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ORIGINAL ARTICLE

Longitudinal overview of digital and media literacy: A taxonomy-based research trends analysis from 1954 to 2023

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ABSTRACT

Objective. A longitudinal analysis was performed to explore the thematic composition of digital and media literacy and define a taxonomy. A generic taxonomy was established in the initial phase, followed by a sub-period taxonomy. This approach facilitated an understanding of the evolution of this field over time.

Design/Methodology/Approach. A total of 11,066 documents were retrieved from Scopus composed the sample. The longitudinal analysis was generated from the defined time coverage, which spanned the period from 1954 to 2023. We considered the division into four subperiods: 1954-1979, 1980-1999, 2000-2009, and 2010-2023. A taxonomy was constructed using the clustering results and the most frequent top terms. The taxonomy was structured hierarchically, with more generic categories and subcategories positioned below them.

Results/Discussion. The general taxonomy comprised five categories: (1) digital literacy and competencies, (2) media literacy and empowerment, (3) digital and media literacies in educational contexts, (4) social impact of literacy, and (5) validation and development. In the initial sub-period (1954-1979), there was an early focus on developing general literacy, media skills, and business-related competencies. During the second sub-period (1980-1999), there was a notable shift in focus towards education, computer literacy, and increasing technology integration in the educational setting. During the third subperiod (2000-2009), the prominence of digital and media literacy issues increased. In the final sub-period (2010-2023), there is evidence of a greater focus on digital skills, big data, and social media literacy. A notable shift towards a greater emphasis on research and the utilization of ICT in education reflects the advent of a fully-fledged modern information age.

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Conclusions. A comprehensive examination of the taxonomy groups reveals many themes, including the personal empowerment of digital literacy and establishing institutional frameworks to validate educational models. Each group encapsulates a particular facet of media, digital, and social literacy while elucidating the broader societal ramifications of these literacies. This analysis demonstrates a progression from general literacy concepts in the early periods to an increasing focus on digital and media literacy in the most recent years.

Keywords: digital literacy; media literacy; information and communication technology literacy; taxonomy; bibliometrics.

1. INTRODUCTION

Integrating information and communication technologies (ICT) into society has introduced a persistent challenge: the need to develop effective training strategies for optimal utilization. This has resulted in developing educational models designed to equip individuals with the skills necessary to navigate digital content and the technologies that surround it effectively. In this context, the various forms of literacy have been given different names. For example, the term digital literacy has undergone a series of transformations, evolving from ICT literacy, technology literacy, online information literacy, and media literacy to its current form (Rafi, JianMing & Ahmad, 2019). While the specific focus and scope of these literacies may vary according to the curricula, educational purposes, and competencies to be achieved (Pasterk & Bollin, 2017), it is evident that they represent a spectrum of literacies.

Baron (2019) states that:

> To be considered digitally literate, a person needs to understand: how to use modern digital technologies to access information, how to maneuver through the complex web of information made available by digital technologies, how to "read" and understand the messages on digital media, and how he or she can contribute to the digital information economy by using digital technology.

It is not only the effective use of technology that is relevant but also the use of the content present in the media. In a 2024 report, the European Commission defines media literacy as follows: "It is a vital skill for citizens of all ages, facilitating critical thinking and enhancing their ability to navigate the digital media environment and identify disinformation." Some scholars argue that the term "digital literacy" is limited to the use of ICT (Koltay, 2011). In this context, we distinguish the concept of media literacy. In other words, we view digital and media literacy as an overarching concept encompassing the full spectrum of literacies associated with the use of both technologies and their content. Multiple forms of literacy can be classified under this umbrella (Bawden, 2008). However, the objective of this discussion is not to delineate or define these distinctions.

The study of digital and media literacies, irrespective of the contexts of application, represents a significant area of interest within the research environment. This is why several bibliometric studies have been developed to examine patterns of scientific publication. This has facilitated identifying the field's interdisciplinarity, the composition or thematic focus, the contributing disciplines, and the most relevant authors, journals, and countries. To illustrate, Purnomo *et al.* (2020) employed Scopus as a data source to map the literature on digital literacy. The authors' principal findings include observing a growing thematic evolution, identifying the United States as the most productive country, and determining computing as the predominant subject area. The authors put forth a classification system for this field of study, comprising the following categories: learning, information communication, technology, human, and education. In a recent study, Fernandez-Pascual, Pinto, and Garcia Marco (2024) examined the area of data literacy. The authors identified four primary thematic trends: data literacy, statistical literacy, data-based assessment, and e-society, and six thematic clusters: data literacy, statistical literacy, quantitative literacy, big data, data science, and quantitative skills. Kutlu-Abu and Arslan (2023) conducted a bibliometric analysis of media literacy over 21 years (2000-2021) using the

Web of Science database. The authors identified a notable evolution in the thematic focus of recent research, emphasizing the prominence of topics such as information and media literacy, citizenship, anti-colonialism, and education and communication. In a recent study, Guerola-Navarro *et al.* (2023) employed bibliometrics to examine the application of information and media literacy in the context of citizen participation. The authors discovered that researchers are more inclined to prioritize information literacy as influencing citizen participation than media literacy. Other articles employing a more general descriptive bibliometric analysis have yielded similar findings (Bapte, 2021; Esh & Ghosh, 2021). Information literacy seems to be, undoubtedly, the subject of the most significant number of bibliometric studies (Pinto, Escalona-Fernandez & Pulgarin, 2013; Kolle, 2017; Bhardwaj, 2017; Chen *et al.,* 2021; Ali, Shoaib, & Abdullah, 2023; Ashiq, Adil, & Batool, 2023).

The present study proposes a bibliometric investigation of digital and media literacy. A longitudinal analysis will be performed to explore the thematic composition of this research area to define a taxonomy. A generic taxonomy will be established in the initial phase, followed by a sub-period taxonomy. This approach will facilitate an understanding of the evolution of this field over time.

2. METHODOLOGY

2.1. Data Collection

The initial methodological decision in this study was to define the data extraction source. We selected Scopus as the data source due to its multidisciplinary scope and comprehensive coverage. The second methodological decision was to determine the terms used for document extraction. As a result of our literature review, we employed terms that have been utilized in other bibliometric studies, including "digital literacy," "ICT literacy," "information literacy," and "media literacy" (Park, Kim, & Park, 2021). Additionally, an exploratory search was conducted in Scopus using the terms mentioned above to identify potential term families for document extraction.

For this reason, we employed terms that not only linked to the word "literacy" but also included the terms "skills" and "competencies." In all cases, both the singular and plural forms were employed. The final search query was as follows:

(TITLE ("Technology literacy") OR TITLE ("Technology literacies") OR TITLE ("Technology competency") OR TITLE ("Technology competencies") OR TITLE ("Technology skill") OR TITLE ("Technology skills") OR TITLE ("Digital literacy") OR TITLE ("Digital literacies") OR TITLE ("Digital competency") OR TITLE ("Digital competencies") OR TITLE ("Digital skill") OR TITLE ("Digital skills") OR TITLE ("Computer literacy") OR TITLE ("Computer literacies") OR TITLE ("Computer skill") OR TITLE ("Computer skills") OR TITLE ("Internet skills") OR TITLE ("Media literacy") OR TITLE ("Media literacies") OR TITLE ("Media competency") OR TITLE ("Internet skill") OR TITLE ("Media competencies") OR TITLE ("Media skill") OR TITLE ("Media skills") OR TITLE ("Data literacy") OR TITLE ("Data literacies") OR TITLE ("Data skill") OR TITLE ("Data skills") OR TITLE ("Data competency") OR TITLE ("Data competencies") OR TITLE ("Information literacy") OR TITLE ("Information literacies") OR TITLE ("Information skill") OR TITLE ("Information skills") OR TITLE ("Information competency") OR TITLE ("Information competencies") OR TITLE ("Media literacy") OR TITLE ("Media literacies") OR TITLE ("Media competency") OR TITLE ("Media competencies") OR TITLE ("Media skill") OR TITLE ("Media skills") OR TITLE ("ICT literacy") OR TITLE ("ICT literacies") OR TITLE ("ICT skill") OR TITLE ("ICT skills") OR TITLE ("ICT competency") OR TITLE ("ICT competencies") OR TITLE ("Information and communication technology literacy") OR TITLE ("Information and communication technology literacies") OR TITLE ("Information and communication technology skill") OR TITLE ("Information and communication technology skills") OR TITLE ("Information and communication technology competency") OR TITLE ("Information and communication technology competencies") OR TITLE ("computer competency") OR TITLE ("computer competencies")) AND PUBYEAR

> 1953 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "re") OR LIMIT-TO (DOCTYPE, "cr"))

As illustrated in the preceding query, specific refinement parameters were employed. To illustrate, we limited our search to keywords within the title field, enhancing the conceptual precision of our document retrieval. 2023 was designated as the maximum year in the temporal scope. Additionally, we considered a range of document typologies, including articles, conference papers, book chapters, reviews, and conference reviews.

2.2. Data Analysis

A total of 11,066 documents were retrieved using the above search query. The initial document was dated 1954. The longitudinal analysis was generated from the defined time coverage, which spanned the period from 1954 to 2023. To divide this period into subperiods with homogeneous coverage, we considered the division into subperiods whose interval was as equal in time as possible. In light of the above considerations, we put forth the following subperiods: 1954-1979, 1980-1999, 2000-2009, and 2010-2023.

To perform the taxonomic analysis based on terms, we utilized those present in each article's title, abstract, and author keywords. However, before this, we normalized them. In this regard, the following steps were taken:

- To ensure consistency, all text was converted to lowercase (e.g., "Digital" became "digital").
- Any special characters or punctuation marks were removed, as they do not contribute significantly to the frequency analysis.
- For example, the stopwords "and," "the," and "is," were removed using the default stopword list of the NLTK (Natural Language Toolkit) library. This was done to focus on the terms with the highest meaning or semantic load.
- The titles were then divided into individual words (tokens) to prepare the data for further vectorization and analysis.

Once the terms had been cleaned, the data set was transformed into numerical functions using the TF-IDF (term frequency-inverse document frequency) vectorization technique. This technique transformed the text into a matrix of numerical values, wherein:

- Term frequency (TF) refers to the number of times a word appears in a document.
- Inverse document frequency (IDF) represents a measure of the importance of a word within the entire data set. In this process, words appearing in many documents are assigned a lower weight, whereas words exclusive to a specific document are given a higher weight.

Consequently, a TF-IDF matrix was generated, which numerically represented the importance of each term within the dataset. The matrix above was then subjected to a clustering algorithm to group related terms. The K-Means clustering algorithm was employed, as this groups nodes into distinct clusters based on their similarity. The following steps were undertaken:

- The number of clusters was set at five to categorize the terms into five thematic or taxonomic categories.
- Model fitting: The K-Means algorithm was applied to the TF-IDF matrix, which iteratively assigned each document to one of the five clusters based on the terms contained therein. This algorithm aimed to minimize the distance between each document and the center point of its assigned cluster.
- The resulting clusters were then labeled with a number, with each document in the dataset assigned a unique number. This process facilitated the identification of documents that exhibited a similar distribution of terms.

Following the clustering process, the most significant terms within each cluster were identified based on their TF-IDF values. These terms facilitated the delineation of the clusters and the differentiation between them. Subsequently, an analysis was conducted to determine the frequency of terms within each cluster. This stage enabled us to ascertain the preponderance of specific terms within a given

thematic grouping, thus facilitating an appreciation of the thematic constitution of each cluster. A taxonomy was constructed using the clustering results and the most frequent top terms. The taxonomy was structured hierarchically, with more generic categories and subcategories positioned below them.

3. RESULTS AND DISCUSSION

3.1. General taxonomy analysis

We now proceed to describe and analyze the taxonomic clusters identified for the whole period of analysis (1945-2023) (See figure 1):

1. **Digital literacy and competencies:** This cluster is concerned with developing, assessing, and applying digital skills in different contexts. The importance of empowering individuals through digital literacy and ensuring the validation of these competencies in educational and professional settings is underscored. This cluster encompasses theoretical and practical aspects, including the theoretical model of graph competence and the practical applications of empowerment and validation. The sub-themes that are present within this cluster are as follows:

1.1. **Digital competencies:** This term refers to individuals' skills or competencies to utilize digital technologies effectively. Furthermore, it encompasses the capacity to use digital tools, navigate online environments, and comprehend digital content.

1.2. **Graph-competence model:** This framework assesses and develops digital competencies, particularly in visual or data-oriented contexts.

1.3. **Digital empowerment:** This concept refers to how digital literacy enables individuals to engage actively in digital societies.

1.4. **Digital validation:** This is the process of confirming or certifying digital competencies, frequently accomplished through formal or informal assessments.

1.5. **Competency development:** The ongoing process of acquiring and refining competencies, particularly within educational or professional contexts, to ensure continued alignment with evolving digital competencies.

2. **Media literacy and empowerment:** This theme pertains to how individuals may become empowered through a more nuanced and thorough understanding of the media. In this theme, the role of journalists and communicators is paramount, given the emphasis on social media and critical thinking to understand content, especially about the novel coronavirus (COVID-19), one of this cluster's subcategories. The scope of this category encompasses both traditional media literacy and new forms of media literacy, such as social media literacy, underscoring its role in public empowerment. The following subcategories have been identified within this cluster:

2.1. **Media literacy initiatives:** This subcategory encompasses programs and policies to enhance audience skills, particularly in critically analyzing media content. It also includes understanding the media's function within society and how information is created and distributed.

2.2. **Roles of journalists in literacy:** This subcategory emphasizes journalists' obligation to cultivate media literacy by disseminating accessible, accurate, and transparent information.

2.3. **Social media literacy:** This subset focuses on social media platforms. The issue concerns how individuals navigate, interpret, and create content on digital platforms such as X, Facebook, or Instagram while exposing themselves to misinformation.

2.4. **Empowerment through media:** This subcategory pertains to how individuals or communities may be empowered through media literacy, enabling them to engage with media or critically create content.

2.5. **Media literacy in the COVID-19 context:** a recently formed subcategory derived from the coronavirus pandemic. This category is noteworthy for its emphasis on media literacy and the need to educate the public about misinformation surrounding the virus.

3. **Digital and media literacies in educational contexts:** This category pertains to examining digital and media literacies in educational contexts, particularly their impact on student engagement and the evolution of novel educational paradigms. The scope of

this category may encompass the design of programs aimed at enhancing educational outcomes and evaluating student competencies in these domains. This cluster demonstrates a pronounced emphasis on the pragmatic deployment of literacy competencies within the educational milieu and their ramifications for student conduct. The following thematic subcategories have been identified:

3.1. **Student engagement:** This subcategory emphasizes the extent to which students are motivated and interested in educational experiences, focusing on technological literacy as a crucial factor for academic success.

3.2. **Influence on student behavior:** This subcategory examines the impact of media literacy, digital competencies, and social participation on students' learning outcomes and attitudes toward education.

3.3. **Literacy in education:** This is a broad and multifaceted concept encompassing media and digital literacy within the context of formal education systems. It ensures that students have the requisite resources to navigate modern information environments.

3.4. **Developing educational models:** This area pertains to creating novel curricula, pedagogical approaches, and assessment instruments to foster digital and media literacy in students.

3.5. **Validation of student competencies:** This subcategory evaluates students' skills and competencies, whether in traditional or digital media. The objective is to guarantee that the educational goals are achieved.

4. **Social impact of literacy:** This cluster of studies focuses on the social impact of literacy, with a particular emphasis on media and digital literacy. It examines how literacy serves as a tool for social change, empowerment, and the advancement of individuals within society.

4.1. **Social influence through literacy:** This theme explores how media and digital literacy shape social behaviors and attitudes, particularly the influence of public discourse, social movements, and collective action.

4.2. **Social empowerment:** This concept refers to how individuals or communities gain power and agency through media and digital literacy, enabling them to participate more fully in societal and civic activities.

4.3. **Engagement through social media:** It elucidates how individuals, particularly younger generations, engage with societal issues through social media platforms. Literacy in this domain enables users to engage in discourse, disseminate information, and participate in activism.

4.4. **Social-based initiatives:** These are programs or policies that utilize literacy to address societal challenges, whether through educational initiatives, public awareness campaigns, or community-driven efforts.

5. **Validation and development:** This cluster encompasses developing and validating literacy models and educational frameworks. It underscores the necessity of guaranteeing that literacy programs are productive and adaptable to novel developments, particularly those posed by the advent of the COVID-19 pandemic. This cluster is primarily concerned with the institutional aspects of literacy, encompassing educational models, validation procedures, and the formulation of frameworks that facilitate the long-term advancement of literacy.

5.1. **Validation of literacy models:** This subcategory pertains to evaluating the efficacy of technological and digital literacy models. This entails guaranteeing that literacy programs achieve their intended outcomes and are adaptable to diverse contexts.

5.2. **Developing frameworks:** This is an area where the ongoing processes of creating and refining models or systems for teaching and assessing literacy skills may be described, particularly in light of the evolving digital media landscape.

5.3. **Competency-based education models:** This refers to an educational system in which students advance based on their ability to demonstrate their competencies rather than on time spent in the classroom. This is particularly pertinent in the context of digital and media literacy.

5.4. **Validation initiatives related to COVID-19:** This subcategory emphasizes the validation of the reliability and accuracy of information related to the pandemic and initiatives to confirm the effectiveness of literacy programs in disseminating accurate information during the pandemic.

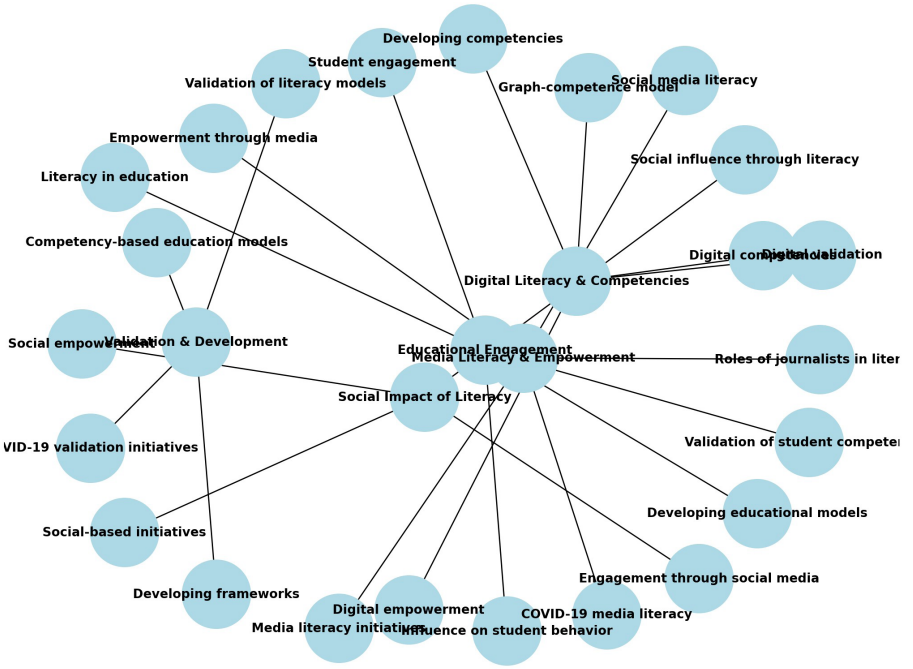

Figure 1. General taxonomy on digital and media literacy.

3.2. Topical evolution analysis

In the initial sub-period (1954-1979), there was an early focus on developing general literacy, media skills, and business-related competencies. This was when the concepts associated with computers and digital technologies emerged. During the second sub-period (1980-1999), there was a notable shift in focus towards education, computer literacy, and increasing technology integration in the educational setting. During this subsequent period, the development of competencies for both students and teachers became a central focus. During the third subperiod (2000-2009), the prominence of digital and media literacy issues increased. During this period, critical thinking, the digital divide, and online education assumed greater prominence, reflecting the advent of the Internet and digital transformation. In the final sub-period (2010-2023), there is evidence of a greater focus on digital skills, big data, and social media literacy. A notable shift towards a greater emphasis on research and the utilization of ICT in education reflects the advent of a fully-fledged modern information age.

The following section provides a detailed description and analysis of the thematic evolution across each sub-period:

1954-1979: Early foundations of literacy and technology

A total of 16 publications were identified during this sub-period, which reflects the limited scope of research at this primary stage of digital and media literacy. Nevertheless, some patterns can be discerned. Cluster 1 is concerned with the initial discussions of using computers in an educational context, focusing on students with disabilities, such as those who are visually impaired. The use of terms such as "literacy," "school," and "business" indicates that researchers were investigating the impact of technology on educational and business settings. Cluster 2 addresses media and information literacy, the formulation of standards for media literacy, and the function of media in the educational context. Using"appropriate" and "definitions" indicates early attempts to define media literacy. Cluster 3 is concerned with teaching literacy and investigating attitudes towards planned changes in the educational system. The terminology suggests an investigation into implementing technology and literacy methodologies within the educational sphere. A smaller cluster, designated Cluster 4, discusses digital literacy in schools and students and integrating education and digital tools in

teaching. The earliest investigations into the use of digital technologies in educational contexts are also evident in this cluster. Lastly, cluster 5 focuses on media and literacy in educational contexts, emphasizing basic skills. It seems probable that researchers were beginning to explore the relationship between media use and fundamental literacy skills in schools.

1980-1999: The expansion of technology and education

The number of publications has increased, with 578 documents indicating a significant expansion of research on literacy and technology in education. Cluster 1 primarily concerns students and literacy, emphasizing competencies and the school environment. The role of educational institutions as a setting for cultivating media and digital competencies is underscored. Cluster 2 shows a notable shift towards exploring education and computer literacy. The increasing prevalence of information and media signals a growing interest in the potential for integrating computers and information technologies into pedagogical practices. Cluster 3 emphasizes literacy but broadens the scope to encompass educational methodologies and student development. Using terms such as "competencies" and "students" suggests a focus on measuring and enhancing students' skills. Cluster 4 highlights the significant role of students in higher education, particularly within the context of universities and medical schools. The discussion of literacy and computer skills is situated within the context of preparing students for advanced fields such as medicine. Building upon the themes explored in preceding clusters, cluster 5 delves into computer literacy in the context of media and educational institutions. In particular, it examines the methods and strategies employed to teach and cultivate these skills.

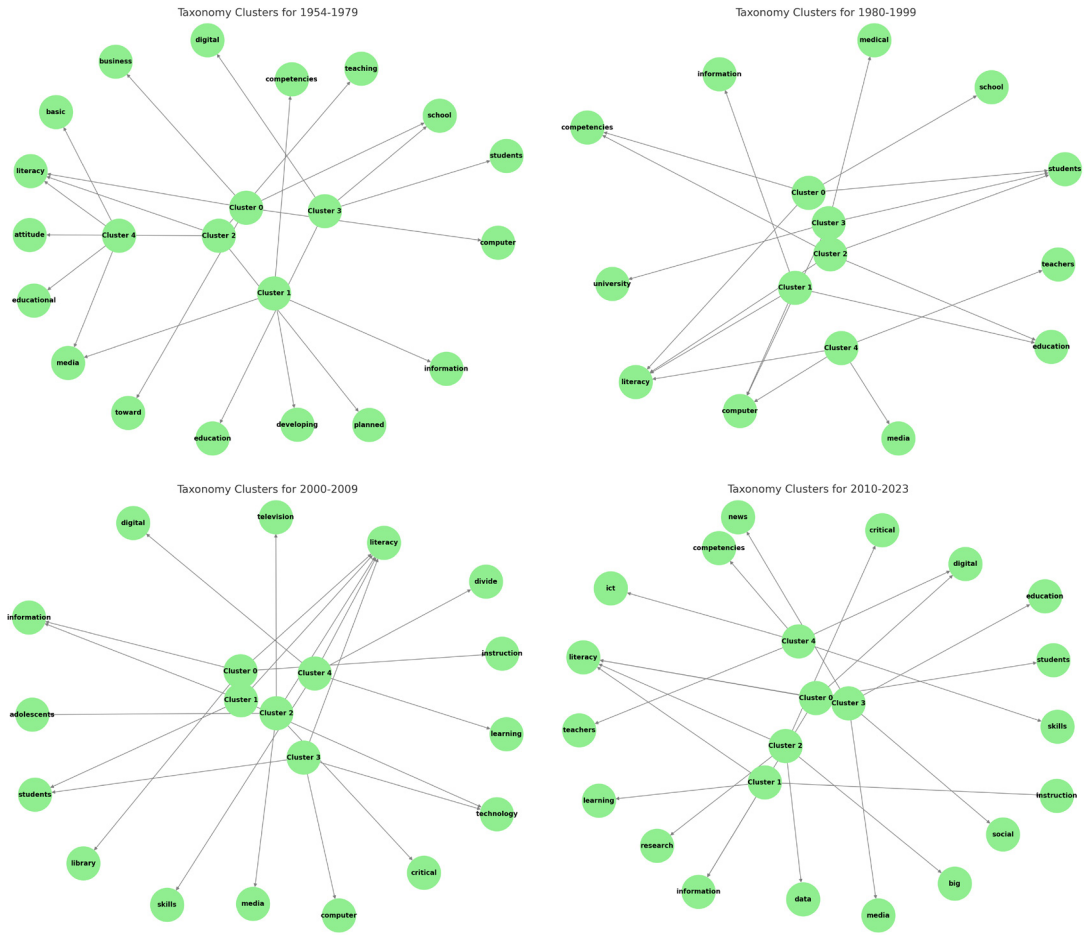

Figure 2. Taxonomy per subperiods on digital and media literacy.

2000-2009: The digital transformation

The 1,649 publications published during this period reflect the growing influence of the Internet and digital tools as the focus shifts more heavily toward digital and media literacy. Cluster 1 primarily provides instruction and library services, particularly on developing information literacy skills. Integrating academic tools, web-based learning, and university environments has precipitated the ascendance of digital tools in higher education. Cluster 2 underscores the increasing significance of information literacy and technology in education. The development of digital competencies remains a central focus, as evidenced by the prominence of skills, students, and learning as key themes. A shift towards media literacy becomes apparent in Cluster 3, particularly in critical thinking about media content. The terms "adolescents," "school," and "television" indicate a focus on younger audiences and the role of media in education. Cluster 4 emphasizes computer literacy and skills, particularly in the context of educational instruction. The prevalence of terms such as "attitudes" and "technology" reflects the growing reliance on digital tools in academic settings. The ascendance of digital literacy is a hallmark of cluster 5, referencing the digital divide and deliberations about novel media. This suggests an emphasis on reducing disparities in access to digital tools and media.

2010-2023: The era of big data and social media literacy

The most recent period encompasses 8,816 publications emphasizing contemporary subjects such as big data, ICT, and social media literacy. Cluster 1 predominantly focuses on students, information literacy, and digital skills. Universities and other educational institutions are of great importance in developing these skills, and the role of undergraduate students is highlighted. The second cluster is primarily concerned with the themes of information literacy and the instruction of these skills within an educational context. The frequent references to these concepts evidence the increasing integration of technology and research in education. In Cluster 3, the topics of big data and research literacy emerge as key areas of interest. This cluster is concerned with the instruction of students in the comprehension and utilization of voluminous datasets, particularly within the context of critical thinking and education. Cluster 4 is devoted to the interdisciplinary study of media literacy and social media, particularly emphasizing the impact of social and digital platforms on information consumption. A critical approach to media, particularly to news, is of significant consequence. Cluster 5 underscores the significance of digital proficiency and ICT competencies. The emphasis on teachers and education reflects the necessity to provide educators with training in digital literacy to facilitate student learning.

4. CONCLUDING REMARKS

A comprehensive examination of the taxonomy groups reveals many themes, including the personal empowerment of digital literacy and establishing institutional frameworks to validate educational models. Each group encapsulates a particular facet of media, digital, and social literacy while elucidating the broader societal ramifications of these literacies. This analysis demonstrates a progression from general literacy concepts in the early periods to an increasing focus on digital and media literacy in the most recent years.

A discernible progression is evident across the four sub-periods, from the initial exploration of fundamental literacy and technology concepts to more sophisticated and intricate investigations into digital literacy, media literacy, and technology integration in education. The research focus shifted as technology advanced, moving from foundational discussions of computer use in schools to more advanced themes such as big data, social media literacy, and information and communication technology (ICT) competencies. The most recent period highlights the growing necessity for digital proficiency and critical media literacy in an era characterized by the dominance of big data and the pervasiveness of social platforms. This trajectory demonstrates a progressive enhancement in the sophistication of the research, which has responded to the ongoing challenges and opportunities presented by a rapidly digitizing world.

Conflict of interests

The authors should declare potential conflicts of interest or not.

Contribution statement

Conceptualization, formal analysis, investigation, methodology: Daniel Cristóbal Andrade Girón, Timoteo Solano Armas.

Data curation, software, validation, visualization: Marcelo Gumercindo Zúñiga Rojas, Flor de María Lioo Jordán, Viviana Inés Vellón Flores, Flor de María Garivay Torres de Salinas.

Writing-original draft, writing-review, and editing: Daniel Cristóbal Andrade Girón, Flor de María Garivay Torres de Salinas, Timoteo Solano Armas.

Statement of data consent

All relevant data has been included in the manuscript. ●

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