective strategies for prevention and intervention.

5. Future Directions

The exploration of gaming disorder research, as illuminated by our comprehensive visual analysis, unveils not only the current state of the field but also points toward promising avenues for future investigations. Building upon the insights gained from this study, we propose several directions that could shape the trajectory of gaming disorder research in the coming years.

5.1. Multidisciplinary Collaboration and Integration

Encouraging collaboration across diverse disciplines, including psychology, medicine, computer science, and education, could foster a more holistic understanding of gaming disorders [3]. Future research should explore the intersections of these fields to develop comprehensive strategies for prevention, intervention, and treatment. The amalgamation of expertise from various disciplines is crucial for addressing the multifaceted nature of gaming disorder.

5.2. Longitudinal Studies and Interventional Research

The exponential growth in publications post-2013 suggests a maturation of the field. Future studies should prioritize longitudinal research designs to track the long-term effects of gaming and discern patterns of gaming disorder development over time. Additionally, intervention-focused research could provide evidence-based strategies for mitigating the negative impacts of excessive gaming[3]. Longitudinal studies offer a nuanced understanding of the trajectory of gaming disorder and the effectiveness of interventions over time.

5.3. Cultural and Contextual Considerations

Recognizing the global nature of gaming, future research should delve into cultural variations in gaming behaviors and the manifestation of gaming disorder. Understanding how cultural factors influence the prevalence and impact of gaming disorders can inform culturally sensitive interventions and policies[4, 5]. Cultural context plays a crucial role in shaping individuals' attitudes toward gaming and their susceptibility to gaming-related issues.

5.4. Development of Standardized Diagnostic Criteria

With the official recognition of gaming disorder in the IDC-11, there is a need for the refinement and standardization of diagnostic criteria[1, 6]. Future research could contribute to the development of universally accepted and culturally adaptable diagnostic guidelines, fostering consistency in diagnosis and facilitating cross-cultural comparisons[7]. Standardized criteria are essential for ensuring a common understanding of gaming disorders across diverse cultural and clinical contexts.

5.5. Technological Interventions and Digital Well-being

Given the omnipresence of digital technologies, exploring the efficacy of digital interventions for gaming disorders is essential[8]. Future research might focus on the development and assessment of digital tools, applications, or interventions aimed at promoting healthy gaming habits and digital well-being[3, 9, 10]. Leveraging technology for interventions aligns with the evolving nature of gaming and provides scalable solutions for addressing gaming-related issues.

5.6. Ethical and Legal Implications

As the understanding of gaming disorder evolves, ethical and legal considerations must be addressed. Future research should explore the ethical implications of gaming disorder diagnosis and treatment, as well as the development of policies to safeguard individuals while respecting their autonomy in the digital age[11]. Ethical considerations are paramount to ensure that interventions and policies are ethically sound and prioritize the well-being of individuals affected by gaming disorder.

5.7. Advances in Neuroscientific Research

Leveraging neuroscientific methodologies can deepen our understanding of the neural correlates of gaming disorder. Future studies might employ advanced neuroimaging techniques to investigate the neurological mechanisms underpinning gaming-related behaviors, providing valuable insights for targeted therapeutic approaches[3, 12]. Neuroscientific research can offer a more granular understanding of the cognitive and neural processes associated with gaming disorder.

5.8. Integration of Virtual Reality and Augmented Reality

The advent of virtual reality (VR) and augmented reality (AR) technologies introduces new dimensions to gaming. Many researchers have studied the role of virtual reality and augmented reality as an intervention in gaming disorders[13, 14]. Future research could explore the impact of immersive gaming experiences on mental health and gaming disorders, paving the way for guidelines on the responsible use of emerging technologies. Understanding how virtual and augmented realities influence gaming behavior can inform guidelines for responsible and healthy

engagement with these evolving technologies[15-17].

In conclusion, the future of gaming disorder research holds immense potential for multidisciplinary collaboration, technological innovation, and cultural sensitivity. By addressing these future directions, researchers can contribute to a more nuanced and comprehensive understanding of gaming disorder, ultimately guiding the development of effective interventions and policies for the digital age. The proposed directions aim to advance the field, ensuring that research remains adaptive and relevant in the face of evolving gaming landscapes and emerging technologies.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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