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Bibliometric analysis of inclusive education research integrating digital technologies and gamification strategies

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Abstract

This study explores the evolving role of digital technologies and gamification in inclusive education for children with special needs, particularly those with intellectual disabilities. The purpose of the research is to identify key trends, influential contributors, and thematic priorities through a bibliometric and thematic analysis. A total of 111 publications from Google Scholar, Crossref, and Scopus (2013–2024) were examined using VOSviewer and SciMAT software to analyze keyword co-occurrences, publication dynamics, and citation patterns. The findings reveal a sharp increase in relevant research after 2018, with the United States, United Kingdom, and Spain leading in output and citations. Dominant themes include gamification, digital tools, motivation, and cognitive development. The study concludes that the integration of gamification significantly enhances learner engagement and educational outcomes in inclusive settings. These results highlight the need for continued development of adaptive digital learning tools and provide practical guidance for educators, policymakers, and developers working to support inclusive educational practices.

Keywords: Children with intellectual disabilities, Children with special needs, Gamification, Inclusive education, Motivation.

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1. Introduction

Digital technologies and gamification are increasingly recognized as effective strategies for educating children with special needs within inclusive education frameworks. These tools support a holistic approach to learning, promoting not only academic achievement but also social engagement and inclusion. The integration of digital games, mobile learning, and gamified platforms creates learning experiences that are interactive, accessible, and tailored to individual abilities and preferences [1, 2]. In the digital era, educational games have become essential tools for engaging learners of all ability levels. Their adaptability allows for personalized learning pathways, enhancing motivation and making education both enjoyable and effective. Mobile learning and gamification transform traditional pedagogies by increasing student participation and fostering continuous interest.

Recent research underscores the importance of understanding how digital tools impact both academic and social outcomes for students with disabilities. Effective integration of these technologies into educational systems is foundational for developing inclusive strategies and ensuring their practical implementation [3]. As Altindağ Kumaş and Sardohan Yildirim [4] highlight, the success of inclusive education depends on the synergy between digital tools and pedagogical approaches. In particular, Khabibullina et al. [5] note that recent studies focus heavily on the implementation of gamified learning in inclusive contexts, positioning digital resources as key to meeting the needs of diverse learners in mainstream classrooms. Moreover, Ntalindwa et al. [6] emphasize that ICTs are particularly beneficial for students with autism spectrum disorders (ASD), supporting their learning in inclusive settings.

A study reporting on the successful application of gamification in education for the scope, interest, student involvement, and content understanding in various academic fields is Chugh and Turnbull [7]. Thus, better learning results occurred. The idea of employing these techniques to develop teaching methods that can accommodate all students and be engaging at the same time was encouraged by Martí-Parreño et al. [8]. To be most effective, such approaches should not only foster active learning but also be adaptable to the individual needs and learning profiles of diverse students [9]. Studies highlight the growing role of gamification and digital tools in enhancing educational experiences for students with disabilities, offering increased engagement and personalization, though challenges remain in accessibility and implementation [10, 11]. Gamified learning encourages active participation and improves the learning experience for children with disabilities [12]. For instance, digital games tailored to dyslexia have shown positive developmental outcomes Mytsyk and Babichenko [13] and inclusive gaming platforms foster higher engagement within disabled communities [14]. Gamification has also been shown to revitalize traditional teaching through interactive and creative methods [15] although it requires digitally competent teachers and inclusive assessment strategies.

Gamified environments can significantly boost student motivation and academic performance [16]. For children with autism spectrum disorder, co-designed gamification methods such as discrete trial training (DTT) improve behavioral outcomes and engagement [17]. Similarly, serious games and gamification enhance academic motivation, particularly by stimulating extrinsic motivation among students with psychosocial difficulties [18].

Despite the benefits, several barriers persist chief among them being limited resources and insufficient teacher training. Many educators lack the confidence or experience to implement digital tools effectively, which hinders adoption [19]. Moreover, professional resistance and the lack of inclusive content add further challenges. Nevertheless, when applied properly, digital games can significantly enhance learning outcomes for cognitively challenged students, although successful integration depends on educator preparedness and responsive classroom strategies [20].

It is an essential task to harmonize the architecture of digital games and gamification venues with the objectives of educational accessibility. To ensure the best customization and meet the individual requirements of learners, teachers of special education should actively participate in the entire process of development [21]. The merger of digital arts and interactive technologies in the metaverse could be an effective way to develop creativity and promote collaboration, while also ensuring the metaverse remains accessible to all. However, this potential can only be realized through thoughtful consideration of accessibility standards and the creation of media that supports a wide range of learning styles [22].

Innovative applications such as *Morning Awakening* illustrate how digital transformation can support inclusive education. Such modern technologies enable social collaboration and user-generated content, where users actively participate in the design and development of educational processes and experiences for exceptional learners [23]. Digital games have helped enhance the learning and intellectual skills of students with intellectual disabilities [7]. This, alongside the new advancements in automating digital technologies, will aid the evolution of education.

As pointed out by Acosta-Medina et al. [24] in 2020, gaps or barriers in teacher training, resources, and information accessibility were some hurdles that needed to be resolved to facilitate fully inclusive education. If these gaps can be overcome, inclusive education can truly work as it should and make real progress for children with disabilities. By the way, Yeşiltaş and Cevher [25] talked about this back in 2022. With the right approach, when not just games are used but specially adapted game methods, children with mental disabilities can not only perceive the material better but also begin to believe in themselves and their abilities. What we wanted to find out in this work:

- First of all, we were interested in how attention to the topics of inclusive education, digital technologies, and gamification has changed in recent years. Especially in the context of helping children with special educational needs. We looked at how actively all this is being discussed in scientific circles and how game techniques really affect the motivation and results of such children. The time period is from 2013 to 2024.
- One more question is who is moving this topic forward right now. We tried to track which countries, universities, authors, and scientific journals are most often published on this topic. I wanted to understand who really influences the development of this area and how significant a role gamification plays here. We also tried to look ahead a bit:

how can this field develop in the future and what problems are most likely to be faced by both teachers and researchers.

- And, of course, we did not ignore the practical side: which topics and approaches each teacher should keep in mind if he works with children with special needs. These are the principles of inclusivity, the proper use of digital tools, and, of course, how to properly implement game elements so that they really work, and not just create the illusion of engagement.

The authors of the present study managed to obtain literature with the help of keyword co-occurrence and theme analysis using VOSviewer and SciMAT software. The methods applied assisted specialists in identifying the most prominent areas requiring immediate attention in inclusive education, particularly with the application of information and communication technology (ICT) and gamification. Results revealed that the proportion of publications has shown a clear growth after 2018, indicating increasing interest from the academic community in this field. It was also observed that the average annual citation count did not vary substantially between 2020 and 2023, suggesting that these publications remained relevant during those years.In terms of citation and publication activity, researchers from the United States, United Kingdom, and Spain lead the field. This underscores the importance of international collaboration and knowledge dissemination. The most prominent keywords "inclusive education," "digital technologies," "gamification," "children with disabilities," and "motivation" reflect current research priorities and highlight areas that are still underexplored and warrant further investigation.

Overall, this study serves as a reference point for understanding the current landscape of inclusive education supported by digital technologies and gamification. It offers both a retrospective overview and a forward-looking perspective, highlighting directions for future research aimed at making education for children with disabilities truly effective, not merely accessible.

2. Method

This section outlines the methodology used to select and analyze studies on inclusive education, digital technologies, and gamification for children with special needs. A systematic bibliometric approach was chosen to ensure objectivity and reproducibility, allowing for consistent evaluation of research trends and key issues. Bibliometric methods are widely used to reduce subjectivity common in traditional literature reviews and to focus on the quality of sources.

The study focused on publications from the last twelve years, assessing titles, abstracts, keywords, and conclusions. Articles were categorized as highly relevant, partially relevant, or irrelevant (excluded). Full-text analysis followed, guided by the PRISMA protocol [26] ensuring transparency and methodological rigor.

The process included three stages Figure 1:

1. Identification – 419 articles were initially found via Google Scholar, Crossref, and Scopus; 64 duplicates and 234 unrelated papers were excluded.
2. Screening – of the remaining 121 articles, 10 were excluded due to insufficient content or lack of access to full text.
3. Included – 111 publications were selected for detailed review.

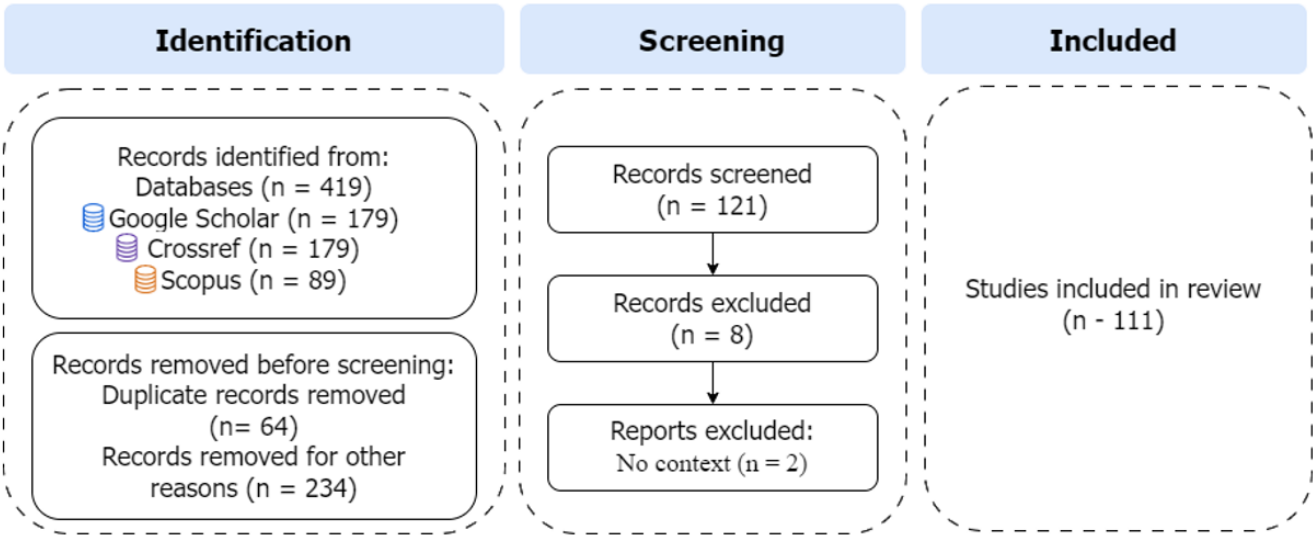

Figure 1.
Article Selection Process and Methodology.

Constraints in information dissemination can slow knowledge exchange, particularly in fast-evolving fields [27]. As Trinidad et al. [28] notes, publication rates have been steadily rising. This study employed bibliometric analysis using the Bibliometrix package in R [29], allowing for the examination of leading authors, publication venues, co-authorship networks, keyword frequency, thematic trends, and strategic research maps.

Citation data and article annotations were sourced from reputable academic databases. The analysis covered publications from 2013 to 2024, with no restrictions on document type or publication year to ensure comprehensive coverage. The selection process followed predefined criteria (Figure 1), [30] focusing on inclusive education and the application of digital technologies and gamification for children with special educational needs. Key bibliometric indicators are summarized in Table 1.

Table 1.
Summary of Bibliometric Objects.

Description	Results
Main Information About Data	
Timespan	2013:2024
Sources (Journals, Books, etc.)	94
Documents	111
Annual Growth Rate%	33,99
Document Average Age	2,4
Average citations per doc	8,73
References	0
Document Contents	
Keywords Plus (ID)	481
Author's Keywords (DE)	320
AUTHORS	
Authors	356
Authors of single-authored docs	18
Authors Collaboration	
Single-authored docs	18
Co-Authors per Doc	3,38
International co-authorships %	28,83
Document Types	
Article	37
Book	38
Book chapter	9
Conference paper	13
Review	14

The analysis reveals key trends, focal areas, and knowledge gaps in the study of inclusive education supported by digital technologies and gamification. The topic was examined from five perspectives:

- Publication activity and citation: Since 2018, the number of publications has steadily increased, with a significant rise in 2022.
- Leading contributors and regions: the USA and Spain dominate both in output and impact.
- Core research themes: the most popular keywords were: "inclusive education," "digital learning," "gamification," "motivation," and "children with mental disabilities." This suggests that many researchers are now working at the intersection of technology and support for children with special educational needs.
- Internal scientific structure: using VOSviewer and SciMAT, three stable thematic clusters were identified.
- Collaboration patterns: co-authorship analysis shows active international collaboration, particularly across Europe and North America.

Beyond quantitative data, the study explores the influence of key researchers, emerging themes, and publication dynamics, offering a comprehensive basis for further research in the field.

3. Results

3.1. General information

This study examines the development of inclusive education for children with intellectual disabilities through digital technologies and gamification. It identifies leading countries, influential authors and sources, and key research trends. The sample included 111 publications authored by 356 researchers, with only 18 single-authored works demonstrating a high level of collaboration and a multidisciplinary approach involving educators, psychologists, and educational technology specialists.

On average, each article received 8.73 citations, reflecting steady academic interest despite the field's interdisciplinary nature. A total of 481 different terms were used to describe key concepts, indicating lexical diversity and varying approaches to the subject. Additionally, 320 unique authors were identified, further confirming the field's heterogeneity. The average number of authors per publication was 3.38, highlighting the importance of teamwork in addressing complex educational needs [31].

The scientific collaboration index demonstrated active co-authorship within multi-author publications. Visualization (Figure 2) reveals not only the most cited sources but also those shaping current discourse offering valuable guidance for new researchers and highlighting unresolved questions.

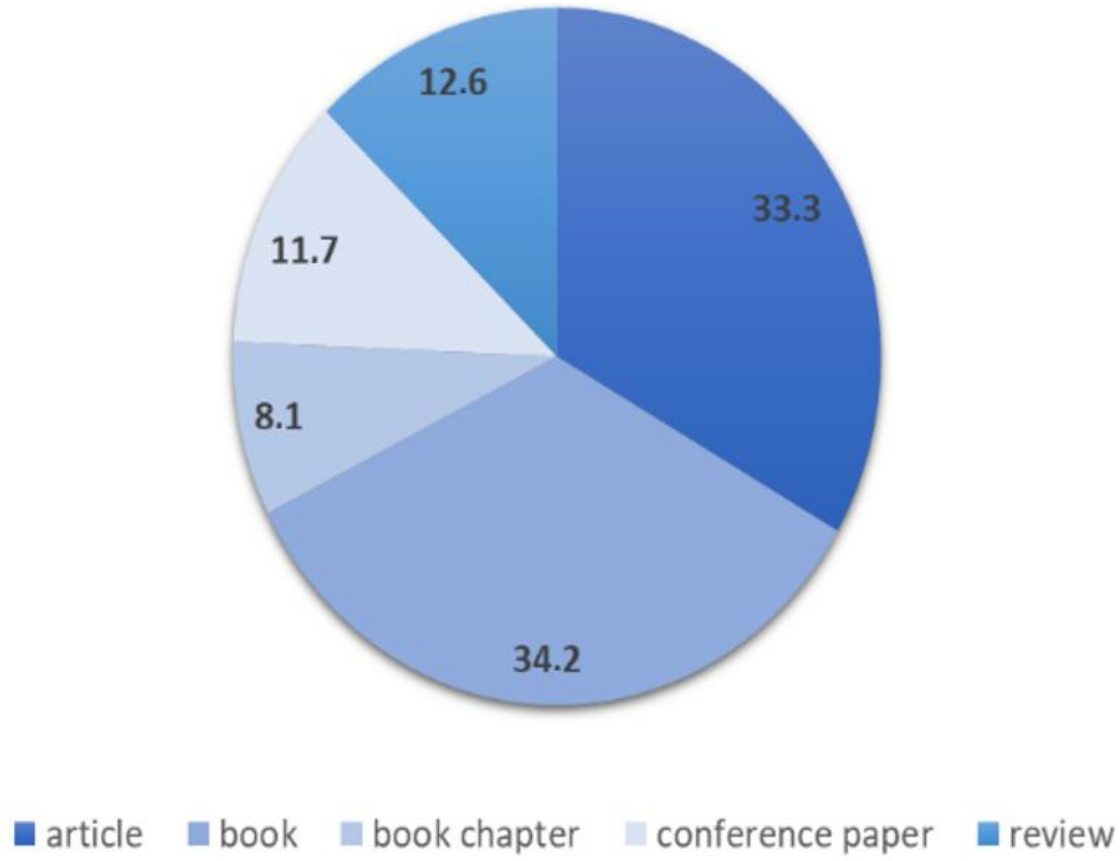

Figure 2.
Graphical representation of the most frequently used documents.

3.2. General information

3.2.1. Publication and Citation Trends

Accessibility in games and gaming applications has gained increased attention in recent years, reflecting broader recognition of the need to include people with disabilities in education, entertainment, and healthcare. However, as noted by Hassan [32], research on accommodating users with hearing, motor, or physical impairments remains limited. Between 2016 and 2020, these groups were among the least studied, particularly within emerging fields such as gamification, exergames, VR, and AR despite their significant potential for rehabilitation and training.

Greater interdisciplinary collaboration is needed to develop inclusive gaming solutions that enhance learning and foster community participation for individuals with disabilities. Since 2021, a notable rise in related publications reaching 25 by August 2024 (Figure 3) signals growing academic recognition of the importance of accessibility and inclusion in game-based technologies.

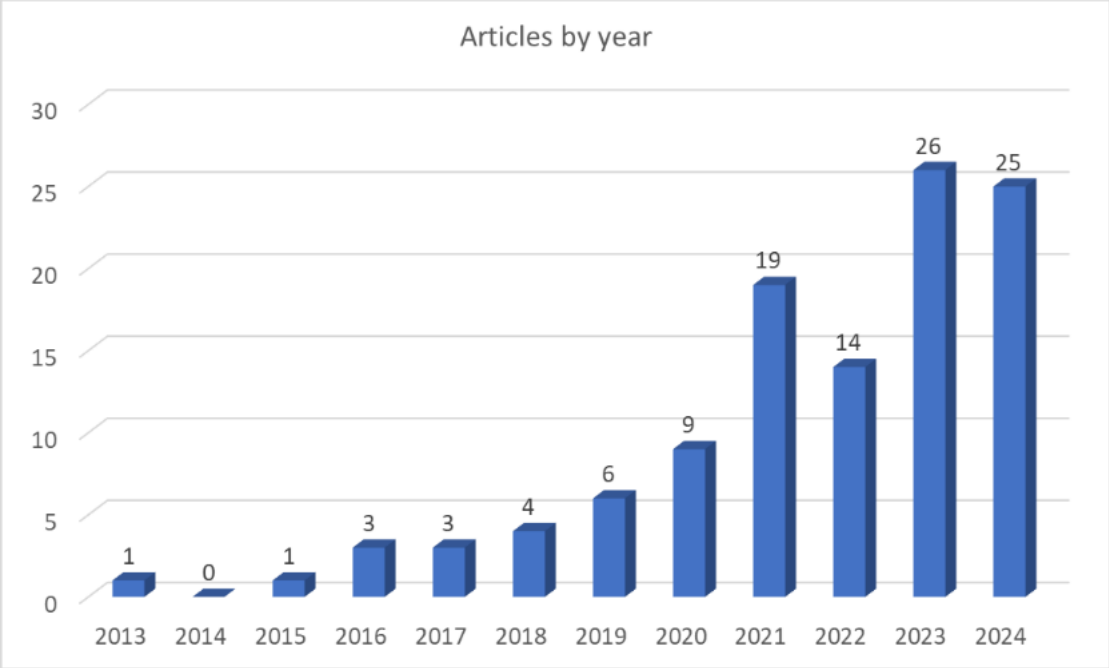

Figure 3.
Year-wise distribution of published papers.

Between 2021 and 2024, scholarly interest in inclusive education, digital technologies, and gamification increased significantly. Notably, August 2024 marked a peak with 25 publications in a single month an all-time record that reflects the growing relevance of this research area. This surge indicates a strong commitment among researchers to explore how digital games can enhance learning for children with special needs. Interestingly, articles published in 2019 received the highest citation rates, after which a decline was observed. This trend may reflect a saturation effect, where an increase in the volume of publications led to a decrease in attention to individual papers a common occurrence in rapidly developing fields. By contrast, the period from 2016 to 2018 showed stable citation patterns, suggesting that research during those years resonated strongly with the academic community. Prior to 2016, a lower average citation rate per paper was noted, possibly due to the field being more niche and fragmented at the time. These dynamics demonstrate that the impact of research should not be measured solely by publication volume. Rather, high-quality, influential studies play a crucial role in shaping the direction of the field and guiding future inquiry.

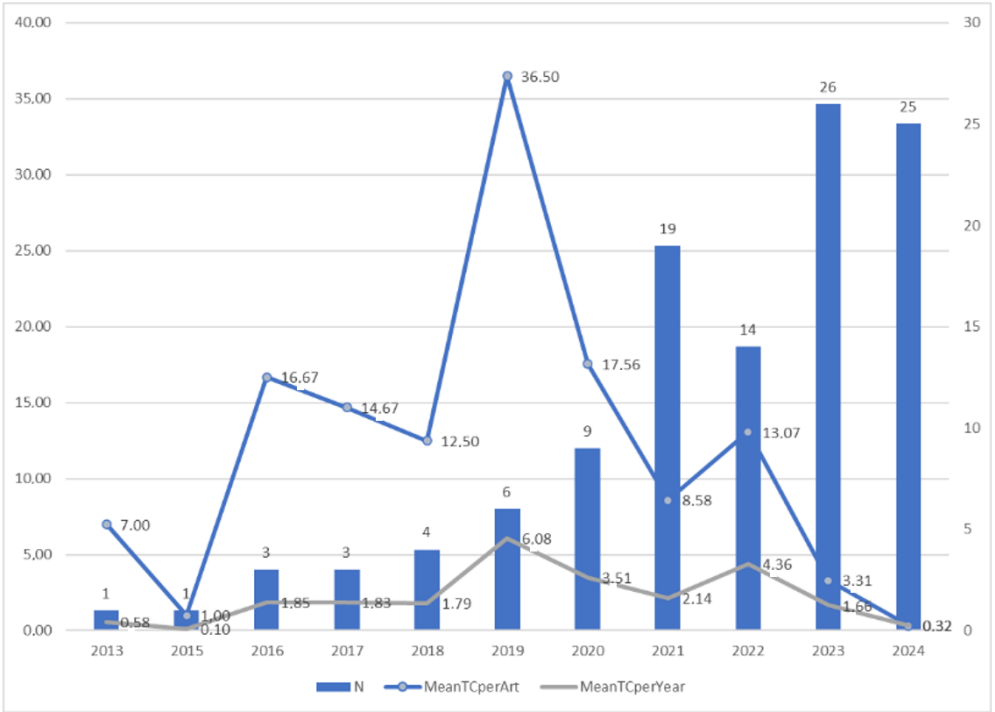

Figure 4.
History of publications and citations.

3.2.2. Source Impact

During the analysis of 111 scientific publications, 96 different sources were identified, which indicates a wide variety of topics and active interaction in the fields of inclusive education, digital technologies, and gamification. It is important to note that not only the number was checked but also the quality, as well as the significance of the links used. The materials of the conference on human factors in computing systems stand out in particular 5 articles have been published in its collection, which makes this source notable for the volume of publications. Figure 5 shows the distribution of sources depending on their contribution to the study. Such a graph helps to visually identify key publications that are considered fundamental in this field, serving as a guide for future researchers in their work.

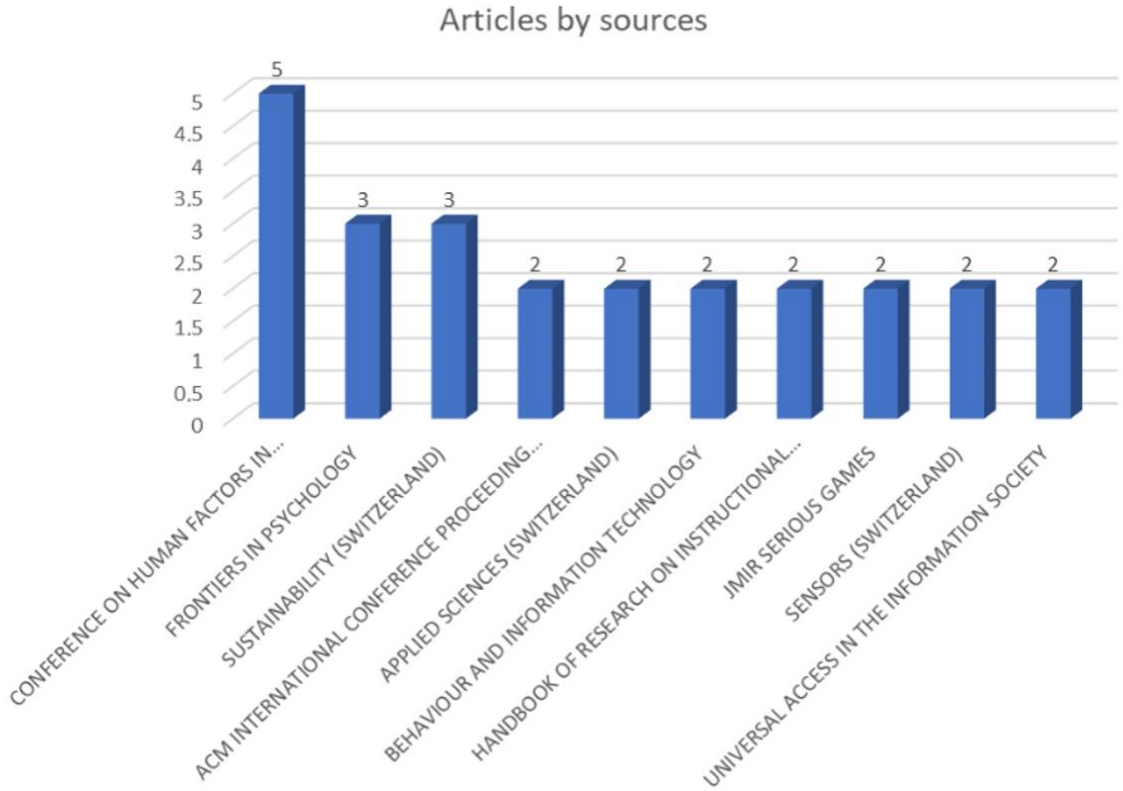

Figure 5.
Top impactful sources.

Table 2 shows the differences in bibliometric indicators across various publication sources. It considers parameters such as the number of published papers, total citations, information prevalence, as well as the Hirsch index (h-index) and the g-index, which reflect the rating and impact of documents. According to these metrics, the materials from the conference on human factors in computing systems are the most cited and recognized as one of the most influential and productive sources in this field. These metrics also indicate that Frontiers in Psychology is equally significant, as it regularly publishes high-impact interdisciplinary research at the interface of psychology, technology, and education [33-35].

Table 2.
List of the leading journals contributing to the selected topic.

Source	h_index	g_index	m_index	TC	NP	PY_start
Conference on Human Factors in Computing Systems - Proceedings	4	5	0.444	48	5	2016
Frontiers In Psychology	3	3	0.75	23	3	2021
ACM International Conference Proceeding Series	2	2	0.222	30	2	2016
Applied Sciences (Switzerland)	2	2	0.667	91	2	2022
Behaviour and information technology	2	2	0.667	19	2	2022
Handbook of research on instructional technologies in health education and allied disciplines	2	2	1	34	2	2023
Jmir serious games	2	2	0.5	42	2	2021
Sensors (Switzerland)	2	2	0.333	64	2	2019
Sustainability (Switzerland)	2	3	0.5	52	3	2021
Universal access in the information society	2	2	0.4	36	2	2020
A cognitive psychology of mass communication	1	1	0.143	1	1	2018
Acm Transactions on Computer-Human Interaction	1	1	0.25	57	1	2021
Advances in experimental medicine and biology	1	1	0.167	12	1	2019
Artificial intelligence applications using Chatgpt in education: case studies and practices	1	1	0.5	2	1	2023
Asian journal of psychiatry	1	1	1	2	1	2024
Cogent psychology	1	1	0.143	15	1	2018
Computer methods and programs in biomedicine	1	1	0.5	1	1	2023
Computers and education	1	1	0.167	106	1	2019
Computers in human behavior	1	1	0.5	20	1	2023
Cyberpsychology: an introduction to human–computer interaction, second edition	1	1	0.125	33	1	2017

Table 2 also includes the g-index, a metric used to assess the impact of an author's most cited works. The Hirsch index, or simply the h-index, is an indicator that shows how many articles an author has that have been cited at least h times. Simply put, it helps to understand how influential the author is in his field. There is also the g-index, which is similar to the h, but takes into account other articles that are also important, although they are not quoted as often. Because of this, the g-index will always be equal to or slightly greater than the h-index, because it is considered only for the main publications of the author. Also, the m-index is the h-index divided by the years of scientific work of the corresponding author. This measure assesses the density of researched and published results within given years of activity, and especially when eventful scientists are temporally measured, they become divergent in career duration. The three metrics provide new insights into the authors' roles and their publications in the creation of scientific knowledge, enabling the identification of the average citation metric while highlighting the more important sources in the area and discipline of greater significance, citing the sources which most need citation.

3.2.3. The Most Impactful Authors

In scientific circles, bibliometric analysis has become a popular tool for identifying patterns of scientific activities. It employs statistical approaches to analyze the frequency distribution of publications and citations. Lotka's law is among the most important tools used in this type of research [36, 37]. It can be applied to practice in the form of the Lotka distribution, which describes the behavior of the number of authors publishing few articles, where most users publish one or two documents [38, 39]. The paper examined 111 scientific publications that contained 356 authors and were based on Lotka's law. Both the publication process of the authors and the area of inclusive education through digitalization with the help of gamification are well illustrated by the graph in Figure 6.

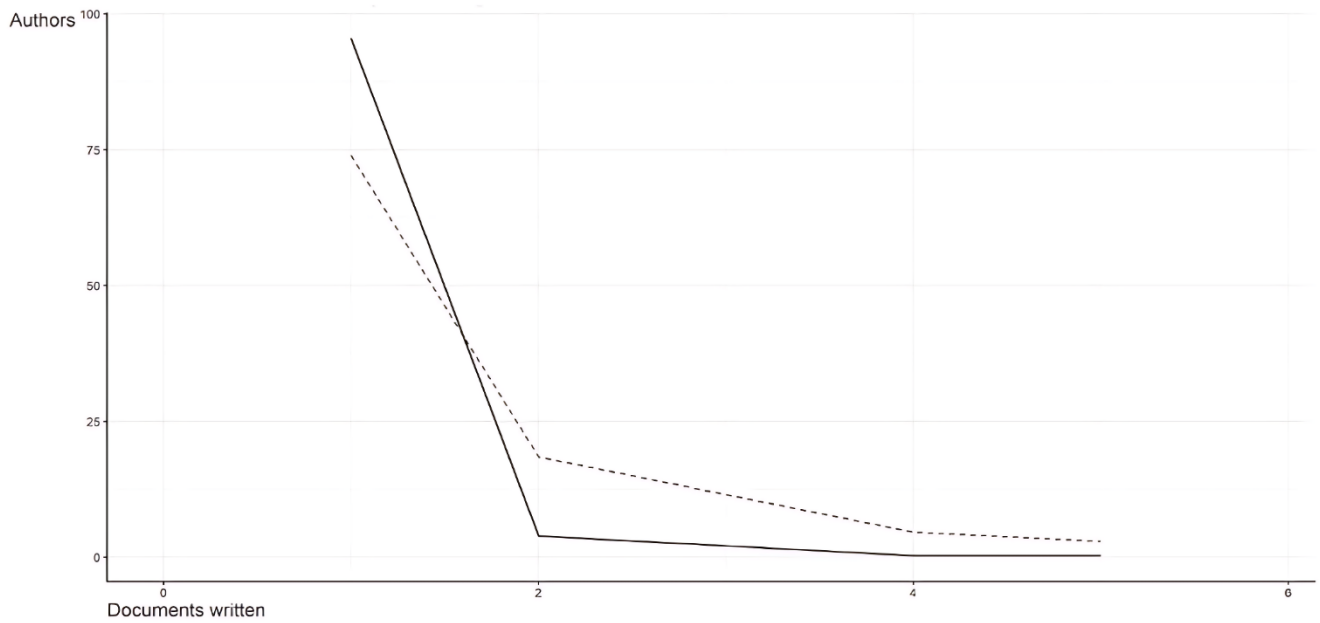

Figure 6.
Scientific productivity frequency distribution.

It can be observed that a great majority of authors have only one or two publications, which can hint at the stage of initial development of the research field and the fact that many participants are there on a one-shot or interdisciplinary basis, instead of as sustainable research groups. It is this very fact that can be a possible explanation for sectoral fragmentation and also for the lack of the studies' depth. The two graphs' lines, i.e., the one with dotted lines and the other with solid lines, depict the ideal expected and actual publication data, respectively, which in other words means the empirical data of the publication activity of the authors, and we can compare them with the model of Lotka. Long-term, systematic research is necessary to improve the quality, depth, and reproducibility of scientific data in this field. Bibliometric citation analysis remains a reliable tool for assessing scientific productivity and impact. To track the dynamics of the publication activity of leading researchers in the field of inclusive education using digital technologies and gamification elements, a bubble diagram is presented in Figure 7. The size of each bubble point indicates the proportion of publications a particular author made in a specific year. This visualization makes it easy to identify which scientists were most active in working on the topic during that time.

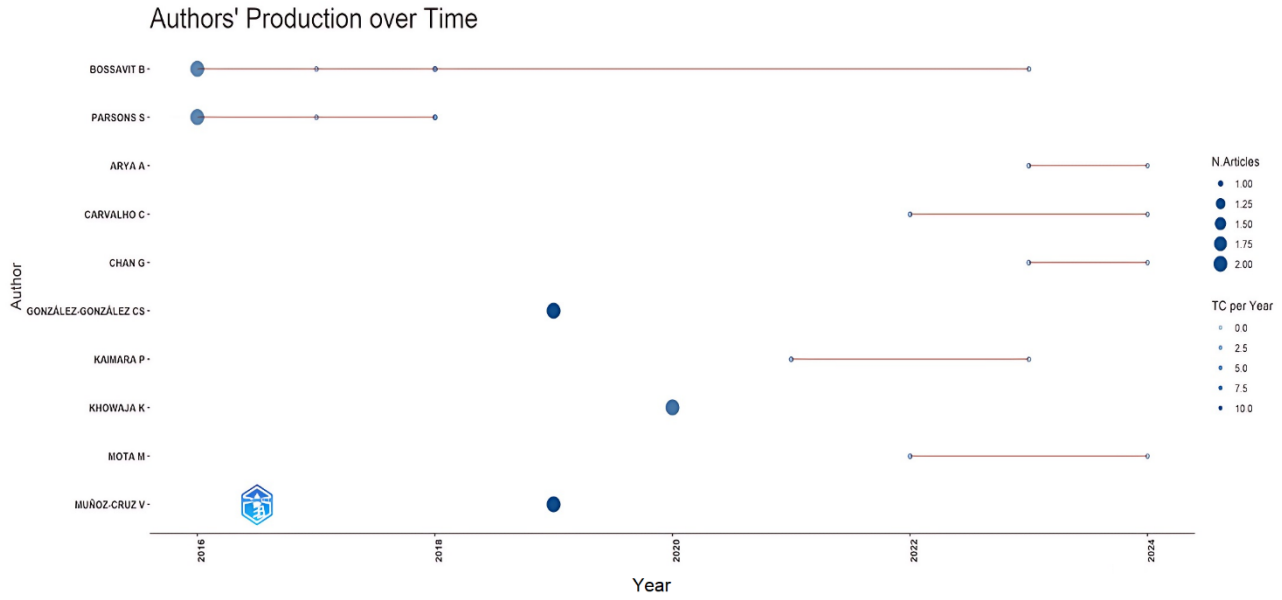

Figure 7.
Year-wise publications by authors

It can be noted that B. Basovit, S. Parsons, and A. Arya have made significant contributions to the development of inclusive education using digital technologies and game methods. Their work is regularly published in reputable scientific journals and is highly cited, which indicates the important role of these authors in developing educational solutions for children with mental disabilities.

According to Table 3, Bossavit and Parsons [40] leads in both publication count and total citations, with five articles, an h-index of 4, a g-index of 5, and 85 citations. Parsons and Parsons [41] follows closely with four publications, an h- and g-index of 4, and 84 citations, indicating a comparable impact. González-González et al. [42], despite having only two publications and an h-index and g-index of 2, it stand out with 840 citations, highlighting the exceptional influence of his work.

These results underscore that scholarly impact should not be measured by publication count alone. Citation metrics reflect not just productivity, but the lasting value and recognition of scientific contributions. The consistently high citation counts of Bossavit and Parsons [40] and Parsons and Parsons [41] affirm the foundational role of their work in advancing research in this field.

Table 3.
Authors' Local Impact.

Author	h_index	g_index	m_index	TC	NP	PY_start
Bossavit and Parsons [40]	4	5	0.444	85	5	2016
Parsons and Parsons [41]	4	4	0.444	84	4	2016
González-González et al. [42]	2	2	0.333	64	2	2019
Khowaja et al. [43]	2	2	0.4	36	2	2020
Mármol et al. [44]	2	2	0.333	64	2	2019
Inayat et al. [45]	2	2	0.4	36	2	2020
Abdool Karim et al. [46]	2	2	0.333	64	2	2019
Abed and Shackelford [47]	1	1	1	1	1	2024
Abrams and Walsh [48]	1	1	0.167	31	1	2019
Aghaei et al. [49]	1	1	0.25	21	1	2021

3.2.4. Most Impactful Documents

Citation analysis is key to understanding who shapes the development of inclusive education through digital technologies and gamification. Table 4 highlights a dozen influential publications, each cited between 27 and 106 times demonstrating their significance in the field. The most cited work is Cinquin et al. [50] with 106 citations, followed by Lampropoulos et al. [51] with 84, and Spiel and Gerling [52] with 57. These studies have become foundational for both theoretical frameworks and practical applications in inclusive digital learning.

The study by Cinquin et al. [50] focuses on online learning for students with cognitive impairments. While online education is often promoted as inclusive, the authors note a lack of research addressing the actual needs of these learners and a frequent neglect of core special education principles limiting real-world effectiveness.

In contrast, Lampropoulos et al. [51] investigate the impact of augmented reality and gamification on learner motivation and engagement. Their findings highlight the value of immersive, learner-centered environments in supporting cognitive, emotional, and social development.

The work by Spiel and Gerling [52] centered on gaming strategies for neurodiverse users in human-computer interaction (HCI), the critique addresses the dominance of top-down, medicalized approaches. The authors advocate for user-driven design, emphasizing the importance of autonomy and user experience in developing effective educational games.

Together, these studies emphasize the need for evidence-based practices, accessibility, and individualized design in advancing inclusive digital education.

Table 4.
Top 10 cited documents.

Paper	Total Citations	TC per Year	Normalized TC
Cinquin et al. [50]	106	17.67	2.90
Lampropoulos et al. [51]	84	28.00	6.43
Spiel and Gerling [52]	57	14.25	6.64
Carlier et al. [53]	52	10.40	2.96
González-González et al. [42]	52	8.67	1.42
Drigas et al. [54]	34	11.33	2.60
Smith and Abrams [55]	31	5.17	0.85
Bossavit and Parsons [56]	27	3.86	2.16
Bossavit and Parsons [40]	26	2.89	1.56
Khaleghi et al. [57]	21	5.25	2.45

3.2.5. Affiliation and Country-Level Analysis

The analysis of the affiliation of authors and research organizations is an important stage of bibliometric research, which allows us to identify key academic and research centers that make the most significant contribution to the development of a particular field of knowledge. Based on the analysis of recent publications, a sample of leading educational institutions has been compiled, which can be seen in Figure 8. It includes 20 of the most active universities and research institutes, whose authors participated in research on the topic of inclusive education using digital technologies and gaming methods.

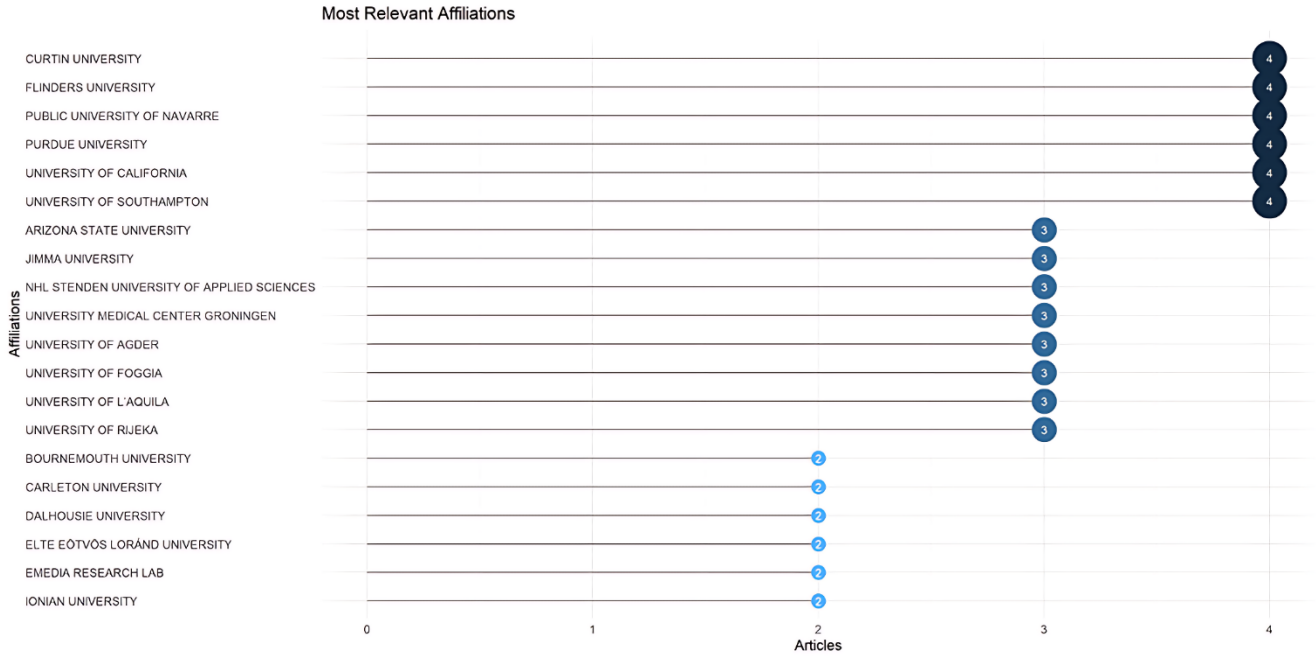

Figure 8.
Most contributing affiliations

Several universities stand out as key contributors to the advancement of inclusive education through digital technologies. Curtin University, Flinders University, and the University of Navarre each account for four publications, indicating sustained institutional engagement. Arizona State University, Jimma University, and NHL Stenden University of Applied Sciences follow with three publications each. These figures suggest that the topic has moved beyond isolated efforts and is gaining momentum across international research centers.

This growing global involvement highlights the importance of international collaboration and knowledge exchange for advancing inclusive practices. Such “activity hubs” help shape the broader research agenda and promote the practical

implementation of inclusivity principles. At the national level, Spain, Greece, and France lead both in publication volume and citation impact, demonstrating not only active research output but also strong academic influence in the area of digital tools and game-based learning for children with special educational needs.

Table 5.
Top countries publishing articles on the selected theme of research.

Country	TC	Average Article Citations
SPAIN	129	12.90
GREECE	124	31.00
FRANCE	106	106.00
UNITED KINGDOM	61	12.20
BELGIUM	52	52.00
PAKISTAN	36	18.00
USA	36	7.20
NETHERLANDS	28	14.00
ITALY	24	6.00
IRAN	21	21.00

Alongside leading contributors such as the United States, the United Kingdom, and Spain, countries like Belgium, Pakistan, the Netherlands, Italy, and Iran also play a significant role in advancing research on digital technologies and gamification in inclusive education. The continued citation of work from these countries highlights their influence on the global scientific discourse. The field has clearly transcended national boundaries and become international in scope. Increasingly, collaborative projects, joint research efforts, and cross-border exchange of experience are contributing to a richer and more diverse body of knowledge. Figure 9 illustrates the difference between single-country publications (SCP) and multi-country publications (MCP). Internationally co-authored studies tend to produce more innovative and transferable outcomes, as they integrate diverse perspectives and educational contexts. These collaborations often yield results that go beyond the sum of individual contributions, reinforcing the value of global partnerships in inclusive education research.

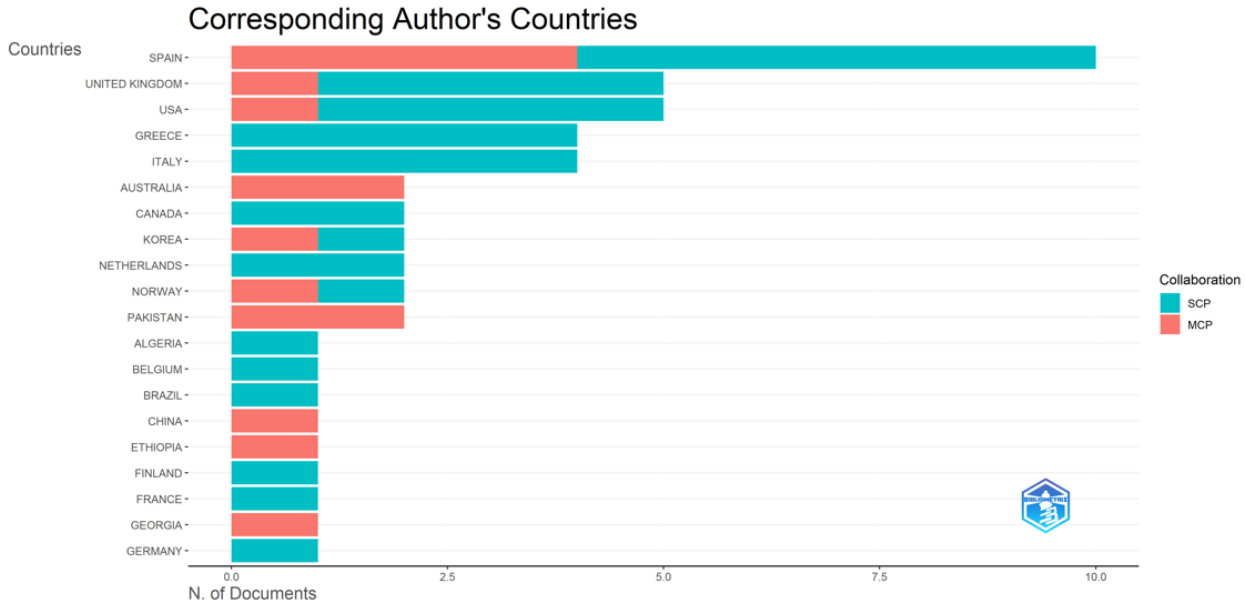

Figure 9.
Collaboration of corresponding authors.

Countries such as Spain, the United Kingdom, the United States, Greece, and Italy demonstrate strong traditions of international scientific collaboration, with researchers frequently forming multinational teams and co-authoring publications. This model proves effective regardless of geographical distance. In contrast, countries like Australia, Pakistan, and China primarily produce research within national teams. While this reflects the strength of their internal research infrastructures, limited international engagement may restrict access to diverse methodologies and innovative perspectives. Expanding international cooperation beyond conferences to include joint publications and collaborative projects is essential, particularly in the field of inclusive digital technologies, which addresses global challenges. Enhancing cross-border dialogue increases the potential for impactful, practice-oriented solutions.

3.3. Analysis of Keywords

3.3.1. Analysis of High-Frequency Keywords

To better understand which topics are most often discussed by scientists in the field of inclusive education and digital technologies, we used the Biblioshiny program, which helped us collect and analyze the most popular keywords that authors use in their articles. Using this method, we created a hierarchical map of keywords with a frequency of more than 50 times, which is shown in Figure 10. Further visualization of the frequency of terms is given in Figure 11, where you can see the most actively used keywords in the selected sample of publications.

Figure 10.
Word Tree Map of high-frequency author's keywords.

Our focus domain is inclusive education with digital technologies such as gamification. However, it is also suggestive that they are also motivation and cognitive development and learning outcomes of children with intellectual disability. The working frequency of these concepts, however, confirms the current focus of the scientific community on issues related to the adaptation of educational practices to the profiles of children with special educational needs, namely when we are contemplating the use of digital interactive and game tools. Therefore, thematic analysis emphasizes that this field is subject to ongoing research interests in the creation and assessment of digital solutions that can be used to motivate and include students with intellectual disabilities.

Figure 11.
Word Tree Map of high-frequency keywords.

3.3.2. High-Frequency Words Analyzed Through Cluster and Multivariate Statistical Techniques

As stated by Buhalis [58] cluster analysis is a multivariate technique in which objects are grouped based on similarity in characteristics. Artificial clustering methods were also employed in this study to determine the semantic relationships of the terms frequently used in the articles on inclusive education, digital technologies, and gamification for children with special educational needs in the field. In an article by Nemani and Venugopal [59] they applied hierarchical cluster analysis

to pool the keywords into coherent sets based on their primary themes. Semantically similar terms coalesced into larger hierarchical structures during the clustering process, as explained by Kettenring [60].

Keyword maps (Figure 12) and dendrograms (Figure 13) illustrate the findings of the research. The leading clusters are in the field of technology adoption in educational processes, motivational aspects of learning, psychological and pedagogical support, and the influence of gamified digital solutions on educational outcomes. Mutatis mutandis, cluster analysis reveals stable and interconnected thematic areas that substantiate the professional orientation of scientific research in the field of inclusive education, which is oriented toward the use of digital technologies and game mechanics.

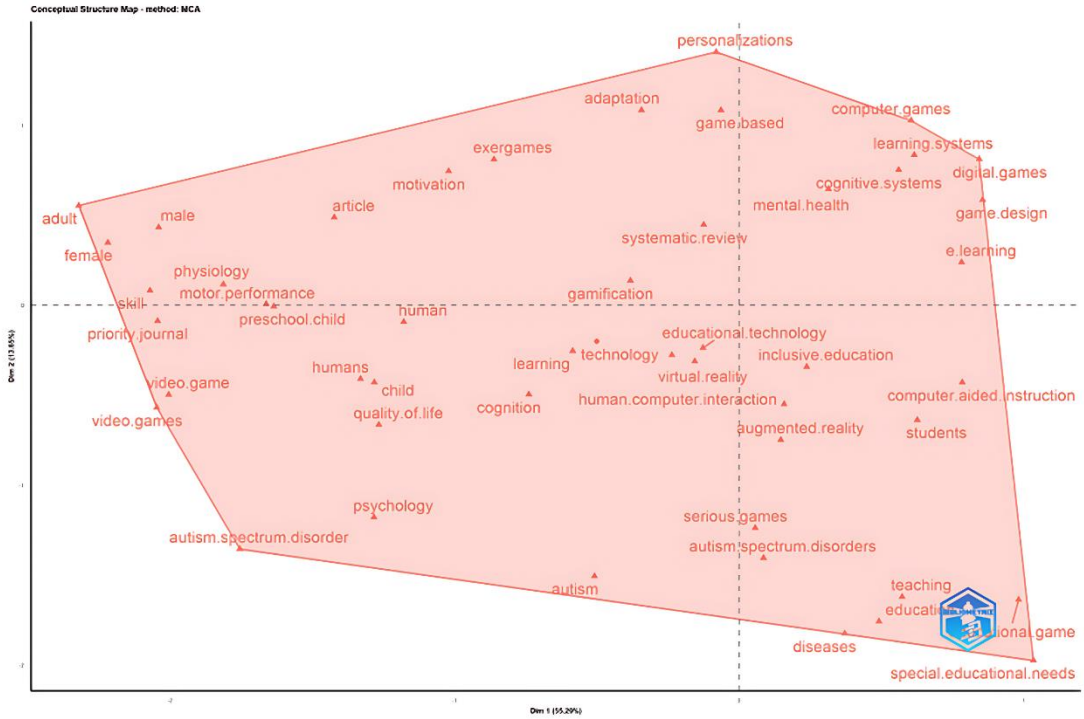

Figure 12.
Keyword clustering a word map.

Based on the hierarchical cluster analysis, we identified two primary clusters that best reflect contemporary research directions in the area of inclusive education, focusing on digital technology and gamification approaches to teaching children with special educational needs (Figure 13). The first cluster of studies focuses directly on research involving children with special needs. The attention here is on research in teaching methods, forms of support, the perception of digital resources, and the development of teaching solutions, mainly addressed to people with mental and cognitive disturbances. As for the second type of clusters, it includes publications that serve as an introduction to the use of digital technologies and gamification in the practice of an inclusive school. In this field, the efficiency of gamified methodologies, e-accessibility, and the motivational and emotional effects of technologies on learning are analyzed. These two repertories of factors demonstrate the complementarity of research: on the one hand, the consumers' theory (children with disabilities), and on the other hand, the media and the methods (digital tools and gamification), which are fundamental for scientific research on digital inclusion in education.

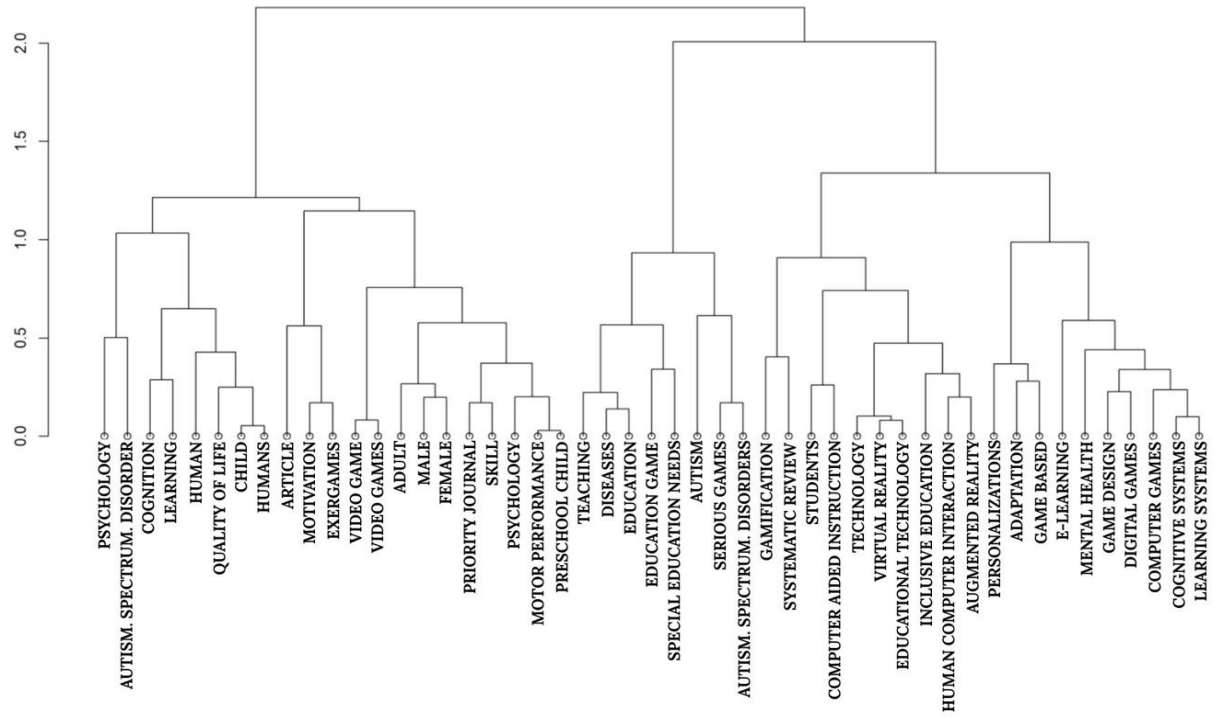

Figure 13.
Keyword clustering a tree dendrogram.

3.4. Mapping Results with the VOS Viewer

Advanced analyses of the relationship of bibliometric indicators were performed with the VOSviewer software to detect geographical and thematic areas of influence in inclusive education through digital technologies and gamification. Throughout the long period of conducting the study, we mapped a graphical scheme according to the information corresponding to the country co-authorships, which is presented in Figure 14, depicting highly collaborating countries in terms of publication, during the previous year, work related to research aimed at improving the motivation and learning of children with intellectual disabilities was also highlighted. The final sample comprised 38 countries, all with a number of publications and citations equal to or higher than five, distributed over five clusters with a total communication strength of 871, corresponding to a very high level of international scientific cooperation. Cluster 1 (Blue) presents the most cooperation, with the UK (160 links) and the US (123 links). Cluster 2 (Red) is composed of links around Malaysia (98 links) and Australia (91 links). Cluster 3 (Green) consists of Spain (66 links) and France (30 links). Cluster 4 (Purple) includes Belgium (10 links). Cluster 5 (Yellow) corresponds to the Republic of Korea (4 links).

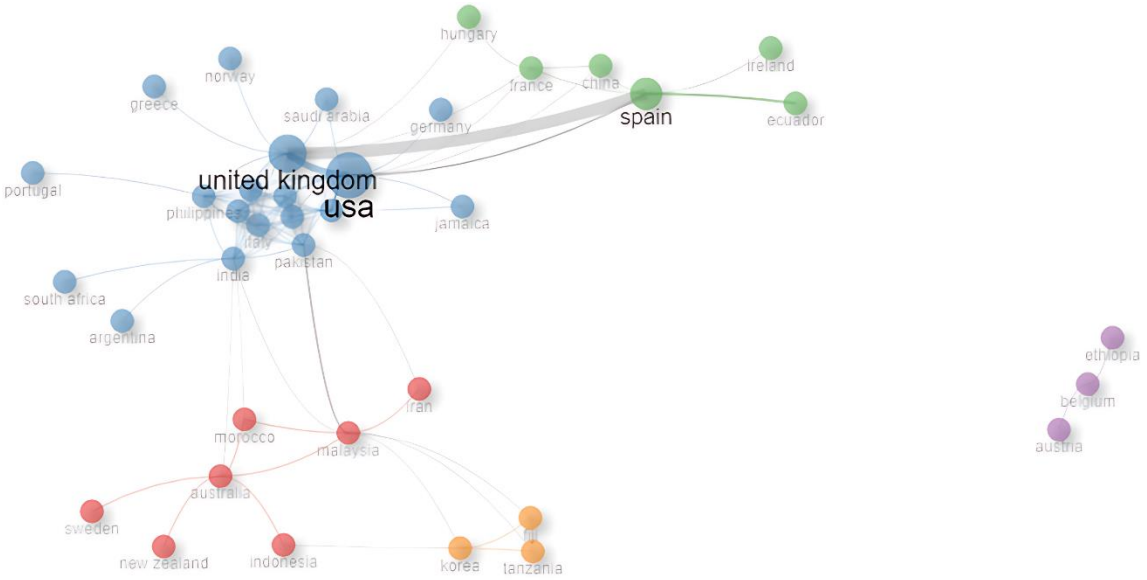

Figure 14.
Bibliometric network map of co-authorship for countries.

In addition to the country analysis, a network analysis of the thematic landscape of the publications was also carried out based on the author's keywords, and the obtained results are shown in Figure 15. The lowest "threshold" for including a keyword into the network graph was 5 warnings, resulting in the recognition of 24 keywords across 5 thematic clusters. Cluster 1 (red) comprised 8 terms dominated by "gamification" (197), "serious games" (50), and "exergames" (22). Cluster 2 (blue) included 2 terms, such as "autism spectrum disorder" (22). Cluster 3 (green) consisted of 5 terms, including "digital games" (31), "accessibility" (20), and "inclusion" (2). Cluster 4 (purple) contained 4 terms, most notably "autism" with 60 connections. Cluster 5 (yellow) included a single term, "augmented reality," with 76 links.

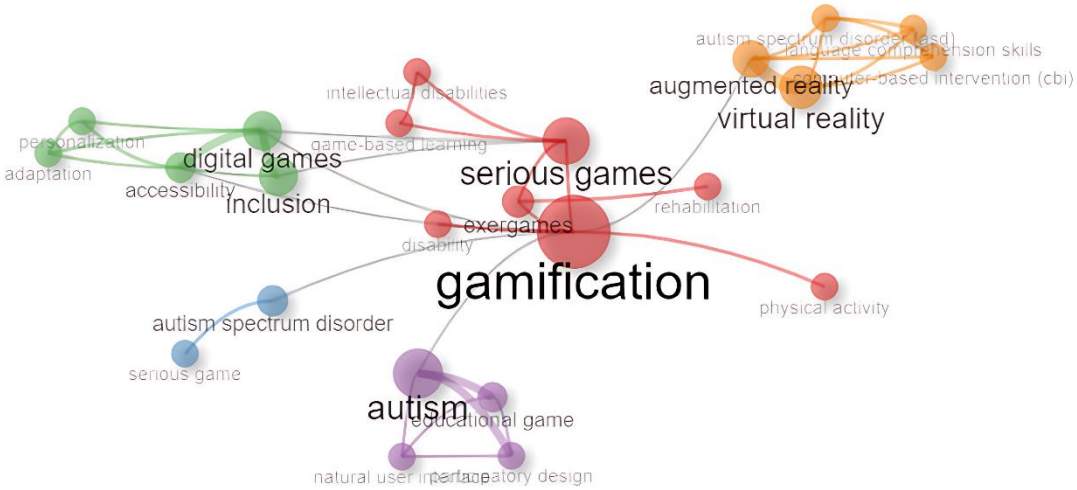

Figure 15.
Bibliometric network map of keywords.

If you examine the results, it becomes evident that the geography of research is extensive, and many topics are covered. This indicates that subjects such as gamification, accessible environments, autism, and AR technology have already become integral parts of the broader discussion on inclusive education in the digital age. The positive development is that international cooperation is increasingly widespread. Researchers from different countries are finding common ground, sharing experiences, and collaborating on joint projects. This is crucial because the most innovative ideas often emerge at the intersection of diverse approaches and cultures. However, a noticeable challenge persists: despite the rising interest, some areas remain underexplored. For instance, there is limited understanding of how effective these digital solutions are in real-world settings or how they influence the motivation of children, particularly those with special educational needs. Accessibility issues are also not entirely resolved. Therefore, it is essential to initiate a dialogue, unite efforts, and seek solutions collectively. Ultimately, when it concerns children and the future of education, collaborative work is indispensable.

3.5. Development of a Model of a System for Monitoring and Evaluating the Results of Education and Social Integration of Children

In recent years, the rapid transformation of education has outpaced traditional evaluation approaches, prompting the need for more comprehensive tools to assess how educational systems function in practice. Modern education faces complex challenges: ensuring equity regardless of health, social status, or geography; adapting to digitalization; and addressing persistent social inequalities that affect student outcomes.

In this context, robust monitoring and evaluation (M&E) systems are essential not as bureaucratic formalities, but as instruments for informed decision-making. Monitoring involves ongoing observation of student engagement and progress, while evaluation interprets this data to assess the effectiveness of methods and identify areas requiring intervention. Contemporary M&E is grounded in three key principles: data-driven decision-making, holistic assessment (including psychological and social factors), and context sensitivity. An approach effective in one setting may not apply elsewhere. Special attention is given to social integration, recognizing that a student's sense of belonging, participation, and acceptance significantly influences motivation and academic success. Thus, a meaningful evaluation of education must go beyond academic scores to include students' emotional well-being, engagement, and the presence of support systems providing a fuller picture of educational effectiveness and equity.

The development of a monitoring and evaluation system (M&E) model requires building a clear and logical structure that includes several key components (Figure 16 shows):

- *What is being evaluated?* First of all, it is important to determine which aspects of the educational process are to be evaluated. This may include academic performance, the regularity of attendance, the degree of student participation in school life, the level of their involvement, as well as the psychoemotional state of children.
- *What indicators are used?* It is necessary to select clear and measurable indicators for each of these areas. For example, you can track the number of students experiencing learning difficulties, record the level of parental satisfaction with the quality of education, as well as the proportion of students participating in extracurricular activities.

- *How is the data collected?* The tools can be very different from questionnaires and testing to interviews, observations, analysis of electronic diaries, or the use of digital trackers.
- *How is the data analyzed?* After collecting the information, it must be processed correctly. It uses both quantitative methods, such as statistics, and qualitative approaches, such as content analysis of responses.
- *What is being done with the results?* It is very important that the collected data does not remain just in the form of reports. They should become the basis for concrete actions: adjusting curricula, providing additional training for teachers, involving parents in the educational process, or revising teaching methods.

Creating a working monitoring and evaluation model is not just another project. This is a step towards education that focuses on the child, his needs, and opportunities. Such a system helps to notice difficulties in time, understand what needs to be changed, and make school a place where everyone is comfortable and safe. Ultimately, this is the basis for the formation of a society in which everyone feels important and needed.

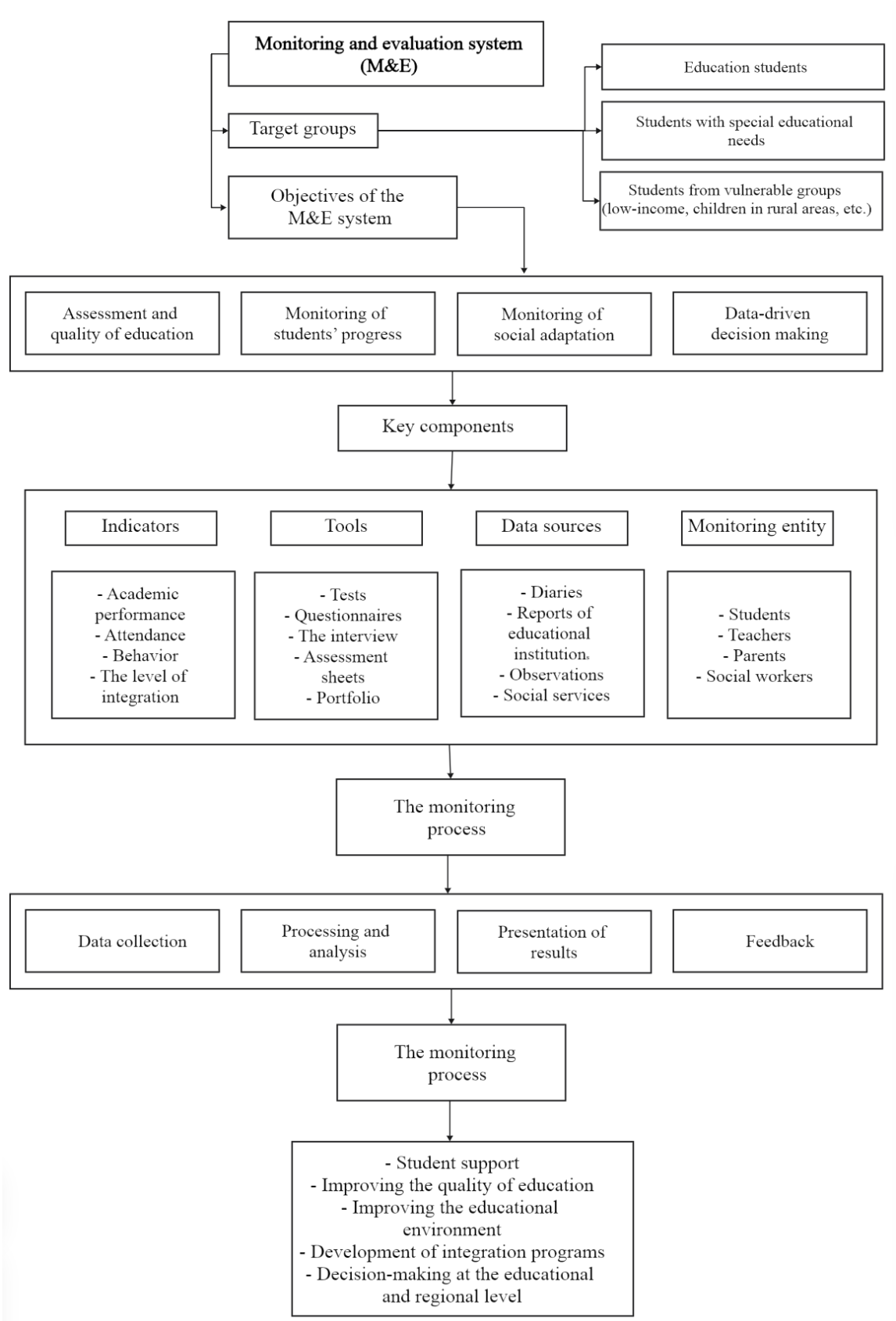

Figure 16.
Monitoring and evaluation system.

4. Thematic Analysis of Bibliometrics

Thematic analysis is an important tool in bibliometry, which helps track the development of a particular scientific field. As Singh et al. [61] and Bagheri et al. [62] point out, this method allows us to understand the structure of knowledge and see in which direction research is moving. In my work, I conducted such an analysis to understand how the literature on inclusive education, digital technologies, and gamification has changed, and how this has affected the motivation and

success of children with cognitive disabilities. To do this, I used the SciMAT program, which helps to visually show the main research directions and track how they have changed over time. In addition, I used strategic diagrams and thematic networks to better understand the meaning of the research, as well as to analyze citations and international collaboration as advised by Karakose et al. [63], Vasconcelos et al. [64] and Qian et al. [65] provides a coherent and holistic research engagement. To develop a solid understanding, the author classified these principal fields into four main categories, as shown in the strategy diagram Figure 16.

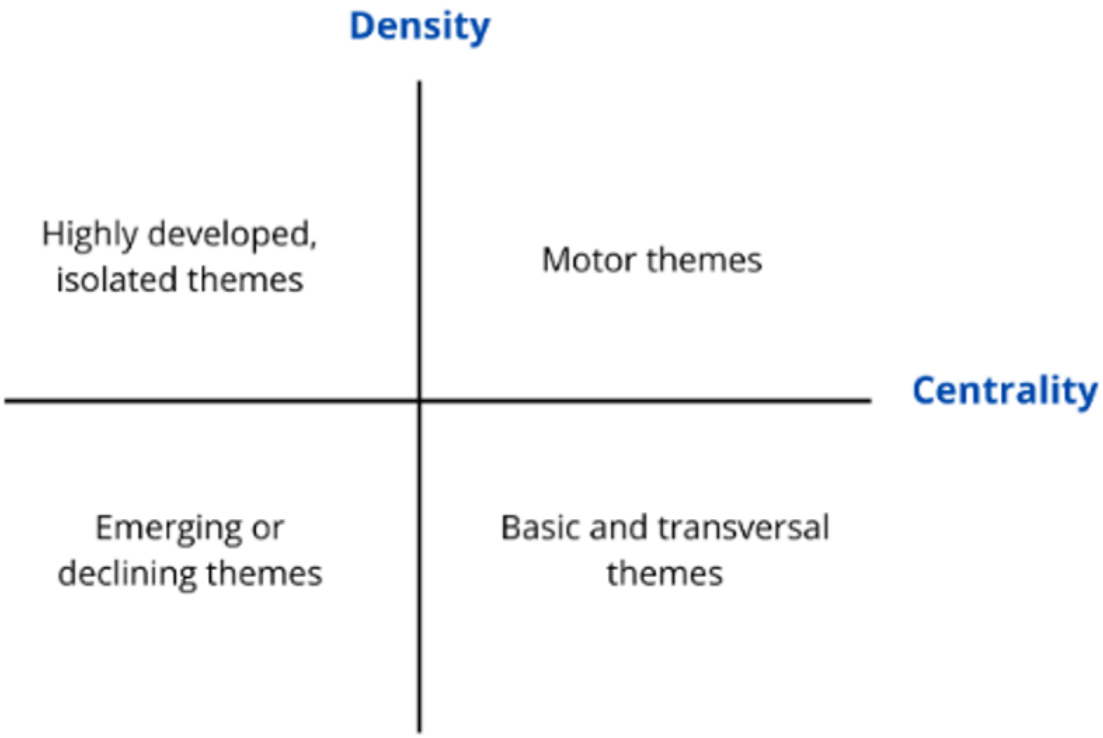

Figure 17.
Strategic diagram for essential themes.

The thematic analysis conducted with the help of Sciath helped to identify both well-established research areas and emerging conceptual trends [66, 67]. These results help us understand which areas should be developed further in the study of digital integration, as well as how to better build international and interdisciplinary cooperation. With the help of the SciMAT program, we were able to track how key topics changed over time and see how the main idea developed. In the course of our analysis, three periods were identified: 2013-2017, 2018-2021, and 2022-2024, each with its own characteristics and level of scientific development.

Initial phase (2013–2017)

In the meantime, we have identified several key research questions regarding inclusive education, digital technology, and gamification for teaching children with special needs, as well as their impact on motivation and academic performance in children with intellectual disabilities. We investigated autism spectrum disorder (ASD), the focal theme of the phase, highlighting the high sensitivity of the scientific community to questions of inclusion for boys with cognitive and neuropsychological disorders. Four significant publications with an H-index and g-index of 3 were discovered within this temporal frame. They had a maximum of 26 citations per article and a total of 57 citations, indicating initial but enduring scientific activity in the field. These studies served as a conceptual and methodological foundation for future projects in digital inclusion, with ASD identified as one of the main groups where educational strategies need to be adapted. Figure 17 is a graphic description of the subjects of the first stage, which are the major nodes and links that control the research stage landscape.

Figure 18.
Key themes observed during the first phase (2013-2017).

Second phase (2018–2022)

The second theme, the evolution stage (2018-2022), comprised the years. This period was characterized by an increase in the breadth and depth of the research landscape in the area of inclusive education with digital technologies and gamification. During this time, there was a growing interest in the effects of digital solutions on the motivation and educational performance of children with ID, and new topics and research areas actively emerged. In this period, seven thematic clusters emerged, as it is presented in Figure 18, of which two were highlighted on account of relevance and scientific content:

- The first theme "Human" is the focus of this period, with 9 issues, Hirsch index (h) of 7, and g-index of 9. These works averaged 59 citations per article, with a total of 253 citations, indicating a significant level of academic advancement on the subject. In the strategic diagram, this category is classified as widely developed and distributed, reflecting a stable and independent scientific field.
- The "Educational inclusiveness" is the second most important topic, consisting of 7 articles with an H-index of 5 and a g-index of 5, which together had 96 citations, with a maximum of 29 per publication. Despite its relevance, this topic in the period under review is in a stage of transformation characterized as developing and disappearing, capable of reflecting both a temporary decline in interest. Thus, the second stage of thematic evolution reflects the tendency toward conceptual complication and diversification of industries, with the simultaneous formation of stable research centers and the emergence of new, promising, but not yet fully integrated topics.

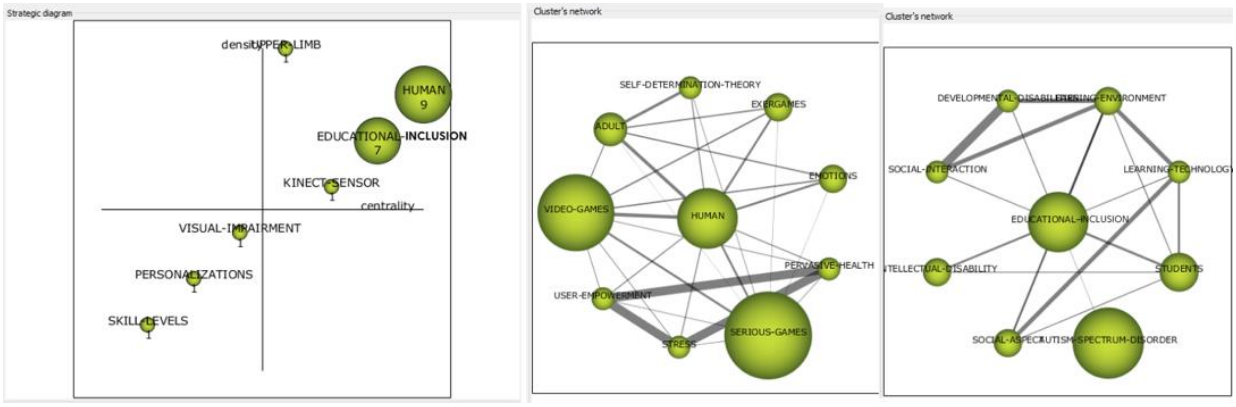

Figure 19.
Key themes observed during the second phase (2018-2022).

Third phase (2022–2024)

In the third phase of analysis, three key thematic clusters emerged, shaping the current research agenda (see Figure 19): 1. «Serious Games» This theme includes nine publications, with an h-index of 3, g-index of 6, and a total of 113 citations (maximum 88). It is categorized as a *mature and well-developed field* in the strategic diagram, reflecting its advanced scientific grounding and pivotal role in shaping game-based educational practices. 2. «Inclusiveness of Education» The most prolific topic in this phase, comprises 13 publications, with an h-index of 5, g-index of 7, and 174 total citations (maximum 88). Strategically, it is classified as a *developing theme*, indicating growing scientific interest and

its transition into a phase of active expansion and conceptual consolidation. 3. «Digital Technologies» Represented by only two publications (h-index = 1, g-index = 1), both with equal citation counts. It is categorized as a *declining theme*, suggesting a shift in scholarly focus toward more specific and applied technologies such as AR/VR, gamification, and AI integration.

These findings reflect the dynamic evolution of research priorities and the reallocation of attention toward more targeted and practice-oriented innovations in inclusive digital education.

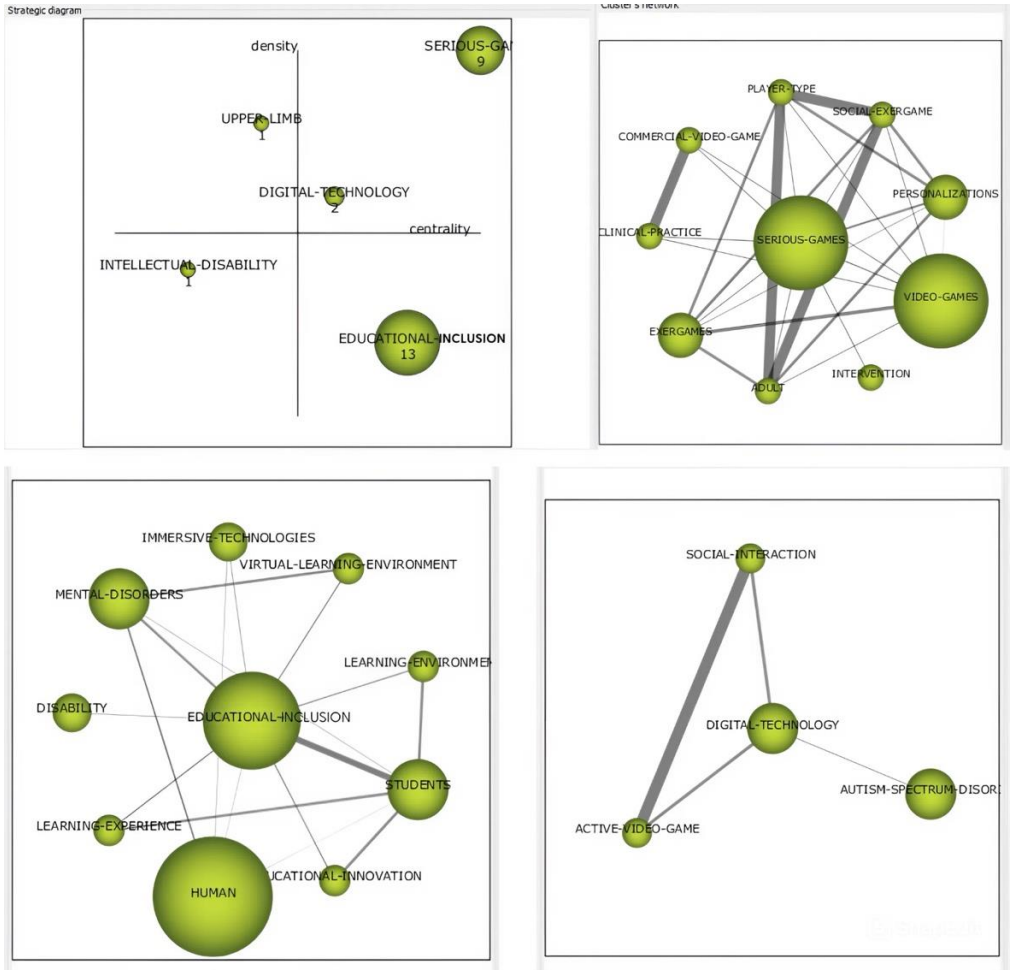

Figure 20.
Key themes observed during the third phase (2022-2024).

The third phase depicts a reinforcement of applied and technology-related topics and a positive trend to elevate scientific interest in gamified formats, as well as a strategic review of the importance of digital solutions in inclusive education. The thematic development model in Figure 20 depicts the changing trends for the main research directions within the interval of studies (2013-2024). Each circle represents an individual theme, and the diameter of each circle is directly proportional to the number of publications on that theme, allowing for easy comparison of the attention given to different areas.

Figure 21.
Evaluation map of themes.

Thematic evolution maps visualize the progression of research topics across time periods. In such maps, bold lines represent thematic continuity when a topic persists into a subsequent phase. Dashed lines indicate fragmentation into diverse subtopics, while dotted lines signal the evolution or transformation of ideas into new areas. Line thickness reflects the intensity of conceptual connections between themes: the thicker the line, the stronger the intellectual continuity. Breaks denote a cessation of scholarly attention or redirection to other disciplines. This methodology offers valuable insight into the sustainability and transformation of research in inclusive education and digital technologies. It highlights emerging "hot spots" and identifies which topics are gaining or losing momentum.

As illustrated in Figure 20, the thematic evolution in this field follows three distinct stages: Phase 1 (2013–2017): Research centered on *Autism Spectrum Disorder (ASD)*, serving as a catalyst for interest in cognitive inclusion. This stage marked the beginning of scholarly attention to specific learner needs within digital contexts. Phase 2 (2018–2022): The agenda expanded significantly to encompass broader themes such as *educational inclusion*, *human factors*, and *interdisciplinary applications*. This period reflects a transition from niche studies to systemic approaches. Emerging applied areas included *customization technologies* and *Kinect-based interaction*. Phase 3 (2022–2024): The focus has shifted toward applied domains such as *serious games*, *digital technologies*, and *inclusive educational strategies*. The increase in both the number of thematic clusters and publication volume indicates growing maturity and relevance of the field. This thematic trajectory reflects the field's evolution from specialized concerns to broad, integrated approaches addressing cognitive, technological, and social dimensions of inclusive education.

5. Conclusion

In this research, we have investigated how digital technologies and gamification are used in connection with inclusive education for children, and how they will be used in the future. We further examined how such tools impact children's motivation and learning when the user has cognitive impairments. To find these insights, we considered 111 scientific papers from the Scopus database published from 2013 to 2024. Our analysis focused on five main themes: publication trends, author contributions, key terms used, important journals, and research geography. It is also evident that interest in this issue, particularly since 2018, has been increasing. We mapped the most active authors, countries, institutions, and journals leading the dissemination of knowledge on this topic. In the keyword analysis, the study identified five clusters within 24 key terms: "gamification," "digital games," "inclusion," and "autism spectrum disorders." This highlights the importance the academic community assigns to how digital games can facilitate learning for students with intellectual disabilities. The use of the SciMAT program allows monitoring the evolution of these topics over three periods: 2013-2017, 2018-2021, and 2022-2024.

- The major theme in the primary stage was autism spectrum disorder (ASD).
- The second wave: the research domains broadened towards educational coverage, human factors, and creative responses with the anticipation of future technological changes (e.g., Kinect sensors).

- At the third stage of the study, it became noticeable how much the focus has shifted, now it's not just about technology or pedagogy, as before, but about specific issues: semantic games, digital accessibility, and an inclusive approach. This indicates that the conversation has become more applied, closer to real problems and people, with fewer theories "in a vacuum" and more practical solutions. Interest in the topic is growing, as evidenced by the increasing number of publications. Researchers are increasingly discussing how to use gamification and digital tools to make learning truly accessible. Moreover, this is not just a trend; one of the most cited works in this field concerns gamification (authors: Bossavit B. and colleagues). The topic effectively addresses current needs. Regarding geography, the USA, Great Britain, and Spain lead in research output, with these countries most often publishing and actively exchanging scientific knowledge. They have become the main centers of international cooperation in this field. Countries such as Australia, Pakistan, and China also contribute. Leading institutions actively publishing on this topic include the University of Southampton, Curtin University, Flinders University, and the University of Navarre, among others. This creates broad opportunities for developing partnerships and international consortia. Analysis of sources shows that journals such as Frontiers in Psychology, Sustainability (Switzerland), and Applied Sciences, along with materials from leading conferences like the Conference on Human Factors in Computing Systems and the Proceedings of the ACM International Conference, significantly shape the scientific landscape. Frontiers in Psychology is particularly notable for its high citation count, h-index, and g-index scores, indicating that articles from this journal are widely read, discussed, and used in further research. Overall, these data help form a clear picture of how the science of digital inclusion and gamification is evolving, especially in working with children who require a special approach to learning. It is possible to observe the emerging trends, key topics, and the direction of future research. These insights can serve as a scientific basis for further research, as well as for developing innovative pedagogical solutions and fostering international collaborations in inclusive education.

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