



## Review article

# Tracing knowledge diffusion trajectories in the research field of cyberbullying

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## ABSTRACT

In today's digital age, cyberbullying has emerged as a pervasive issue that affects individuals across various social media platforms and digital communication channels. This review explores the developmental trajectory of cyberbullying as an interdisciplinary academic field, employing a unique combination of co-word analysis and main path analysis (MPA) across a substantial body of 5183 documents. This integrated methodological approach allows for a nuanced examination of the evolution of themes and influential works within the realm of cyberbullying research. The findings highlight a complex landscape where initial focus areas, such as the behavioral and psychological triggers of cyberbullying, progressively expand towards exploring effective preventive measures and intervention strategies. Key themes identified include the impact of digital literacy, the dual role of social media as both a vector and a tool against cyberbullying, and the potential of technological advancements in detecting and mitigating cyberbullying. This comprehensive mapping and analysis deepens our understanding of cyberbullying and highlights the dynamic nature of this field, suggesting new directions for future research and practical applications to effectively address cyberbullying across various social and technological contexts. This study represents a pioneering effort in synthesizing a broad spectrum of research to offer detailed insights into the changing dynamics of cyberbullying, marking a significant contribution to both academic knowledge and practical approaches to handling cyberbullying.

## 1. Introduction

Conceptually, cyberbullying is defined as aggressive behavior enacted through electronic or digital media [1–3]. Cyberbullying targets individuals with hostile messages meant to inflict discomfort or harm [4,5]. This form of bullying manifests as repeated actions by individuals or groups leveraging the veil of anonymity provided by the internet, amplifying the aggressors' ability to continually reach their victims [6,7]. Significantly, those affected by cyberbullying often experience traditional bullying as well, indicating a pervasive cycle of harassment [8,9]. Despite some researchers treating it as an extension of conventional bullying, others argue for its distinction due to its unique characteristics and implications [4,10]. The main distinctions between cyberbullying and traditional

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bullying lie in the methods and reach of the aggressors. Cyberbullying is executed through digital platforms like social media, texts, and emails, allowing bullies to transcend physical boundaries and time constraints [11]. Unlike traditional bullying, which requires the physical presence of the victim and the bully, cyberbullying can occur 24/7, making it difficult for victims to find refuge even in their own homes [12]. The anonymity afforded by the internet can also embolden cyberbullies, who might not engage in such behaviors face-to-face.

The impact of cyberbullying is profound, leading to severe consequences such as depression, anxiety, and even suicidal ideation [13–15]. These effects emphasize the urgent need to understand and address the issue comprehensively. The root causes of cyberbullying are influenced by an interplay of factors involving peers, family, educational institutions, and broader societal norms [16]. Peer influences can prompt individuals to engage in or become targets of cyberbullying. Family dynamics also play a crucial role, as poor communication may prevent the detection and intervention in cyberbullying cases [17,18]. Furthermore, schools are critical in combating cyberbullying through positive culture and effective policies, although challenges remain in governing online behavior outside school premises. Broader societal norms that trivialize aggressive behavior online also contribute to the issue [19]. Therefore, addressing cyberbullying requires holistic approaches, combining education, legislation, and community engagement to promote digital literacy and empathy, alongside supporting legal frameworks to protect and aid victims [13,20].

Recent statistics underscore the escalating prevalence of cyberbullying and signal an urgent need for both academic and practical interventions. For instance, in 2023, a study by the Cyberbullying Research Center revealed that 26.5 % of middle and high school students reported experiencing cyberbullying [21]. It is a noticeable increase from previous years, highlighting the growing impact of this issue. This statistic reflects a broader trend and indicates a rise from 23.2 % in 2021 and even more from earlier years [21]. Additionally, a 2022 survey by the Pew Research Center found that cyberbullying rates were particularly high among older teen girls and lower-income households, demonstrating specific demographic vulnerabilities [22]. This survey highlights how socio-economic factors and gender can influence the experience of cyberbullying, with some groups being more at risk than others.

This alarming trend has galvanized the academic community, which recognizes the critical role of research in developing effective strategies to mitigate the adverse effects of cyberbullying. The surge in scholarly publications and research efforts aimed at understanding the nuances of cyberbullying and its far-reaching consequences is a testament to this burgeoning interest. For example, Aboujaoude et al. [23] underscore the prevalence and demographic specifics of cyberbullying while also exploring the mental health implications and management strategies. This study, alongside others such as Selkie et al.'s [24] systematic review of cyberbullying among US adolescents, emphasizes the need for robust, consistent methodologies and definitions to enhance the quality of research and interventions.

Further deepening the field, Gaffney et al. [25] evaluate the effectiveness of intervention programs and demonstrate a significant potential to reduce cyberbullying through structured preventative programs. Similarly, Zych et al. [26] provide a comprehensive overview of the existing knowledge on these issues and highlight the effectiveness of various intervention strategies. On a more specific note, Watts et al. [27] explore cyberbullying within higher education and feature unique challenges and the need for tailored approaches in universities and colleges. Additionally, Brochado et al. [28] critically examine how different methodologies influence prevalence estimates, adding another layer of complexity to the understanding of cyberbullying dynamics. The issue of measurement is tackled by Berne et al. [29], who review various assessment instruments for cyberbullying, focusing on their structural and psychometric properties; Peter & Petermann [30] offer a concept analysis aimed at refining the definition of cyberbullying, ensuring more standardized research outcomes. Lastly, Sabella et al.'s [2] work on debunking cyberbullying myths and Zych et al.'s [31] review of the historical and impact-focused research highlight the evolving nature of the field and emphasize the importance of informed and evidence-based responses to cyberbullying.

Moreover, recent bibliometric studies have analyzed the landscape of cyberbullying research across various domains. For instance, Achuthan et al. [32] examined the correlation between cyberbullying research and sustainable development, as well as the effects of COVID-19, identifying a total of 7045 papers published from 2010 to 2021. Cretu and Morandau [33] provided a bibliometric analysis of three decades of research on bullying and cyberbullying in education, reviewing 1633 papers from 1991 to 2020. A notable contribution is the study of Saif and Purbasha [34], which examined cyberbullying among youth in developing countries via a qualitative systematic review and bibliometric analysis, encompassing 47 articles published from 2007 to 2021. In a similar vein, Barragán Martín et al. [35] conducted a bibliometric analysis of 1530 papers published from 2010 to 2020 to investigate cyberbullying among adolescents. In a study, Cáceres-Reche et al. [36] examined the phenomenon of cyberbullying specifically among children and adolescents, analyzing 1097 papers published prior to 2018. Furthermore, López-Meneses et al. [37] evaluated the socioeconomic impacts of cyberbullying within educational settings via a bibliometric analysis of 1128 publications from 2004 to 2019. Finally, Peker and Yalçın [38] conducted a bibliometric and network analysis of global research on cyberbullying in the context of cross-cultural collaborations, reviewing 2270 papers published from 1970 to 2021.

Despite the comprehensive array of research, there remains a notable gap in studies employing co-word and main path analyses to delve into cyberbullying research. The purpose of employing these bibliometric techniques and co-word analysis in this review is to address two key research questions: 1) What are the dominant themes in the literature, and how are they interconnected? 2) How has the field of cyberbullying research evolved over time, as identified through key citation paths? This review employs these advanced techniques with a clear and detailed approach, which are essential for uncovering deep thematic connections and pinpointing seminal works that conventional bibliometric techniques might overlook. We utilize the Scopus database as the primary data source, with data collection following a rigorous multistage filtering process to ensure the inclusion of high-quality and relevant research. Scopus was selected for its comprehensive coverage of high-quality peer-reviewed journals across multiple disciplines, including social sciences, technology, and health sciences, all of which are relevant to cyberbullying research. This ensures a reliable basis for our analysis. Such techniques excel in constructing detailed thematic structures and tracing the intricate evolution of academic topics [39,40].

By applying co-word and main path analyses, we aim to contribute to the paper's overall goal of mapping the intellectual development and thematic progressions within cyberbullying research. Researchers can gain transformative insights into the intellectual trajectory and theoretical development of cyberbullying studies. Furthermore, these techniques could unveil emerging research frontiers and significant knowledge gaps in the field. Co-word analysis, performed using CiteSpace 6.3, investigates the patterns and relationships of keywords in research, uncovering fundamental themes in the cyberbullying literature. Co-word analysis, which examines the patterns and associations of keywords across studies, can highlight neglected or minimally explored topics [41,42]. Additionally, main path analysis (MPA) is performed using Pajek software, focusing on the progression of key ideas over time and showcases how certain concepts have emerged and their impact on the field [43]. These methodologies allow us to track the flow of ideas and identify the most influential research paths, thereby providing deeper insights into how the field of cyberbullying has developed over time. This review not only enriches our comprehension of the current research landscape but also steers future investigations toward more holistic and in-depth explorations of cyberbullying and ensures a more comprehensive field exploration.

The structure of this article is organized as follows: Section 2 details the methodologies applied in our research. In Section 3, we explore the outcomes from the co-word analysis. Section 4 presents the findings from the MPA. In Section 5, a thorough discussion is provided, along with directions for future research initiatives. The article concludes in Section 6, where we summarize both the theoretical and practical implications of the study and discuss its limitations.

## 2. Research methods

### 2.1. Data collection

For the current study, we chose the Scopus database as our primary data repository due to its comprehensive scope, reliable data quality, and inclusion of a diverse and respected range of journals. These features make Scopus a preferred choice for conducting MPA and bibliometric studies, which are pivotal in our research [41,44]. The research procedure of our review is detailed in Fig. 1. Our research began with an extensive search in the Scopus database, focusing on cyberbullying-related terms outlined in the Appendix. We limited our search to English-language journal articles to ensure consistency and clarity in our analysis. Data collection, completed in February 2024, followed a strict protocol influenced by Fahimnia et al. [45]. Initially, we retrieved 8390 documents. To guarantee the inclusion of only high-quality and peer-reviewed publications, non-peer-reviewed sources, including conference proceedings, books, chapters, editorials, commercial magazines, and other grey literature, were excluded from the data collection process. This was

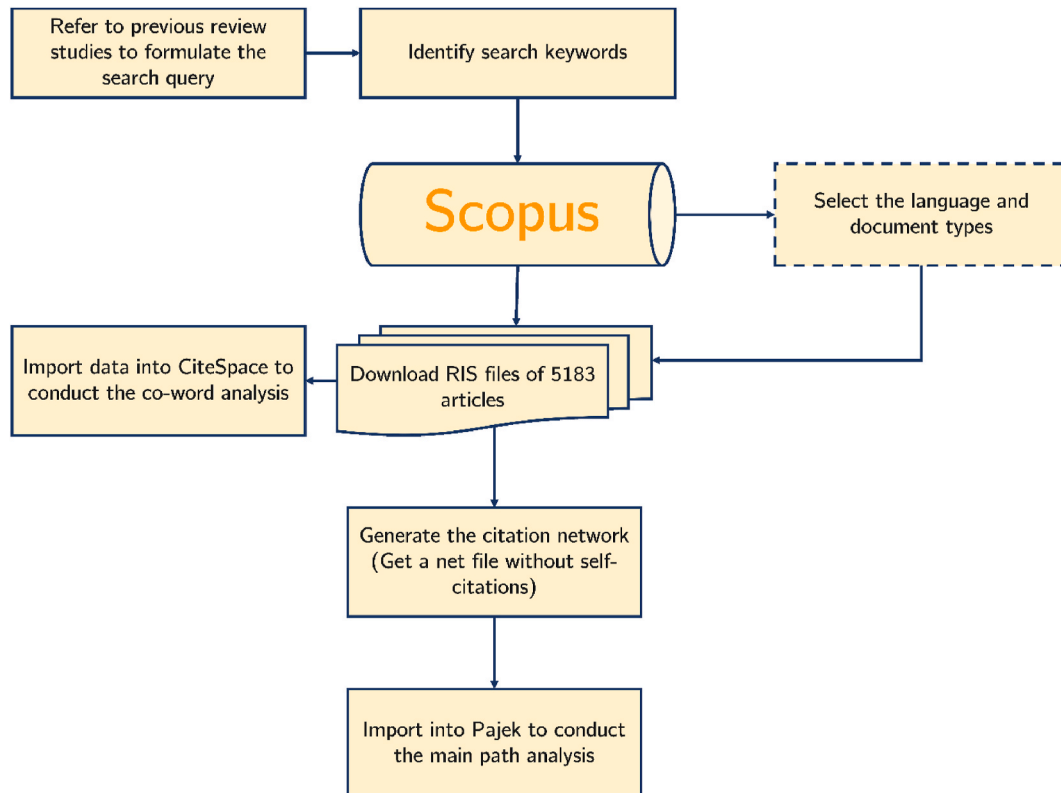


Fig. 1. Review process.

accomplished using Scopus's filtering options for document and source types, enabling a focus solely on peer-reviewed journals articles. After implementing a language filter to retain only English articles, we narrowed down our collection to 5428 documents.

Further refinement involved screening for relevance by excluding articles not centrally focused on cyberbullying. We then applied additional filters based on document types and source types, selecting only journal articles and reviews as per the methodology described by Fahimnia et al. [45]. To maintain academic rigor and quality, we refined our selection to include only journal articles published in Q2 journals as per the Scimago ranking. This approach ensured that the examined documents originated from credible and high-quality sources. This step left us with 5215 documents. The titles and abstracts of the remaining articles were reviewed to assess their relevance, and full texts were examined when necessary to confirm inclusion. During this process, articles that did not directly address cyberbullying were excluded. Through this meticulous process, we ensured that our final dataset of 5183 documents was representative of high academic quality, providing a comprehensive overview of the current state of cyberbullying research. The final selection of 5183 journal articles constitutes a robust dataset, reflecting the extensive scope of contemporary research on cyberbullying.

These documents formed the foundation for our citation network. To analyze and visualize this network effectively, we utilized the Pajek software package. We chose Pajek for several reasons: its capability to handle large datasets was crucial given the extensive volume of articles we needed to analyze [39]. Pajek also provides a comprehensive suite of tools for network analysis, including various network centrality metrics and clustering methodologies, which were essential for our study. Additionally, the frequent use of Pajek in bibliometric research lends credibility to our analytical methods, making it a trusted component in our research toolkit [40].

## 2.2. Bibliometric techniques

CiteSpace 6.3 is a robust tool employed in scientometric and bibliometric research, recognized for its sophisticated capabilities in co-word analysis. This approach enables researchers to identify and illustrate thematic patterns, emerging trends, and the intellectual structure of a research domain through the mapping of keyword co-occurrences in academic literature. CiteSpace 6.3 has been acknowledged as an outstanding instrument for performing co-word analysis to identify and emphasize thematic patterns and emerging trends in research areas, including cyberbullying [46]. Co-word analysis is recognized for its ability to reveal the essential thematic structures within academic literature, assuming that selected keywords can effectively summarize and reflect the core subjects of scholarly articles [47]. Our first research objective is to investigate the cyberbullying research landscape and identify prevalent research themes in the literature. Consistent with recent scholarly methods [42], we applied co-word analysis to investigate the cyberbullying research landscape, identify prevalent themes, and uncover potential gaps and future directions. This approach helps map the intricate web of research topics, offering insights into the progression and focal areas of cyberbullying studies.

To generate the co-word network, we adopted the g-index as the standard for visually representing keywords, resulting in a network comprising 794 nodes and 2616 connections. The scale variable "k" played a crucial role in determining the depth of our network analysis, affecting the comprehensiveness and detail of the network illustration. For our purposes, we chose a "k" value of 25, balancing precision with clarity [48]. Utilizing CiteSpace's clustering features, we organized the data into clusters with a modularity measure of 0.4821. The silhouette metric, a measure of clustering quality, stood at 0.7643, affirming the reliability and consistency of our clustering results. We labeled the clusters using latent semantic indexing (LSI) and provided a detailed analysis of each cluster. This structured approach allowed us to effectively dissect the evolving patterns within cyberbullying research and identify key themes and emerging areas of focus. The temporal trajectory of the co-word clusters unveils the evolving and multifaceted landscape of cyberbullying research. Through its unique lens, each cluster collectively provides a deeper understanding of the progression and varied dimensions of cyberbullying in recent years.

In addition to co-word analysis, citation analysis is utilized to investigate the intellectual development of the field, thereby providing a thorough approach that aligns with our aim of tracing knowledge evolution in cyberbullying research. Chen et al. [49] discuss the widespread use of citation-focused methodologies such as bibliographic coupling analysis, co-citation analysis, and MPA for delineating the intellectual contours and developmental trajectories of a field while leveraging the depth of citations. Bibliographic coupling analysis delves into the shared intellectual lineage of articles by examining their common references. This approach suggests that articles with many overlapping references likely share substantial thematic commonalities [50]. In contrast, co-citation analysis

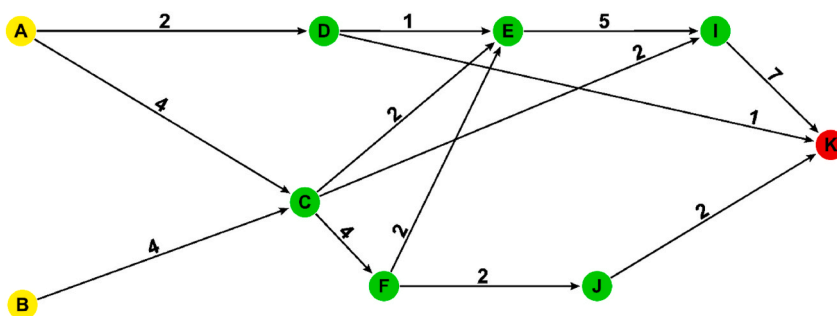


Fig. 2. An illustration of a citation network.

reveals shifts and structural evolutions within knowledge domains by analyzing how documents are co-cited, highlighting the interconnectedness of ideas within the field [51]. In 1989, Hummon and Dereian [52] proposed MPA as a method that utilizes direct citation links to trace the evolution of knowledge through scholarly articles. MPA has been applied in diverse areas like conflict management and social network analysis [39]. Enhancements to MPA include [53] the Search Path Count (SPC) algorithm and further developments by Liu and Lu [54], who introduced techniques like the key-route main path to refine the analysis. Current main path techniques distinguish between local main paths, which track the most cited articles within a specific cluster, and global main paths that span across the entire citation network. By exploring these main paths, researchers can identify the most influential ideas and trends within a domain [55]. In our study, we utilize a citation network approach to construct the main path and evaluate the significance of each citation in the chain [54].

Fig. 2 presents the methodology we employed, depicted as a citation network featuring interconnected nodes and arrows that represent academic papers and the directional flow of scholarly ideas, respectively. Within this network, nodes are categorized into three distinct types: source nodes, displayed in yellow, which are exclusively cited; sink nodes, shown in red, which only cite other works; and intermediate nodes, colored green, which engage in both citing and being cited.

The SPC for each link in the network is calculated by counting how frequently each connection appears in paths that run from source nodes to sink nodes. For example, the link from node A to node D shows an SPC count of 2, appearing in two different paths: A-D-E-I-K and A-D-K. Each link in the network is assigned a value based on its SPC, and these values are crucial for subsequent analysis phases.

Using specialized algorithms, we then define the main paths within the network. The forward local main path starts from the source nodes and proceeds to the sink nodes, selecting the link from each node that has the highest SPC. This procedure constructs a coherent trajectory of nodes that most significantly represent the flow of ideas through the network, such as the paths B-C-F-J-K and A-C-F-E-I-K. This approach effectively maps the dominant scholarly trajectories and illustrates the propagation of knowledge within the field.

In contrast, the backward local main path initiates at the sink nodes and traces back to the source nodes, selecting connections that display the highest SPC. This approach results in distinctive trajectories like A-C-F-E-I-K and B-C-E-I-K, highlighting the most influential paths within certain sections of the network. While local paths focus on the highest values within specific zones, the global main path aims to identify the route across the entire network that accumulates the highest total SPC value, often coinciding with paths like B-C-F-E-I-K and A-C-F-E-I-K. However, this method might miss some high-SPC links not included in these main paths. To bridge this potential gap, the key-route main path technique is utilized [54]. This technique begins with the link holding the highest SPC and strategically connects through to both source and sink nodes, potentially revealing multiple significant paths with high SPC values. This method offers a detailed exploration of the network that uncovers intricate insights into the flow of citations. Overall, by integrating local (both forward and backward), global, and key-route main paths, this analytical approach provides a comprehensive view of the evolving patterns within a research domain. It is crucial for identifying key trajectories of knowledge dissemination and pinpointing seminal contributions throughout the field's development.

### 3. Co-word analysis results

Fig. 3 illustrates a co-word network of cyberbullying research, delineating seven thematic clusters derived from keyword co-occurrences, which reflect the main research themes and their evolution over time. Cluster 0, with a focus on "moral disengagement," stands out as particularly significant in exploring the intersection of cyber-aggression and psychological mechanisms in online settings [56]. This cluster delves into how moral disengagement facilitates cyberbullying behaviors, serving as both a precursor and a mediator in the bullying process. For example, Bussey et al. [57] investigated the relationship between moral disengagement and cyberbullying, demonstrating that students exhibiting high self-efficacy in cyberbullying are more likely to disengage morally from their detrimental actions. This underscores the significance of moral disengagement in allowing perpetrators to rationalize their

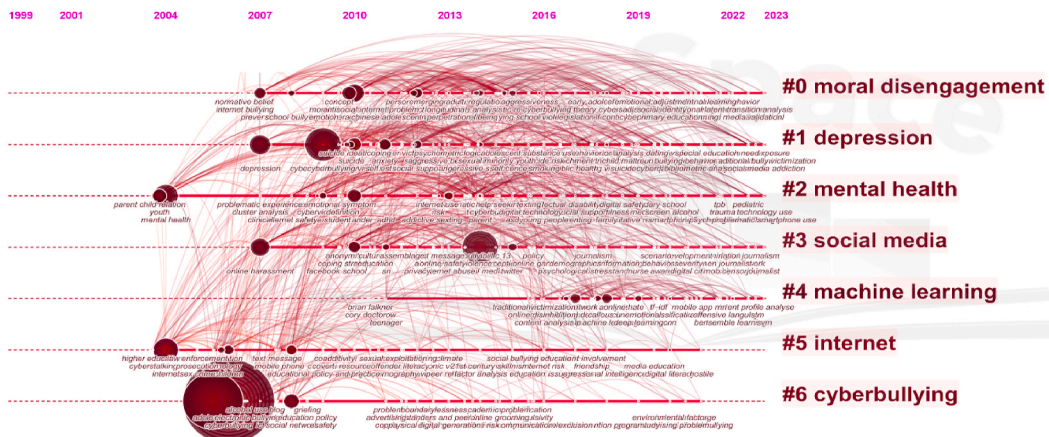


Fig. 3. Co-word network clusters.



behaviors. Gini et al. [58] provided evidence for this relationship through a meta-analysis, showing a consistent association between moral disengagement and aggressive behaviors, including cyberbullying, in a substantial sample of children and adolescents. Furthermore, Perren and Gutzwiller-Helfenfinger [59] found that moral values and emotions are significant predictors of both traditional bullying and cyberbullying, with morally disengaged justifications occurring more frequently in traditional bullying contexts.

The high-frequency keywords such as "cyber-aggression," "moral disengagement," "prevention," and "cyberbullying perpetration" highlight the cluster's emphasis on the psychological underpinnings that enable individuals to partake in harmful online behaviors without moral restraint (Table 1). Research within this cluster critically examines the roles of moral disengagement in the perpetration of cyberbullying. For instance, Chen et al. [60] conducted a meta-analysis identifying moral disengagement as a key predictor of cyberbullying perpetration, highlighting the influence of risky ICT use and social norms in facilitating this behavior. Kowalski et al. [61] adopted a developmental perspective, highlighting the variation of moral disengagement, in conjunction with risk and protective factors, across different age groups and its influence on the likelihood of involvement in cyberbullying. Wong et al. [62] demonstrated that moral disengagement negatively correlates with psychosocial health and a sense of belonging, thereby increasing the likelihood of cyberbullying among adolescents with low school attachment. The cluster also explores how individuals, particularly adolescents, dissociate from the ethical implications of their actions to justify harm against others, thus increasing the likelihood of engaging in repeated online aggression. Ang and Goh [63] found that interventions aimed at enhancing empathy and moral engagement effectively reduced moral disengagement and, as a result, decreased incidents of cyberbullying. Findings from this cluster suggest that interventions aimed at enhancing moral engagement and empathy could significantly reduce cyberbullying by reinforcing perpetrators' awareness of the impact of their actions on peers' well-being [60,64].

The analytical lens then shifts to Cluster 1, which focuses on "depression" and explores the profound emotional impact of cyberbullying, particularly how cyber-victimization is linked to depression, lowered self-esteem, and increased suicidal ideation. According to Bauman et al. [14], adolescents subjected to cyber-victimization exhibit a markedly higher propensity for depression and suicidal ideation. Selkie et al. [65] indicate that victims frequently experience a significant reduction in self-esteem, potentially resulting in increased emotional distress. Fisher et al. [66] demonstrated that extended exposure to cyberbullying elevates the risk of enduring mental health problems, highlighting the necessity for specific mental health interventions. Jhaver et al. [67] emphasized the need for establishing strong support systems for victims to alleviate these psychological effects. The inclusion of keywords like "cyber-victimization," "self-esteem," and "suicide" underscores the psychological dimensions under scrutiny. The research within this cluster provides essential insights for developing targeted support mechanisms to mitigate the adverse effects of cyberbullying on mental health [68–70].

Moreover, Cluster 2 centers on "mental health" and delves into the broader psychological effects of cyberbullying across different demographic groups, including youth, college students, and educators. Bennett et al. [71] highlight that educators can experience emotional distress due to exposure to student cyberbullying incidents, potentially affecting their mental well-being. Doane et al. [72] emphasize the increased anxiety and depression among college students subjected to cyberbullying, whereas Bastiaensens et al. [73] underscore the critical influence of bystanders in either worsening or mitigating the psychological impacts of cyberbullying. Barrense-Dias et al. [74] identified that cyberbullying associated with sexting results in significant mental health repercussions, particularly among youth populations. The use of keywords such as "youth," "bystander," and "problematic internet use" emphasize the diverse aspects of mental health being examined. The studies within this cluster highlight the complex interplay between cyberbullying and mental health, showing how cyberbullying can exacerbate existing mental health issues and how different social supports, such as parental or educational interventions, can mitigate these effects [75–77]. The research points to the need for comprehensive strategies that include education, awareness, and direct support to address and prevent the mental health repercussions of cyberbullying [78–80]. This cluster's findings are crucial for designing effective policies and programs that enhance the mental well-being of all individuals affected by cyberbullying.

**Table 1**  
Co-word analysis clusters.

Cluster ID	Size	Silhouette	Mean (year)	Label (LSI)	High-frequency keywords
0	90	0.719	2016	Moral disengagement	Cyber-aggression; moral disengagement; prevention; cyberbullying perpetration; intervention; school bullying; well-being; risk factor; systematic review; perpetration; meta-analysis
1	84	0.725	2016	Depression	Cyber-victimization; depression; cyber-bullying/victimization; self-esteem; anxiety; suicide; student; social support; suicide ideation; peer victimization; coping; internet addiction; loneliness
2	77	0.609	2015	Mental health	Mental health; youth; bystander; sexting; college student; parent; teacher; cyber-victim; problematic internet use; ASD
3	74	0.787	2016	Social media	Social media; online harassment; school; SNS; twitter; coping strategy; anonymity; education; Facebook; BIM
4	55	0.834	2019	Machine learning	Machine learning; NLP; deep learning; hate speech; cyberbullying detection; sentiment analysis; CNN; perpetrator; content analysis; online social network; text classification
5	55	0.815	2010	Internet	Internet; children; victim; technology; cyberstalking; emotional intelligence; higher education; mobile phone; behaviour; communication; digital literacy;
6	51	0.817	2011	Cyberbullying	Cyberbullying; adolescent; social network; ICT; parental style; bystander behaviour;

Shifting focus to Cluster 3, which is identified with the theme "social media," academic research examines how social media platforms contribute to and influence the dynamics of cyberbullying. Baccarella et al. [81] emphasize that platforms such as Facebook and Twitter enable online harassment due to the anonymity they provide, thereby intensifying bullying behaviors. Kelly et al. [82] highlight that social media functions as a dual-edged sword, serving both as a platform for cyberbullying and as a potential intervention tool. Fox and Tang [9] examined coping strategies employed by victims of online harassment, indicating that the effectiveness of these strategies varies considerably based on the platform's design and the presence of support networks. Keywords such as "social media," "online harassment," and "coping strategy" pinpoint the specific aspects of cyberbullying being addressed. The studies within this cluster explore the dual role of social media as both a vector for cyberbullying and a potential tool for intervention and education against it [82–84]. Scholars often analyze how anonymity on platforms like Twitter and Facebook can exacerbate bullying behaviors, but also how these platforms can be used to spread awareness and provide support to victims [67,85,86]. This cluster's insights are vital for developing more nuanced social media policies and educational programs that aim to leverage the positive aspects of these platforms while mitigating their potential for harm.

Furthermore, Cluster 4, which focuses on "machine learning," this segment of the literature highlights the technological advancements in detecting and addressing cyberbullying [87,88]. Dinakar et al. [89] were among the first in demonstrating the efficacy of machine learning for identifying harmful content, illustrating how algorithms can be trained to detect patterns associated with cyberbullying. Van Hee et al. [90] enhanced this approach by utilizing natural language processing (NLP) and deep learning techniques to improve the accuracy of offensive language detection. Al-Garadi et al. [85] highlighted the significance of these technologies in real-time moderation, proposing that machine learning can proactively notify moderators and avert the escalation of cyberbullying. The frequent appearance of keywords such as "machine learning," "NLP," "deep learning," and "cyberbullying detection" underscore the technical approaches explored. Studies within this cluster investigate how algorithms can automatically detect harmful content and behaviors on social media platforms, potentially alerting moderators and preventing the spread of cyberbullying [85]. These technological solutions aim to identify cyberbullying and analyze sentiment and context, improving the precision of detection mechanisms [91]. The insights gained from this cluster are critical for developing more effective automated tools that support existing social media policies and help safeguard users from online harassment.

Moving on to Cluster 5, which delves into the broad impacts of internet usage on cyberbullying, research emphasizes the critical role of digital literacy [78,92]. In this regard, scholars explore how internet access among children and adolescents correlates with instances of cyberbullying [93]. Key terms such as "internet," "children," "technology," and "digital literacy" guide the focus of this cluster. Research in this area examines the influence of technology on young users, stressing the importance of equipping them with robust digital literacy skills [84,94]. This involves understanding online safety, ethical behavior, and effective communication in digital realms [95–98]. Additionally, this cluster addresses the challenges of cyberstalking and the need for emotional intelligence to manage and interpret online interactions safely [99–101]. Findings from this cluster advocate for educational programs that reinforce internet safety and promote responsible online interactions [92,102]. By enhancing digital literacy, these initiatives aim to prepare young users not only to respond to cyberbullying but to actively prevent it. The emphasis on comprehensive education in this cluster highlights the need for proactive strategies that support safer and more respectful digital communities [103].

Finally, Cluster 6 specifically addresses "cyberbullying" and its dynamics within social networks and information communication technologies (ICT). This cluster highlights various dimensions of cyberbullying among adolescents. Key terms such as "cyberbullying," "adolescent," "social network," and "ICT" reflect the central focus of the cluster. The research within this cluster investigates how social networking platforms and ICT usage contribute to the prevalence and nature of cyberbullying [75,97,104]. It explores how adolescents interact on these platforms and the role that parental styles, bystander behavior, and peer interactions play in either mitigating or

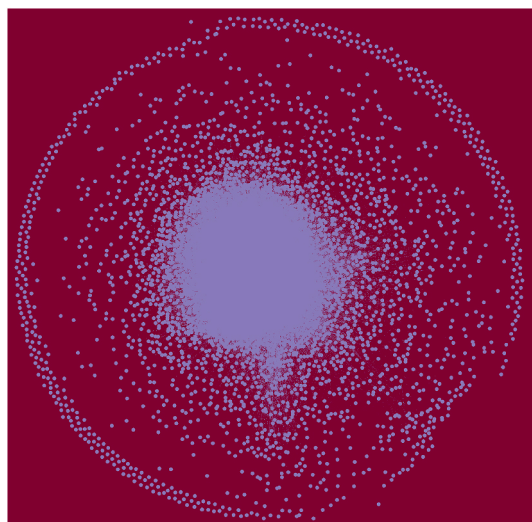


Fig. 4. The entire citation network of cyberbullying research.

exacerbating cyberbullying scenarios [17,73,105]. The cluster also considers how these technologies can both facilitate and hinder efforts to address cyberbullying. Insights from this cluster are critical for developing targeted prevention and intervention strategies that leverage technology and social media dynamics. By understanding the specific behaviors and interactions that occur within these digital environments, educators, parents, and policymakers can better design measures that protect young users from cyberbullying and promote a healthier online community. This research underscores the importance of informed and contextually adapted approaches to combating cyberbullying in the digital age.

Overall, the detailed examination of these co-word clusters provides a thorough understanding of the thematic framework of cyberbullying research, highlighting the intricate interconnections among psychological, technological, and social aspects. To further enrich this analysis and trace the development of key themes over time, we employed the main path analysis. This method enables the identification of the most influential studies and facilitates the tracking of the research field's evolution, offering a historical perspective on the shifting and deepening focus areas of cyberbullying.

#### 4. MPA results

Fig. 4 presents the complete citation network developed from the chosen studies for this investigation, featuring 5183 nodes and 64236 connections. The core component of this visual includes 4770 nodes that form the most extensive linked segment, illustrate the key citation connections between papers, and outline the main paths under examination. A secondary group includes nodes with fewer citations that connect only to a select few articles and are typically located on the periphery of the network. The last category consists of isolated nodes, highlighting their relative isolation from the central structure of the network.

##### 4.1. Local main paths

The forward local main path consists of 28 nodes and 27 edges, while the backward local main path contains 34 nodes and 35 edges. These paths highlight the chronological progression and the foundational works in the cyberbullying field, respectively. Interestingly,

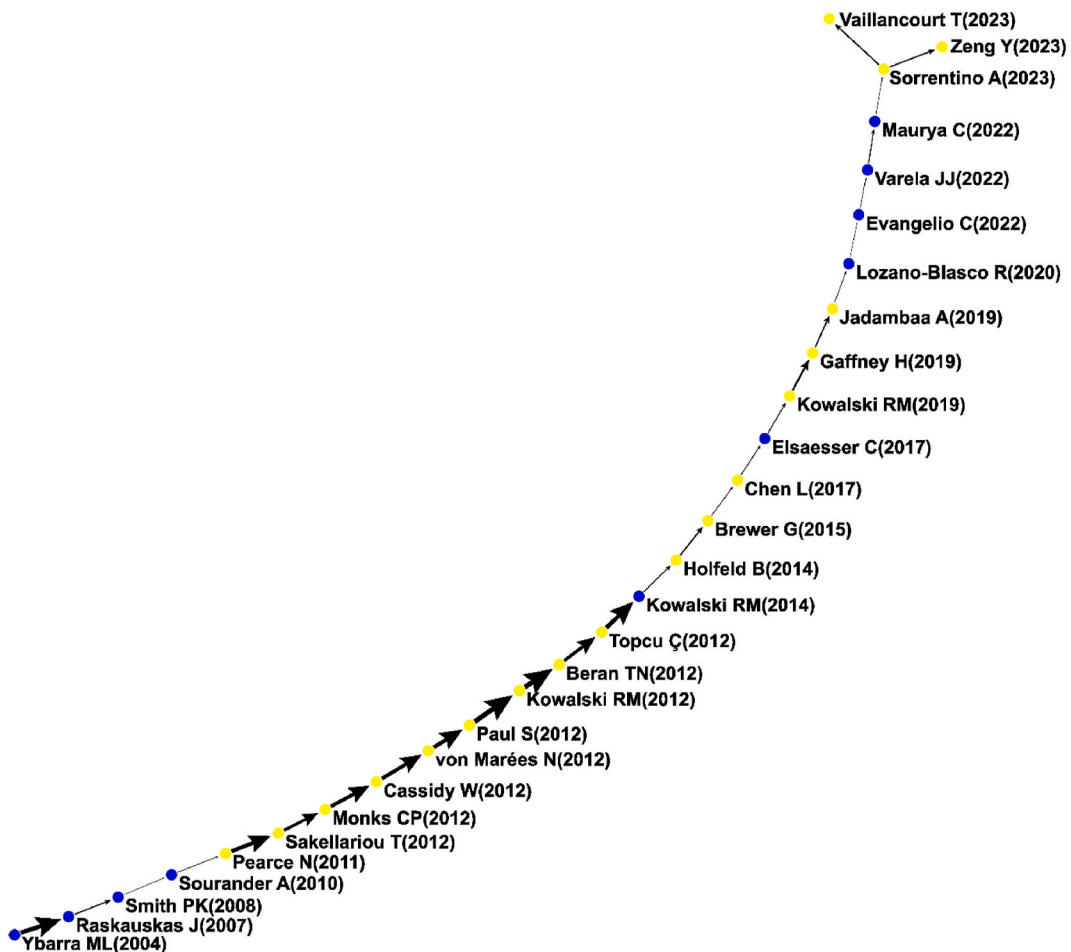


Fig. 5. Forward local main path.



there is a significant intersection between these two paths: they share 18 studies, which are colored yellow in the visual representation to denote their importance and commonality across both directions. The articles exclusive to each path are marked in blue, emphasizing their unique contributions to the research landscape.

#### 4.1.1. Forward local main path

The forward local main path kicks off with a detailed exploration of online harassment among young children, spearheaded by the study of Ybarra and Mitchell [106] (Fig. 5). This foundational research delves into the associations between cyberbullying, caregiver-child relationships, and the personal characteristics of young internet users. The findings suggest that online harassment among children is not only prevalent but also linked to broader psychosocial challenges, such as poor parent-child relationships and delinquency.

Next, the path introduces the study of Raskauskas and Stoltz [107], which expands the scope to the role of educators in preventing cyberbullying among adolescents. Raskauskas and Stoltz [107] point out the significant gaps in awareness and preparedness among educators, revealing a lack of effective strategies to address cyberbullying within schools. Continuing along the path, Smith et al. [108] offer a comparative look at traditional and electronic bullying among secondary school pupils. The authors emphasize the unique aspects of cyberbullying, such as its perceived anonymity and the 24/7 nature of online harassment, which distinguish it from traditional bullying scenarios. Lastly, Sourander et al. [109] broaden the perspective further by examining psychosocial risk factors linked to cyberbullying among adolescents on a global scale. The authors stress how the COVID-19 pandemic has influenced cyberbullying trends, pointing to a varied impact across different regions.

As the main path progresses, it intersects with the backward local main path, sharing several studies that mark a significant convergence in cyberbullying research focus, all highlighted in yellow. These studies collectively enrich the dialogue on cyberbullying interventions and empirical understandings across various educational stages and geographies. Pearce et al. [110] underline the efficacy of whole-school bullying interventions and extend these practices to cyberbullying, emphasizing the necessity of systematic approaches in schools to prevent and manage all forms of bullying. This perspective aligns with the findings of Sakellariou et al. [111] on the prevalence of cyber victimization among Australian male students and the role of educational settings in tackling cyberbullying. Monks et al. [112] provide insight into the perceptions and experiences of cyberbullying among younger primary school children and note the emotional impact on victims and the continuity between traditional and cyberbullying roles. This study complements the findings of Cassidy et al. [113], who discuss the challenges educators face in recognizing and responding to cyberbullying despite acknowledging its severity.

von Marées and Petermann [114] and Paul et al. [115] both delve into the challenges and potential solutions for cyberbullying in schools. von Marées and Petermann [114] outline the increase of cyberbullying as a pressing issue for school stakeholders, while Paul et al. [115] explore the use of Quality Circles in schools to engage students in addressing and solving bullying issues. Kowalski et al. [116] link traditional bullying behaviors to cyberbullying and suggest that patterns in the former can predict similar behaviors in the latter, with notable gender differences in these dynamics. This connection is echoed by Beran et al. [117], who examine the progression from high school harassment to cyber-harassment in university, elucidating the lasting impacts of these experiences. Finally, Topcu and Erdur-Baker [118] investigate the psychological underpinnings of gender differences in bullying and identify affective and cognitive empathy as key mediators in these behaviors.

The trajectory of cyberbullying research is enriched by a series of studies that examine both the psychological impacts and the effectiveness of interventions across various settings. For example, Kowalski et al. [119] and Chen et al. [60] both provide meta-analytical reviews that explore significant psychological factors and predictors related to cyberbullying. Kowalski et al. [119] emphasize the role of normative beliefs about aggression and moral disengagement, while Chen et al. [60] identify risky ICT use and the historical experiences of traditional bullying as major predictors. These studies highlight critical areas for targeted research and intervention and suggest a strong foundation for theoretical exploration within cyberbullying studies.

Two other studies delve into the dynamics of individual behaviors within cyberbullying scenarios. For instance, Holfeld [120] highlights the varied roles and responses of bystanders and reveals how these can significantly impact the continuation or cessation of bullying. Meanwhile, Brewer and Kerlake [121] focuses on internal factors such as self-esteem, empathy, and loneliness, showing how these personal traits influence one's likelihood to engage in or fall victim to cyberbullying. Collectively, these studies suggest that both external interventions and personal development are crucial in combating cyberbullying. Similarly, scholars started to explore the broader societal and developmental contexts. In this regard, Elsaesser et al. [17] discuss the influential role of parenting and emphasize that parental warmth and effective monitoring can dramatically reduce cyberbullying risks. Kowalski et al. [61] take a developmental perspective by analyzing how age, sex, and racial/ethnic differences affect cyberbullying involvement. The authors point to the need for tailored intervention strategies that consider these demographic factors. Finally, Gaffney et al. [25] confirm the positive impact of structured anti-cyberbullying programs, while Jadambaa et al. [122] call for standardized measures and consistent data collection to better understand and address cyberbullying among Australian youth.

As the forward local main path unfolds, it introduces four unique studies that are not shared with the backward path. For instance, Lozano-Blasco et al. [123] delve into the phenomenon where individuals assume dual roles as both victims and perpetrators of cyberbullying. The authors note significant cultural influences and how adverse family dynamics correlate with psychological issues such as depression and anxiety. Following this, Evangelio et al. [124] target younger demographics and explore how early exposure to cyberbullying impacts elementary and middle school students. The findings underline the critical need for early educational interventions that can preempt and mitigate cyberbullying's harmful effects. Concurrently, Varela et al. [125] investigate the emotional toll of cyberbullying during the COVID-19 pandemic among Chilean youths and conclude how experiences of loneliness and depression vary significantly between adolescents and young adults, thereby requiring the need for age-specific support strategies. Maurya et al.

[126] offer a longitudinal view from India, link persistent cyberbullying to severe long-term mental health outcomes like depression and suicidal ideation, and advocate for robust preventative measures and ongoing support systems.

The concluding segment of the forward local main path ties together the effects of the COVID-19 pandemic on cyberbullying with insights into bystander dynamics. In this context, Sorrentino et al. [127] analyze how the pandemic influenced cyberbullying rates differently across the globe and suggest a need for region-specific cyberbullying interventions. Zeng et al. [128] investigate how victims' self-disclosure affects bystander responses in cyberbullying incidents, revealing that the nature of disclosure can either encourage or deter bystander intervention. Vaillancourt et al. [129] contrast bullying behaviors before and during the pandemic and note variations in bullying rates due to differing levels of social restrictions. The findings also point to increased teacher supervision as a potential deterrent. Together, these studies highlight the varying impacts of social conditions on cyberbullying and the critical role of bystanders and educators in addressing and preventing it.

#### 4.1.2. Backward local main path

At the outset of the backward local main path, a distinct set of studies introduces fresh perspectives on cyberbullying, differing significantly from those explored at the beginning of the forward path (Fig. 6). These studies lay a foundational understanding of the breadth and implications of both traditional and electronic bullying. At the start of the path, Borg [130] conducts a national survey among Maltese schoolchildren and uncovers high rates of traditional bullying, which provides crucial baseline data on the nature and settings of bullying behaviors. Later, Finn [99] and Beran and Qing [131] extend the discussion to cyberbullying, with Finn [99] identifying a significant incidence of online harassment among university students, notably higher among sexual minority students. Beran and Qing's [131] research among Canadian middle schoolers reports the emotional toll of cyber-harassment and calls for further investigation into the use of digital platforms for peer aggression. Moreover, Strom and Strom [132] outline the unique challenges that cyberbullying poses beyond traditional school bullying, while Patchin and Hinduja [5] discuss the transformation of bullying with the advent of digital technology and its profound impacts on victims. Finally, Li [20,133] highlights the significant role of gender in cyberbullying dynamics and the disparities in reporting behaviors between males and females, stressing the need for adult intervention and the development of supportive policies to manage and mitigate bullying and cyberbullying.

The prior studies collectively set the stage for more targeted research and policy development, merging into further investigations led by Aricak et al. [134], where the path continues to explore deeper aspects of cyberbullying. Aricak et al. [134] examine cyberbullying among Turkish adolescents and reveal high involvement in bully behaviors and notable gender differences, with boys more actively involved than girls. The authors also elaborate on adolescents' coping strategies and emphasize the need for more comprehensive research to develop effective interventions. Vandebosch and van Cleemput [135] study cyberbullying profiles among Flemish school children and highlight the overlap between online and offline bullying. The authors suggest that cyberbullies and victims

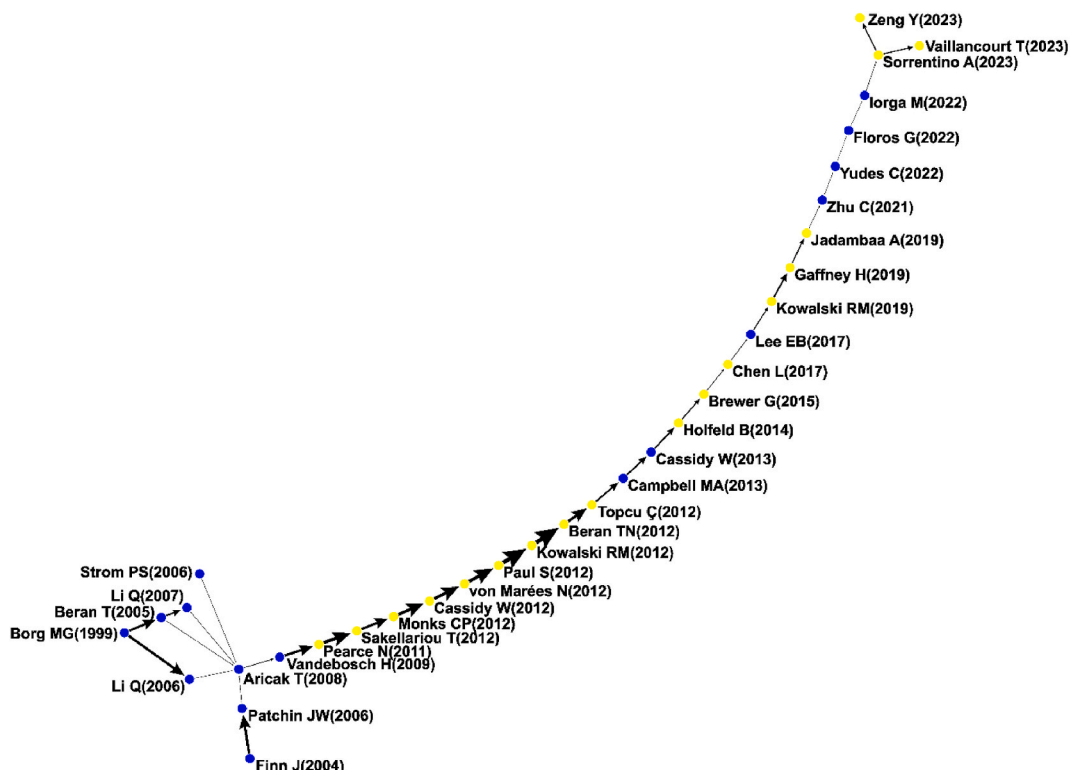


Fig. 6. Backward local main path.

exhibit distinct internet behaviors and social dynamics, which must be addressed in prevention strategies.

Several unique studies that appear in the middle of the backward local main path provide deeper insights into the psychological impacts of cyberbullying and intervention strategies. For example, Campbell et al. [136] examine the self-perception of cyberbullies regarding the harm they cause and their own mental health. The findings suggest that many cyberbullies are unaware of the impact of their actions on victims and report higher levels of stress, depression, and anxiety among these perpetrators compared to non-bullies. This highlights the dual need for interventions that address both the victims and the perpetrators' wellbeing. Cassidy et al. [78] offer a comprehensive review of international research on cyberbullying and emphasize evidence-based prevention and intervention strategies. According to the authors, there is a need for integrating cyberbullying education into school curricula, promoting a positive home and school culture, and implementing non-punitive intervention methods. In addition, Lee and Shin [137] focus on cyberbullying among African American college students and identify common venues and predictors of victimization and perpetration. The authors conclude significant gender differences in cyberbullying behavior and argue that online disinhibition plays a crucial role in encouraging such behaviors.

As the backward local main path unfolds, four recent and unique studies mark the latter stages, each contributing distinct perspectives on cyberbullying. More specifically, Zhu et al. [138] provide a comprehensive review of the global cyberbullying landscape and address its prevalence and the effectiveness of various prevention measures. The authors indicate the critical need for enhanced global cooperation and systematic approaches to tackle cyberbullying, stressing the importance of considering cultural factors in prevention strategies. Likewise, Yudes et al. [139] explore the moderating effects of emotional intelligence on the relationship between problematic Internet use and cyberbullying among adolescents. The authors highlight gender differences and note that emotional intelligence can buffer the impact of internet misuse on cyberbullying behaviors, particularly among boys. Floros and Mylona [140] critically assess the relationship between cyberbullying and Internet use disorder (IUD), calling for a renewed focus on longitudinal studies and the environments where these behaviors overlap, such as social media and online gaming. This review stresses the need for more standardized research methodologies and broader demographic studies beyond primary and secondary education. Iorga et al. [141] investigate cyberbullying among Romanian adolescents and examine factors such as gender, family affluence, and parenting styles. The authors also reveal the nuanced ways in which family dynamics and personal psychological factors like loneliness contribute to cyberbullying victimization and aggression. Overall, these studies underscore the evolving complexity of cyberbullying

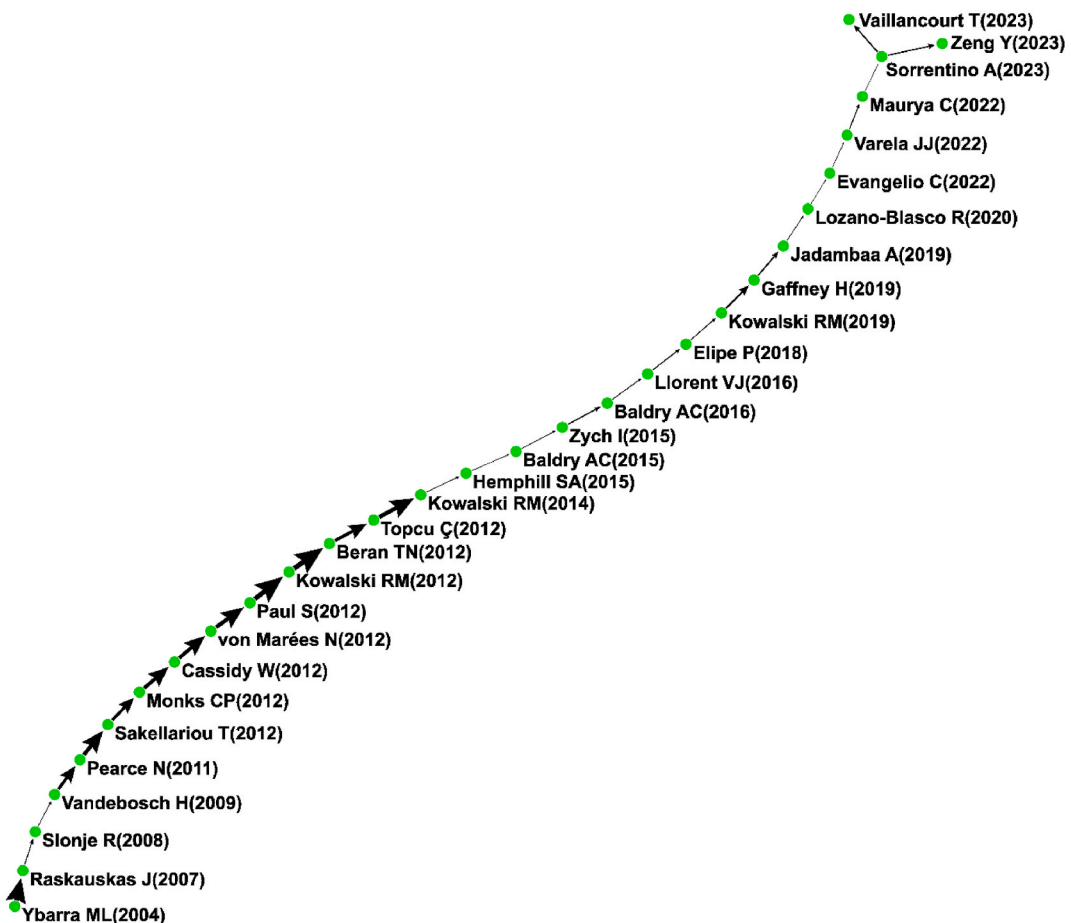


Fig. 7. Global main path.

research and advocate for more nuanced and culturally sensitive approaches to better understand and combat this pervasive issue.

#### 4.2. Global main path

The global main path is a rich tapestry woven from 30 seminal papers, each contributing unique insights into the complex dynamics of cyberbullying (Fig. 7). Among these, several key connections stand out and significantly shape the academic conversation around this modern social issue.

Firstly, the linkage between Kowalski et al. [116] and Beran et al. [117] is particularly influential, underscoring the evolution of cyberbullying from its identification to deeper exploration of its psychological impacts. Kowalski et al.'s [116] work, which positions cyberbullying within the broader context of traditional bullying, finds a natural continuation in Beran et al.'s [117] focus on the emotional and social repercussions for those involved in cyberbullying. Another notable connection is between Paul et al. [115] and Kowalski et al. [116]. The study of Paul et al. [115] ties directly back to the foundational theories of Kowalski et al. [116], suggesting practical applications and strategies that leverage insights to mitigate cyberbullying. Additionally, the path from Ybarra and Mitchell [106] to Raskauskas and Stoltz [107] showcases a chronological progression in understanding cyberbullying's effects from the early

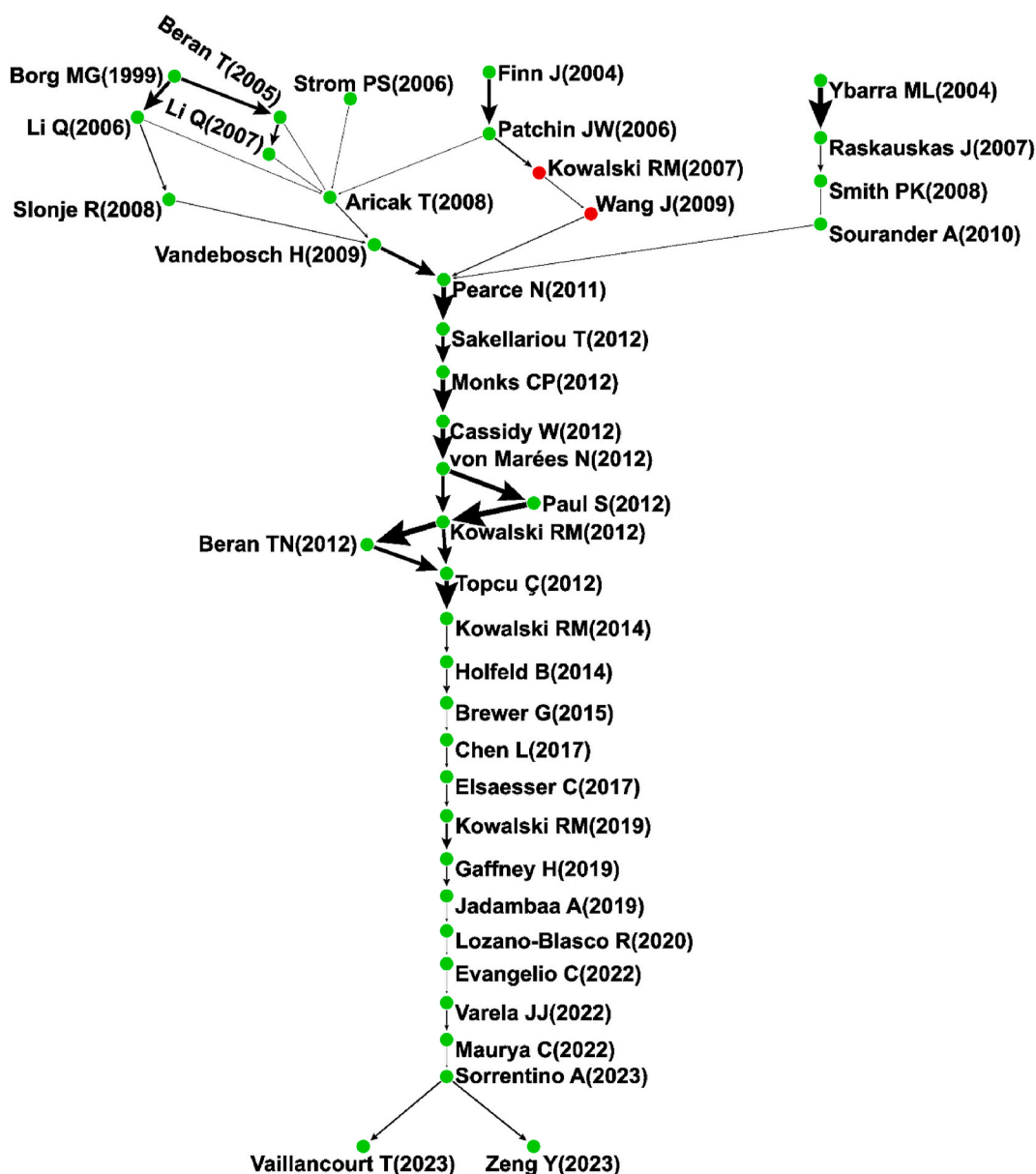


Fig. 8. Key-route main path.

stages of internet use in adolescence to more defined behaviors among older students.

These connections not only illustrate the interlinked nature of cyberbullying research but also reflect how earlier studies set conceptual frameworks that later research expanded upon, providing a more nuanced understanding of cyberbullying's implications. This dense network of seminal works significantly influences both academic discourse and practical approaches to dealing with cyberbullying, accentuating the importance of both foundational research and its contemporary applications. As cyberbullying continues to evolve with technology, the ongoing relevance of these studies ensures they remain critical to both understanding and addressing the issue effectively.

#### 4.3. Key-route main path

The key-route main path diverges into three streams, each providing unique insights into the dynamics of cyberbullying, before converging on the seminal work by Pearce et al. [110] (see Fig. 8). The first stream traces the psychological impacts and behavioral aspects starting with Ybarra and Mitchell's [106] exploration of online harassment's link to adverse psychosocial conditions. This narrative is expanded through subsequent studies by Raskauskas and Stoltz [107] and Smith et al. [108], highlighting the overlap of traditional bullying and cyberbullying roles and their broader implications. The second stream, initiated by Finn [99] and expanded by Patchin and Hinduja [5] and Kowalski and Limber [142], investigates cyberbullying's characteristics across educational contexts and emphasizes the urgent need for effective intervention strategies. The third stream, beginning with Borg's [130] broad survey on bullying behaviors, followed by detailed analyses from Beran and Qing [131], Li [133], and others, delves into cyber harassment's specific patterns and gender dynamics. These studies collectively highlight the complexity of cyberbullying and observe the varied manifestations and significant psychosocial impacts on all involved parties. Ultimately, all three streams converge on the study of Pearce et al. [110], which synthesizes these diverse perspectives into a cohesive understanding of cyberbullying. This convergence signifies a collective advance toward comprehensive strategies that are grounded in a deep understanding of cyberbullying's multifaceted nature, guiding both policy and practical interventions in educational settings.

An additional divergence emerges with studies led by von Marées and Petermann [114], which explore the intricate challenges of cyberbullying within school settings. This research strand rigorously delves into the prevalence, impacts, and prospective interventions for cyberbullying, emphasizing the pressing need for all-encompassing prevention measures in educational environments. Following this, studies by Paul et al. [115] and others propose dynamic interventions, such as Quality Circles, which actively involve students in crafting solutions to cyberbullying. This approach posits that student empowerment is crucial for effective problem resolution and adapting anti-bullying strategies within schools. The research trajectory then converges in the work of Topcu and Erdur-Baker [118], which pivots to psychological aspects and specifically focuses on the role of empathy in mitigating cyberbullying effects across different genders. This convergence highlights a synthesis of educational strategies and psychological insights, thereby presenting a unified approach to both understanding and addressing cyberbullying.

While the local main paths have offered extensive insights, they have certain limitations, primarily in the depth of their focus on the dynamics of electronic bullying among specific age groups and the broader sociodemographic influences on bullying behaviors. The key-route main path analysis addresses these gaps by introducing new studies that provide fresh perspectives on these issues. For instance, Kowalski and Limber [142] focus on the prevalence and nature of cyberbullying among middle schoolers. The authors highlight the anonymity of bullies, which is a less explored aspect in previous studies. Wang et al. [143] broaden this by examining the links between various forms of bullying and sociodemographic factors, parental support, and peer relationships in US adolescents. These studies offer a deeper understanding of how personal and environmental factors influence bullying behaviors, providing valuable insights for developing targeted anti-bullying strategies.

## 5. Discussion

In this study, we conducted a thorough examination of 5183 documents using co-word analysis and main path analysis, revealing intricate patterns of cyberbullying dynamics and their intersections with various psychological, technological, and social themes. Through our analysis, we identified key clusters that highlight both the challenges and the innovative strategies emerging in the field. Cluster 0, focusing on moral disengagement, underscores the psychological facilitators that enable cyberbullying and suggests targeted interventions that enhance moral responsibility and empathy. Cluster 1's examination of the links between cyber-victimization, depression, and lowered self-esteem calls for robust mental health support systems tailored to the needs of cyberbullying victims. In addition, the role of social media is scrutinized in Cluster 3 for its dual capacity as both a facilitator of and a platform for combating cyberbullying, thereby guiding the development of nuanced social media policies. Technological advancements in cyberbullying detection are the main focus of Cluster 4, which highlights the potential of machine learning and natural language processing to proactively identify and mitigate harmful online interactions [87,88]. Cluster 5 addresses the significance of digital literacy and stresses the preventive power of equipping young users with essential online navigation skills. Lastly, Cluster 6 delves into the dynamics within social networks and ICT, advocating for contextually adapted prevention strategies that leverage both technological insights and social dynamics. The comprehensive analysis of these documents maps the current landscape of cyberbullying research and sets the stage for future interventions and policies that are informed by a deep understanding of the multifaceted nature of cyberbullying.

Unlike previous bibliometric studies that mainly concentrated on descriptive trends or citation analyses, our research uses co-word analysis and main path analysis to provide a more profound and nuanced understanding of the evolution of cyberbullying research themes over time. Prior studies, including those by Cretu and Morandau [33], Achuthan et al. [32], and Barragán Martín et al. [35],



offered significant insights into publication trends and the distribution of research across specific fields such as sustainable development, adolescents, or education; however, these investigations did not explore the thematic structure of cyberbullying research or the interconnections among various concepts. Through co-word analysis, we were able to map the conceptual structure of the research field, identifying clusters of related themes and highlighting the intersections between psychological, technological, and social factors in cyberbullying.

The MPA further refines this perspective by tracing the most influential studies that have shaped the evolution of cyberbullying research. Previous studies used citation counts and temporal analyses to delineate trends [33,144]; nevertheless, our MPA elucidates the pivotal works that have instigated significant transformations in the field, providing an exhaustive perspective on the progression of cyberbullying research. This approach allows us to see how early foundational research on the psychosocial impacts of cyberbullying evolved into more recent work focused on technological tools for detection and intervention, particularly in Clusters 4 and 5, which explore machine learning and digital literacy [88,145].

Our work corroborates several established findings from prior research [37,146], including the psychological effects of cyberbullying and the significance of social actors, such as educators and parents, in intervention measures. Our research substantially extends the current literature by providing a more thorough integration of both technological and digital literacy issues, which have been mainly neglected in previous bibliometric reviews. For example, studies like Achuthan et al. [32] focused on the impact of COVID-19 and sustainable development on cyberbullying but did not explore the role of technological tools in combating cyberbullying, which is a critical focus of our analysis in Clusters 4 and 5. Our use of co-word analysis and main path analysis allows us to clarify how these technologies are progressively integral to cyberbullying prevention initiatives, a domain that prior review studies failed to thoroughly explore.

The co-word analysis identifies significant thematic intersections overlooked in previous bibliometric studies, which typically divided the research field by domain or time frame. For example, although Cretu and Morandau [33] analyzed three decades of educational research on bullying and cyberbullying, it failed to identify the thematic intersections between psychological and technological dimensions, which our co-word analysis reveals. In contrast, our study highlights the increasing significance of digital tools in the prevention and facilitation of cyberbullying, as demonstrated by the identified clusters—a theme that remains underexplored in prior bibliometric reviews.

Previous bibliometric studies have identified trends in cyberbullying research [33,35]; however, they did not comprehensively examine the implications of emerging technological tools. Our study addresses this gap through Clusters 4 and 5. Our findings enhance the existing literature by highlighting the potential of technological interventions, specifically machine learning and digital literacy education, to improve early identification and prevention of cyberbullying incidents. This broadened scope, extending beyond previously examined psychological and social dimensions, addresses a significant gap highlighted by prior bibliometric analyses. Recent data indicate a concerning prevalence of cyberbullying, especially among adolescents and females in developing nations. In 2018, 60 % of U.S. teenagers experienced cyberbullying, with 75 % of these incidents taking place on social media platforms such as Facebook, X, and Instagram [147]. Research indicates that females in developing countries experience higher rates of cyberbullying, with 38.7 % of female students reporting victimization [34]. This finding is consistent with our observations in Cluster 1 regarding the necessity for targeted mental health interventions for victims.

The MPA of cyberbullying research offers a captivating narrative of scholarly exploration and evolution. The analysis charts the development of key themes and shifts in focus over the years. More specifically, the progression through the forward local main path of cyberbullying research vividly illustrates the field's changing priorities and the deepening of our understanding of cyberbullying's dynamics and impacts. Initially, the path introduces studies that lay the groundwork by identifying fundamental aspects of cyberbullying, such as its prevalence and the psychosocial issues associated with it, beginning with foundational research from the early 2000s. As the path develops, it integrates studies that broaden the scope of inquiry to include the roles of various social actors, like educators and parents, in managing and preventing cyberbullying. Research along this trajectory explores the effectiveness of school policies, the impact of parental involvement, and the unique challenges presented by digital environments. This segment of the main path highlights the complexity of cyberbullying and shows it as a multifaceted phenomenon that intersects with educational, familial, and technological spheres.

Further along in the main path, attention shifts to more targeted aspects of cyberbullying, such as the specific effects of cyberbullying across different demographic groups and the efficacy of intervention programs. Studies become more focused on evaluating the psychological impacts of cyberbullying and the role of bystanders, illustrating a shift toward understanding the nuanced interactions that contribute to cyberbullying dynamics. The research delves into the development of predictive models and preventative strategies that leverage insights from psychology and educational theory to mitigate the risks associated with cyberbullying. The concluding segments of the forward local main path synthesize these insights and draw attention to the need for comprehensive strategies that address cyberbullying through multiple lenses, including policy, education, and community involvement. This progression highlights a move from foundational explorations of cyberbullying to a sophisticated understanding of its mechanisms and the development of multifaceted interventions designed to combat this pervasive issue effectively.

Unlike previous bibliometric studies that primarily documented the psychological effects of cyberbullying [37,148], our analysis underscores the increasing focus on preventative and proactive measures, including the creation of predictive models and technology-driven interventions. While studies such as [33,149] have concentrated on scientific production within particular age groups or educational contexts, our analysis highlights the interdisciplinary nature of contemporary cyberbullying research, integrating psychological, technological, and educational strategies.

The backward local main path provides a contrasting perspective to that of the forward path, enriching our understanding of the evolution and complexity of cyberbullying phenomena. This progression initially focuses on traditional forms of bullying, explores

their settings and implications, before transitioning into the nuances of cyberbullying and underlines its distinct challenges and broader psychosocial impacts. This path critically explores the evolution from an awareness of bullying in physical contexts to a recognition of its digital manifestations. It examines how cyberbullying extends beyond traditional frameworks, necessitating new approaches to mitigation and prevention. The research trajectory shifts from merely documenting incidents to analyzing the roles of various social actors, including educators and parents, in shaping the cyberbullying landscape. As the path develops, it reveals a deepening understanding of the psychological effects of cyberbullying, elucidating the need for targeted interventions that address both perpetrators and victims. The themes evolve to highlight the importance of socio-dynamic aspects, such as the impact of digital platforms and the anonymity they can provide, which complicates traditional bullying interventions. The culmination of this path reflects a sophisticated understanding of cyberbullying as a complex and multidimensional phenomenon. It advocates for holistic strategies that effectively combine cultural, emotional, and technological elements. Furthermore, it promotes the adoption of research and intervention approaches that are both adaptive and culturally sensitive. This underscores the progression from basic awareness to a nuanced understanding of cyberbullying, where a shift in educational and policy strategies is needed to effectively combat this evolving challenge. In contrast to previous research that centered on conventional bullying models [150], our backward path analysis emphasizes the emergence of cyberbullying as a unique phenomenon necessitating novel mitigation strategies, particularly in light of the complexities associated with anonymity and the digital environment. This enhances the discussion in a manner that prior bibliometric reviews, such as [37], did not comprehensively address. This analysis offers new perspectives on the challenges associated with digital anonymity, which is a topic that is gaining prominence in the study of cyberbullying yet remains insufficiently examined in previous bibliometric research.

The global main path distills key insights from a series of foundational studies, establishing a detailed overview of how cyberbullying has been conceptualized and addressed academically over time. This path showcases the evolution from initial identification and characterization of cyberbullying behaviors to advanced discussions on its psychological effects and the effectiveness of various interventions. Here, the linkage between theoretical research and practical application becomes apparent, highlighting critical transitions in understanding that inform current prevention and intervention strategies. Meanwhile, the key-route main path analysis reveals a more detailed exploration through its division into three streams before converging on Pearce et al.'s [110] influential work. This analysis brings fresh perspectives by deeply engaging with the psychological impacts, the role of educational systems, and the dynamics within social media platforms. By merging these diverse viewpoints, it emphasizes a holistic approach to understanding and addressing cyberbullying and advocating for strategies that are comprehensive, culturally sensitive, and adaptable to the changing digital environment. This convergence synthesizes the findings from multiple research avenues and highlights the necessity for strategies that integrate both educational and psychological insights to effectively combat cyberbullying.

### 5.1. Theoretical implications and future research directions

The theoretical implications of the current study suggest several foundational shifts and advancements needed in our understanding of cyberbullying within digital contexts. This analysis underscores the complex interplay between technological, psychological, and social factors in shaping cyberbullying behaviors and outcomes. One of the key theoretical implications is the necessity for dynamic models that not only address the multifaceted nature of cyberbullying but also integrate emerging technologies and digital cultures. These models should consider the rapid evolution of online platforms and how these changes influence bullying behavior, moving beyond traditional bullying paradigms to encompass digital-specific dynamics such as anonymity, digital disinhibition, and the non-physical nature of interactions [83,151,152].

The analysis also highlights significant gaps in understanding the systemic responses required to mitigate cyberbullying effectively. There is a clear indication for the development of comprehensive theories that can guide policy making, curriculum development, and intervention strategies at multiple levels—school, community, and online environments. These theories need to align with the nuanced realities of digital engagement among youth, recognizing the diverse ways children and adolescents interact online and how these interactions can shift from playful banter to harmful bullying. Looking forward to future research directions, the MPA opens several avenues for deeper investigation. Cross-cultural studies are particularly important as they can uncover how cultural norms and technology usage patterns influence cyberbullying behavior and victimization [153,154]. Such research could help in tailoring interventions that are culturally sensitive and more effective across different global contexts. Furthermore, longitudinal studies are critical in understanding the long-term effects of cyberbullying on mental health, social relationships, and educational outcomes. These studies can provide valuable insights into the persistence of cyberbullying impacts and the effectiveness of various interventions over time.

Another vital area for future research is the examination of new and emerging technologies, such as virtual reality and augmented reality platforms, where cyberbullying could manifest in entirely new ways [73]. Understanding these platforms' unique challenges and opportunities for bullying behavior is essential for proactive prevention and intervention strategies. Additionally, the role of parental and educator interventions needs further exploration, particularly in developing strategies that leverage their positions of influence while respecting the autonomy and privacy of young internet users [91].

In synthesizing these areas, future research should aim to create a holistic understanding that not only addresses the prevention and mitigation of cyberbullying but also promotes positive digital citizenship and resilient digital communities. The goal is to develop theoretical frameworks and practical strategies that are robust, adaptive, and responsive to the evolving landscape of digital interactions and the ongoing challenges of cyberbullying. This comprehensive approach will ensure that efforts to combat cyberbullying are grounded in a deep understanding of all facets of the issue, from individual behaviors to broader societal and technological trends.

## 5.2. Practical implications

The MPA of cyberbullying research offers significant practical implications for educators, policymakers, parents, and digital platform designers aiming to create safer online environments. Firstly, the findings emphasize the importance of integrating cyberbullying education into school curricula at an early stage. Educators should be equipped with the knowledge and tools to recognize signs of cyberbullying and intervene effectively. This involves addressing incidents and fostering an inclusive school culture that discourages all forms of bullying. For policymakers, the study highlights the need for clear and enforceable policies that address cyberbullying at both school and community levels. Policies should include guidelines for prevention, detection, and response to cyberbullying, ensuring they are adaptable to the rapidly changing digital landscape. It also suggests that legal frameworks should be updated to reflect the realities of digital interactions and provide protections that are relevant to the ways children and adolescents engage online. Moreover, parents play a critical role in monitoring and guiding their children's online behavior. The findings advocate for parental involvement programs that educate parents about the internet and social media's nuances. These programs should encourage open communication between parents and children about online experiences and the potential risks of cyberbullying. Finally, the analysis underscores the responsibility of social media platforms and technology providers to enhance safety features that can detect and mitigate cyberbullying. This includes developing advanced algorithms for identifying harmful content and providing users with more robust tools for reporting and blocking bullying behavior. Platforms should also work on creating more transparent moderation processes and collaborating with educational institutions to spread awareness about digital safety.

## 6. Conclusions

The comprehensive analysis of cyberbullying research through MPA and co-word analysis has illuminated critical developments and the evolution of this important social issue. This study stands as a pioneering effort to apply these methodological approaches to cyberbullying literature, offering a deep understanding of the key academic and practical trends that have shaped the field. By merging these analytic methods, the study has transcended traditional literature reviews, providing a unique perspective on the dynamics of cyberbullying and its mitigation strategies across various social contexts. This methodology, however, has its limitations. Focusing primarily on published academic articles may overlook grey literature or emerging discussions in non-academic platforms, which can also offer valuable insights into cyberbullying trends and interventions. Future research could expand the database to include these sources and potentially offer a broader view of the cyberbullying landscape. Moreover, while this approach highlights the interconnectedness of research studies, it treats all studies with equal weight. As a result, this can possibly obscure the varying impact of different research contributions. Future analyses might benefit from weighting studies based on citations or other impact metrics to refine the understanding of each study's influence on the field. In conclusion, this study advances the knowledge of cyberbullying and sets a new standard for analyzing complex research landscapes. It underlines the need for ongoing innovation in research methodologies to keep pace with the evolving nature of cyberbullying and other dynamic research areas. This innovative approach encourages a more nuanced exploration of academic contributions and guides future strategies to address cyberbullying effectively.

### CRediT authorship contribution statement

**Abderahman Rejeb:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Karim Rejeb:** Visualization, Validation, Software, Resources, Project administration, Methodology, Data curation. **Imen Zrelli:** Validation, Resources, Funding acquisition, Conceptualization. **Edit Süle:** Writing – review & editing, Supervision, Resources, Project administration, Funding acquisition, Formal analysis, Conceptualization.

### Data availability statement

Data will be made available on request.

### Ethical statement

This study does not involve any human or animal subjects, and it is in accordance with research ethical standards.

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### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix

TITLE-ABS-KEY ("cyberbullying" OR "internet bullying" OR "electronic bullying" OR "technology bullying" OR "cyber-bullying" OR "online bullying" OR "cyber aggression" OR "cyber violence" OR "online victimization" OR "chat bullying" OR "chat victimization" OR "cyber mobbing" OR "cybermobbing" OR "cyber bullying" OR "cyber victimization" OR "cyber-aggression" OR "cyber harassment" OR "digital bullying" OR "e-bullying" OR "electronic harassment" OR "electronic victimization" OR "online harassment" OR "online bullying" OR "phone bullying" OR "SMS bullying" OR "text bullying" OR "virtual aggression" OR "virtual mobbing")

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