Mapping the Research Landscape of Internet Addiction and Attention Deficits

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The internet's omnipresence has transformed information-seeking, social interaction, and self-identity. With smartphones enabling constant connectivity, concerns about internet addiction and attention deficits have increased. This study conducted a bibliometric and science mapping analysis of 402 documents indexed in the Scopus database (1982–2023) to assess the research landscape on these topics. The primary objectives were to identify prominent themes, examine the evolution of the field, and highlight emerging directions for future research. Findings indicate a surge in publications on these topics since 2008, highlighting growing interest. Keyword co-occurrence maps and Enhanced Strategic Diagrams (ESDs) revealed four major thematic clusters: mental health, behavior, cognition, and neuroscience. Within these key topics are anxiety, smartphone addiction, impulsivity, and executive function. The analysis also identified emerging areas, including gender, neurodevelopmental disorders, insomnia, Tourette syndrome, compulsivity, dopamine, and artificial intelligence. Despite some limitations, this comprehensive analysis provides valuable insights, establishing a robust foundation for future research in the dynamic interplay of digital technology and human behavior.

Keywords. Internet addiction, attention deficits, Scopus, VOSviewer, enhanced strategic diagrams

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In recent times, the widespread incorporation of the internet has been intricately woven into the everyday lives of both adults and teenagers (Nagata et al., 2025). This integration has caused a global shift in the methods used by individuals to find and distribute information, build relationships, gain social recognition, and identify their social standing (Anderson & Jiang, 2018; Perrin & Jiang, 2018). The emergence of smartphone technologies has significantly emphasized this paradigm shift by enabling constant internet access and promoting a culture of continuous online connectivity (Firth et al., 2020).

Amidst the myriad possibilities that the internet offers for personal and societal enhancement, the attendant risks of excessive internet use are becoming increasingly apparent (Loh & Kanai, 2016). The idea of internet addiction was first proposed by American psychiatrist and researcher Ivan Goldberg. It was later defined as a behavior-control disorder by psychologist Kimberly Young in 1996 (Young, 2009). This concept has evolved from a psychological construct to a subject of interest in psychiatry. Despite this evolution, a universally accepted definition of internet addiction remains elusive (Chen et al., 2023).

Internet addiction is commonly conceptualized as the manifestation of compulsive behaviors and cognitions linked to internet use, resulting in considerable disruption to everyday life (Shapira et al., 2000). The repercussions of this condition extend beyond mere behavioral manifestations, encompassing social isolation, suicidal thoughts, and various other psychological and behavioral problems in youth and adolescents (Guo et al., 2020; Kato et al., 2020). Recent studies have increasingly focused on the association between internet or social media usage and cognitive or behavioral issues such as attention deficits, hyperactivity, impulsivity, and memory problems (Augner et al., 2023; Firth et al., 2020; Wang et al., 2017). While these studies contribute to understanding specific aspects of internet addiction, the broader research landscape remains fragmented, with limited efforts to systematically map the evolution and thematic trends in this field.

Given the rapid expansion of digital technology and its profound psychological and behavioral implications, there is a pressing need to comprehensively assess the intellectual structure and thematic development of research on internet addiction and attention deficits. A bibliometric mapping approach provides a systematic means of synthesizing existing evidence, identifying influential research clusters, and evaluating trends that may otherwise remain obscured in traditional narrative reviews (Shafin et al., 2022).

Therefore, the broader objective of this study is to map the research landscape on internet addiction and attention deficits to better understand its intellectual evolution and future trajectory. Specifically, the study aims to (i) identify the most prominent themes and research clusters within the field, (ii) examine how the thematic structure of the field has evolved, and (iii) determine which research topics are emerging, stable, or declining.

By addressing these objectives through bibliometric analysis and Enhanced Strategic Diagrams (ESDs), this study seeks to provide valuable insights that can guide future research and inform interventions addressing the complex interplay between digital technology, cognition, and behavior.

Method

Data for this study were obtained from the Scopus database on November 23, 2023. Scopus database was selected due to its extensive range of journal and citation coverage (Pranckutė, 2021; Zhu & Liu, 2020), and because most journals listed in Web of Science are also included in Scopus (Singh et al., 2021). The utilization of the research field title and abstract was deemed the most suitable choice and was used in this study for the following reasons. Despite exhibiting high performance in terms of selection efficiency when searching in the title as a research field, it was found to be too restrictive and excluded a significant number of important documents (Pallottino et al., 2020). The search strategy comprised three groups of terms:

(i) Technology-related terms: Internet, cyber, computer, social media, smartphone, gaming, Facebook, TikTok.

(ii) Addiction-related terms: Addiction, compulsion, overload, overuse, dependence, pathological.

(iii) Attention-related terms: Attention deficit, ADHD, psychiatric comorbidity.

In total, 402 documents were identified and included for detailed examination. The inclusion criteria were: (i) documents indexed in Scopus; (ii) availability of bibliographic data in English; (iii) relevance to internet addiction, attention deficits, or closely related psychological and behavioral issues based on title or abstract; and (iv) all document types, except errata. VOSviewer software (version 1.6.20) was employed to visualize author keywords, with data formatted as .csv files (van Eck et al., 2023). This tool, known for its user-friendly interface, facilitated the construction of co-authorship network maps

and keyword co-occurrence analyses. This method was particularly advantageous for identifying central research themes and significant research clusters concerning internet addiction and attention deficits. VOSviewer facilitated data cleaning by incorporating a thesaurus file, which enhanced the precision of the analysis. Using data from VOSviewer, the median values for Total Link Strength (TLS), average publication year, and frequency of occurrence were determined (Cobo et al., 2011; Feng et al., 2021).

The study's key findings included theme networks, overlay visualization, and ESDs (Cobo et al., 2011; Feng et al., 2021). The ESD utilized a three-dimensional framework where centrality, density, and time were mapped on the x, y, and z axes respectively, based on research by Feng et al. (2021). Centrality quantified the interaction level between networks through the average strength of external links like TLS, highlighting nodes with higher scores for their significant influence on field progression. Density, determined by the co-occurrence of author keywords, indicated the internal robustness of a network. The novelty of topics was gauged by the average publication year, with values at or above the median considered novel, and those below categorized as old.
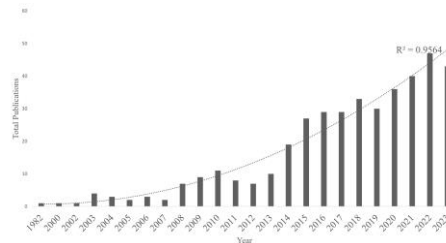
Results

The results of this bibliometric analysis provide an overview of the publication trends, thematic structures, and emerging research directions in the field of internet addiction and attention deficits. Following the data retrieval and screening process, bibliometric indicators were analyzed to examine annual publication output, identify clusters of related topics through keyword co-occurrence, and evaluate thematic development using ESDs. These methods allowed us to capture both the historical evolution of the field and the emergence of novel research areas (Cobo et al., 2011; Feng et al., 2021; van Eck & Waltman, 2023). The findings are presented in three parts: (a) publication trends over time, (b) thematic clusters identified through co-occurrence analysis, and (c) thematic categorization and evolution as revealed by ESDs.

The Pattern of Annual publications

The publication trend focuses on internet addiction and attention deficit, demonstrating a noteworthy evolution over the years. Starting with a single publication in 1982, there is a discernible gap until 2000, indicating a slow start or minimal emphasis on these topics. A gradual

increase in publications is observed from 2003 to 2007, possibly reflecting a growing recognition of the issues associated with internet addiction and attention deficit. The most substantial surge occurred from 2008 to 2013, suggesting a heightened interest during this period. Subsequently, the years 2014 to 2019 depict a period of relative stability with fluctuations, indicating a potentially mature field. From 2020 to 2022, there was a sharp and consistent rise in publications, pointing towards sustained and growing attention to internet addiction and attention deficit. The trend analysis indicates a polynomial growth in the number of publications ($R^2 = 0.96$), surpassing the rate of linear increase (see Figure 1).

Figure 1: *The Trend of Publications: Themes and Topics Derived from the Co-Occurrence of Authors' Keywords*

The keyword co-occurrence map was generated using VOSviewer. applying a threshold of three keyword co-occurrence. Four primary themes emerged from the analysis of cluster terms in the literature: the correlation between internet addiction and mental health, behavior, cognition, and neuroscience. The thematic map is depicted in Figure 2, while Figure 3 illustrates the temporal co-word analysis, highlighting peaks in the popularity of specific themes over time. Clusters 1 to 3 (Red, Green, and Blue) are notable for incorporating more recent keywords compared to other clusters.

Figure 2: *The Main Clusters Through Analysis of Keyword Co-Occurrence*
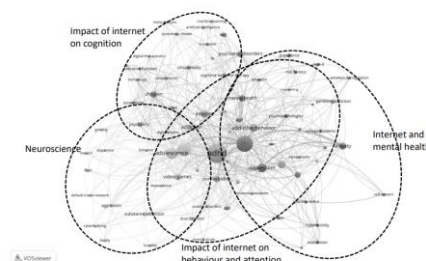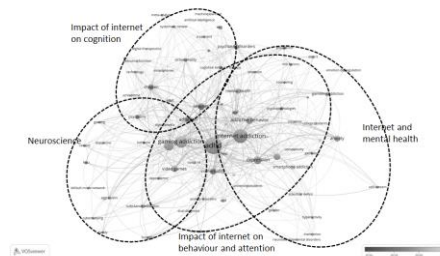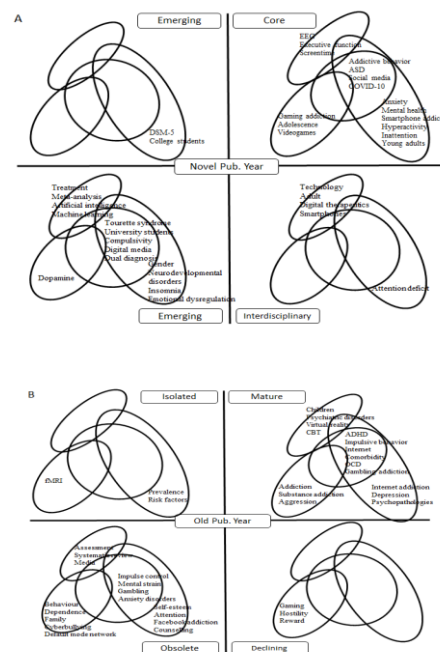
Figure 3: *Overlay on Keyword Co-Occurrence Over Time*

ESDs were created by evaluating each keyword's occurrence (density), average publication year (novelty) and total link strength (centrality) relative to their median values. The spatial arrangement of themes categorized them into four types based on their density and novel publication year (Figure 4a): Emerging themes with high density (upper-left quadrant), core themes (upper-right quadrant), emerging themes with low density (lower-left quadrant), and interdisciplinary themes (lower-right quadrant). Figure 4b illustrates the categorization of themes based on their density and older publication year, identifying them as isolated (upper-left quadrant), mature (upper-right quadrant), obsolete (lower-left quadrant), and declining (lower-right quadrant).

Figure 4: *ESDs Illustrate Themes in (A) Novel Publications, and (B) Older Publications*

Discussion

This study aimed to explore internet addiction and attention deficit literature, utilizing a science mapping approach and integrating theories of scientific change (Chen, 2017). The examination revealed that the internet addiction and mental health cluster emerged prominently with the highest keywords, underscoring a considerable focus and extensive research volume in this domain. Intricate connections were observed as this cluster intersected with three other clusters. Core keywords in each cluster were identified based on their high frequency and strong external links. Within the cluster focused on internet addiction and mental health, notable keywords include anxiety, smartphone addiction, hyperactivity, inattention, and young adults.

The surge in smartphone usage has prompted increased research into its potential adverse effects on daily routines and overall well-being. An increasing number of youths dedicate their free time to various digital media platforms, which include smartphones, computers, and tablets (Twenge & Farley, 2021). Multiple studies underscore heightened smartphone usage among individuals, which disrupts daily routines, compromises safety, and affects overall well-being (Cazzulino et al., 2014; Clayton et al., 2015; Kumcagiz, 2019; Lepp et al., 2015). Additionally, prolonged and excessive usage of smartphones correlates with adverse effects on mental health and behavior (Alhassan et al., 2018; Demirci et al., 2015; Elhai et al., 2016; Svensson et al., 2022; Twenge & Martin, 2020). Research consistently indicates that internet addiction is linked to challenges in interpersonal relationships, reduced well-being, academic underachievement, and psychological disorders such as anxiety, depression, and attention-deficit/hyperactivity disorder, particularly among young adults (Ansari et al., 2022; Boers et al., 2019; Kim et al., 2019; McNamee et al., 2021; Riehm et al., 2019; Viner et al., 2019).

The second largest cluster, focusing on internet addiction and behavior (Green cluster), encompasses core topics such as addictive behavior, ASD, social media, and COVID-19. Recognizing behavioral addictions as akin to substance addiction emphasizes the diverse nature of addictive tendencies. Various addictive behaviors, such as gambling, video gaming, eating disorders, sports, media consumption, sex addiction, pathological work habits, and compulsive criminal conduct, are likened to chemical addictions by experts (Griffiths, 1990; Horvath, 2004; Keepers, 1990; Kubey et al., 2001; Lesieur & Blume, 1993; Morgan, 1979; Vaugeois, 2006). Behavioral addictions encompass both passive activities like watching television and active engagements such as playing computer games, often characterized by reinforcing

mechanisms that foster addictive tendencies (Widyanto et al., 2006). Individuals with Autism Spectrum Disorder (ASD) may be particularly susceptible to these behaviors (Tateno et al., 2023). Studies highlight a higher occurrence of internet addiction, notably among younger adults amidst the COVID-19 pandemic (Biswas et al., 2022; Gavurova et al., 2022; Onukwuli et al., 2023; Pan et al., 2022; Tahir et al., 2021).

The internet addiction and cognition cluster (Blue cluster) delves into neuroscientific aspects, emphasizing EEG, executive function, and screen time as the core keywords. The hypothesized neural mechanisms contributing to internet addiction and gaming disorders shed light on the cognitive impact of excessive internet use. The neural mechanisms implicated in internet addiction and internet gaming disorders are thought to involve an intense cortico-limbic reward system and impaired inhibitory control within the executive control network (ECN). These conditions share similarities in impulsivity but differ in rewarding stimuli reinforcing addictive behaviors (Burleigh et al., 2020; Sharifat & Suppiah, 2021). Internet addiction is associated with deficits in attention span, working memory, and decision-making abilities, particularly in risk assessment (Dong et al., 2013). Smartphone addiction correlates with declined cognitive function and impairments in attention, inhibition, and working memory (Lee et al., 2017; Lin et al., 2015). Digital addiction can also impact social cognition, affecting empathy and interpersonal interactions (Tao et al., 2010). Frequent engagement with social networking sites has been linked to poorer social skills and difficulties in recognizing facial expressions (Błachnio et al., 2016). According to Ratnasari and Haryanto (2019), extended use and dependency on mobile devices among youth may adversely affect their neurocognitive development. Extended use of gadgets has been linked to impaired cognitive development in youth, affecting their creative thinking, imagination, sensorimotor skills, language abilities, executive functions, and academic performance (Felix et al., 2021; Liu et al., 2022; Suggate & Martzog, 2021). Moreover, regular interaction with digital media and high-speed games has demonstrated a decline in the executive functioning abilities of youth (Sigman, 2017).

The core keywords under the internet addiction and neuroscience cluster were gaming addiction, adolescence, and video games. Engaging in internet gaming, including video games, offers benefits such as enhancing quality of life, reducing stress, and fostering social interactions. However, excessive engagement in online gaming carries risks, especially for susceptible populations like youth and adolescents (King & Delfabbro, 2014). The prevalence of gaming addiction varies widely because of differences in study populations, methodologies, and

survey timelines. For instance, studies have reported diverse prevalence rates: 1.2% in Germany (Rehbein et al., 2015) and 8.5% among youths in the US meeting the criteria for addiction to internet gaming (Gentile, 2009). In Asia, addiction to internet gaming affects around 5% of adolescents, with significantly higher rates in males compared to females (Cheng & Li, 2014; Fam, 2018). Youth and adolescents exposed to excessive gaming are vulnerable to various mental health issues, including depression, anxiety, and aloneness (Lo et al., 2005; Tsui & Cheng, 2021; Wang et al., 2018).

Low-density emerging keywords under internet addiction and mental health (Red cluster) include gender, neurodevelopmental disorders, insomnia, and emotional dysregulation. While the high-density emerging keywords include DSM-5 classification and college students signify an evolving discourse around formalizing diagnostic criteria and understanding internet addiction in higher education. The recognition of gender-related factors highlights a growing understanding of how gender influences mental health outcomes in the digital era. Research indicates that heavy digital media use is associated with poorer psychological well-being, with stronger effects observed in adolescent girls compared to boys (Svensson et al., 2022; Twenge & Martin, 2020). Despite this, males exhibit a higher propensity for internet addiction (Su et al., 2019). Individuals with neuro developmental disorders are particularly vulnerable to such addictive behaviors (Tateno et al., 2023). In 2020, the World Health Organization formally recognized addiction to digital technology as a global concern, linking extreme online activity to impaired daytime functionality and disrupted sleep patterns (Evli et al., 2023; Nikolic et al., 2023). Moreover, emotion dysregulation, characterized by impaired emotional processing and regulation strategies, is prevalent among individuals with attention deficits (Ambrosini et al., 2013; Tonacci et al., 2019). The intersection of attention deficit and internet use underscores potential associations between these conditions (Panagiotidi & Overto, 2018; Zakaria et al., 2023).

Although the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) or the International Classification of Diseases (ICD-10) (American Psychiatric Association, 2013) do not currently classify addiction to smartphones as a recognized clinical disorder, its characteristics share similarities with recognized behavioral addictions (Ting & Chen, 2020). Although there is no formal diagnostic classification for addiction to smartphones, research involving college students has led to the development and validation of suggested criteria (Lin et al., 2015; Lin et al., 2016).

Tourette syndrome, university students, compulsivity, digital media and dual diagnosis were the emerging keywords with low density under the internet addiction and behavior cluster (Green cluster). An evident rise in Tic-Like Behaviors (TLBs) among youth, adolescents, and young adults has been noted. Many individuals attribute the onset of TLBs to exposure to videos on platforms like TikTok or YouTube depicting individuals purportedly affected by Tourette's syndrome (Frey et al., 2022; Heyman et al., 2021; Hull & Parnes, 2021; LaFaver & Pringsheim, 2021; Paulus et al., 2021). Tourette's syndrome, marked by frequent motor tics and at least one vocal tic preceded by a premonitory urge, is classified as a neurodevelopmental disorder (Novotny et al., 2018; Robertson et al., 2017). It commonly co-occurs with conditions, for instance, attention deficit hyperactivity disorder, obsessive-compulsive behavior, and various mood disorders (Xu et al., 2020).

The low-density emerging keywords in the internet addiction and cognition cluster (Blue cluster) include treatment, meta-analysis, artificial intelligence and machine learning. In recent years, digital tools like social media, smartphones, and artificial intelligence have fundamentally altered how people interact with information. These technologies offer substantial benefits, enhancing connectivity, speed, convenience, and productivity in daily life. Smartphones facilitate instant access to information and communication, while social media platforms revolutionize global interaction and information exchange. Additionally, artificial intelligence automates tasks, optimizing workflows. However, research into how these digital tools affect brain function and cognition is still difficult and complex (Shanmugasundaram et al., 2023). In the domain of Artificial Intelligence (AI), there is growing support for employing automated assessment technologies to improve cognitive evaluation (Javed et al., 2023) and treatment outcomes (Vieira et al., 2022). Meta-analyses were frequently conducted to consolidate findings on cognitive deficits linked to internet addiction (Ioannidis et al., 2019), numerous interventions for managing internet addiction (Zhang et al., 2022), cognitive behavioral therapy role in addressing internet addiction (Zhang et al., 2019), and associated factors such as gender, urban living, and prolonged online activity (Zewde et al., 2022). This cluster's key interdisciplinary topics are technology, digital therapeutics, and smartphones.

In the internet addiction and neuroscience cluster (Yellow cluster), dopamine has been identified as a low-density emerging keyword. Researchers found that internet addiction patients have altered brain structure and function, emphasizing the role of dopamine in craving

and uncontrolled behavior. Recent research examining the volume of gray matter and functional connectivity in internet addiction individuals indicates impairments in executive, reward, and decision-making systems. These alterations in brain structure and connectivity contribute to abnormal brain function in individuals with internet addiction (Chen et al., 2023). Dopamine, a neurotransmitter responsible for feelings of pleasure, plays a crucial role in brain areas like the prefrontal cortex, anterior cingulate gyrus, and insula, which govern reward processing, decision-making, and executive functions. Dysregulation of the dopamine system is implicated in the behavioral patterns and cravings associated with internet addiction, leading to compulsive behaviors (Chen et al., 2023). The dopamine loop theory suggests that smartphone notifications can trigger a surge in dopamine levels, quickly followed by a decline, prompting repeated checking behaviors. Neuroimaging studies, akin to those in substance abuse, reveal a lower density of dopamine-transporter and occupancy of dopamine D2 receptor in the striatum among internet gaming disorder individuals (Ariatama et al., 2019; Weinstein, 2017; Weinstein & Lejoyeux, 2020).

Limitations and Suggestions

Several constraints were identified in our current bibliometric analysis. First, the reliance on a single database may have resulted in the exclusion of several significant papers. Second, the methodology allowed us to ascertain only the mean occurrence of keywords, lacking the ability to pinpoint each keyword's occurrence within exact years. Third, the possibility of overlooking keywords with occurrences below the predefined minimum occurrence was also acknowledged, though it was not expected to be of substantial impact. In addition, the methodology did not enable the identification of external factors influencing scientific research directly. Finally, formal optimization of thematic categories was not undertaken, potentially leading to variations in the interpretation of descriptive themes among different readers.

Conclusion

This study provides a comprehensive bibliometric mapping of research on internet addiction using keyword co-occurrence analysis and ESDs. The findings reveal four dominant thematic domains: Mental health, behavior, cognition, and neuroscience. Key topics include anxiety, attention deficits, and smartphone addiction, while

emerging areas such as neurodevelopmental disorders and insomnia suggest future research directions. Despite the above limitations, this study carries important implications for both research and practice. It provides a useful foundation in identifying research gaps and prioritizing underexplored themes for future work on internet addiction related to psychological and behavioral issues in the digital age. Practically, the findings may inform educators, clinicians, and policymakers in developing evidence-based strategies to mitigate the psychological and behavioral impacts of problematic internet use, thereby contributing to healthier digital engagement in society.

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