Security as an emerging dimension of Digital Literacy for education: a systematic literature review

Francisco Javier Rocha Estrada[a], Carlos Enrique George-Reyes[a],
Leonardo David Glasserman-Morales[a, b]

[a]*Tecnologico de Monterrey, School of Humanities and Education - Monterrey (Mexico)*
[b]*Tecnologico de Monterrey, Institute for the Future of Education - Monterrey (Mexico)*

Abstract

The mass use of the Internet, networks and digital devices has intensified the training processes in digital literacy; however, the risks related to the safety of users have also increased. The objective of this article is to analyze the scientific production related to digital security literacy, as well as to identify consolidated and emerging lines of research. To achieve this, a systematic literature review was carried out during the 2010-2020 period, taking as sources of information the Scopus and Web of Science databases. We used the systematic literature review method which has been adjusted for its application in the area of social sciences. The results indicate that most of the scientific texts have been produced in English, and that the treatment of the subject has been developed from perspectives related to criteria for the protection of personal data. Therefore, it is concluded that there is a need to develop a more solid body of scientific work that considers aspects such as safety in social networks, skills for digital security and digital intelligence.

KEYWORDS: Digital literacy, Security, Systematic Literature Review, Technology.

1. Introduction

The mass use of technologies in society has had a great influence determining the modifications in the way of accessing and sharing information, and the digital literacy as a set of skills to interpret information and generate knowledge has accompanied these changes (Cabero & Fernández, 2018). However, overcrowding has also increased dependence on technology to carry out socialization processes such as establishing synchronous/asynchronous communication, exchanging data of various types, which has made users of computer networks vulnerable to suffering threats that violate their personal and professional identity security in cyberspace (Ibarra Rius et al., 2018).

1.1 The concept of digital literacy

The conceptual development of digital literacy originates with the proposal of Gilster (1997), who stated that a digitally literate person was who had sufficient skills to understand and use information from different digital sources, as well as to solve problems related to access and selection of information. This concept has evolved due to the demands of the interconnected world, where it is not enough to have the knowledge for reading, writing and understanding messages, but in which it is also necessary to learn new cognitive mechanisms, and to search, filter, categorize and use pertinent information (Gértrudix et al., 2016), as well as to establish effective communication using various technological means (Bhatt & Mackenzie, 2019), and even develop computational logical thinking (Gutiérrez et al., 2016).

It has also been argued that it is a set of skills to know how to communicate and obtain information through electronic tools (Shafirova, 2018), which has a close
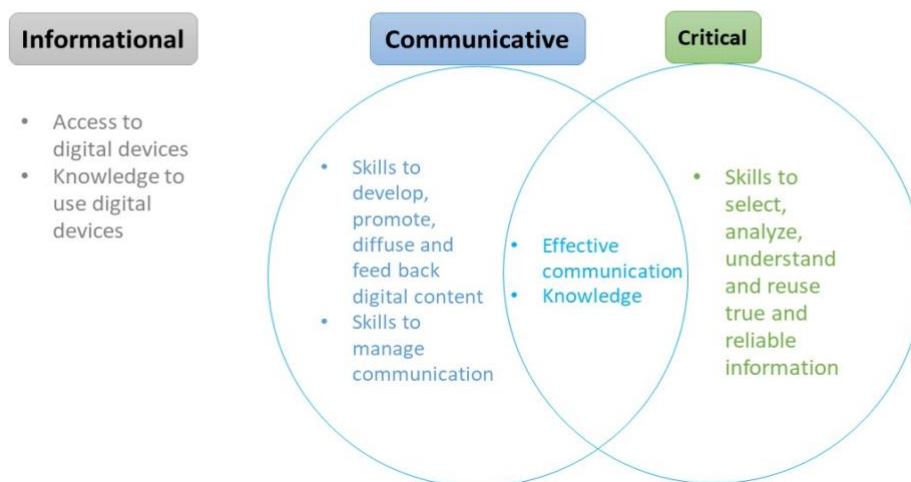
Figure 1 - Dimensions of digital literacy.

relationship with the ability to use digital media to evaluate the quality of information (Shin, 2015), and that is expressed as the knowledge and skills shown by individuals in digital environments effectively (Harati et al., 2018). Therefore, digital literacy is a complex skill that encompasses a diversity of awareness related to the knowledge of digital ecosystems, the critical use of technological devices, and the analysis of the information that can be obtained and produced through them (Terreni et al., 2019).

The issue has also provoked multiple reconceptualizations and research interests in recent years (Leaning, 2019), some of which aimed at developing proposals to identify the dimensions that compose digital literacy. In this sense, Nichols and Stornaiuolo (2019) mention computing, informational and media as main dimensions, while other authors include critical/cognitive skills, informational and communicative as their main components (Area Moreira, 2015; Demoiny & Ferraras-Stone, 2018; Holladay, 2018; Moreno Rodríguez et al., 2018; Rodríguez de Dios & Igartua, 2016) (see Figure 1).

In the academic field, digital literacy has gained relevance due to the increasingly intense incorporation of technologies in daily teaching and learning practices, which require the use of interactive tools based on the Internet, mobile devices, administration platforms of knowledge, and other digital resources (Tomczyk, 2019). Faced with this situation, educational institutions have invested considerable budget to increase the technological infrastructure to promote activities related to management, research and teaching.

In addition to the above, in recent years emphasis has been placed on aspects related to the safety of subjects who interact in educational settings with technologies and digital environments. Digital literacy not only implies using agile computer programs and information from digital networks, but also having the ability to guarantee students own security to prevent practices such as identity theft and unauthorized access to personal data. In this sense, Sonck et al. (2011) affirmed that if the digital literacy processes include components related to the prevention of risk behaviors associated with the use of digital tools, users will have the ability to better cope with the dangers present in a computerized society.

1.2 An emerging dimension: Digital security

Although the access and use of digital technologies in education offers disruptive opportunities to achieve better learning and socialize knowledge, it is also associated with risks and the development of potentially dangerous attitudes (Rodríguez de Dios & Igartua, 2015). It is not enough to handle computer devices and programs properly, but the ability to guarantee one's own security when using them is also required (Tomczyk, 2019). For this reason, an emerging dimension of digital literacy is related to the prevention of these risks and the ability to respond correctly to critical situations in the inappropriate handling of security (Rodríguez de Dios & Igartua, 2016; Kopecky & Szotkowski, 2017).

Digital security is the discipline that allows the protection of information, through the treatment of threats that put at risk the data that is processed, stored and transported on the Internet, it is oriented both to information systems and to users (Ghafir et al, 2018). Therefore, knowledge about how to deal with online dangers has become one of the key literacies, to ensure that people use the Internet in a safe way it becomes increasingly important to acquire the ability to recognize and deal with the dangers that appear in virtual spaces (Kopecky & Szotkowski, 2017).

In the educational field, well-founded fears have been expressed about the security conflicts that may exist in digital networks accessed by students (Pulak &

Wieczorek-Tomaszewska, 2015), such as cyberbullying, the invasion of privacy due to the unethical use of personal data (Ibarra Rius et al., 2018; Shin, 2015), weaknesses in the construction of digital identity (Moreno Rodríguez et al., 2018). Moreover, the emerging cyberwellness culture involves understanding the risks of harmful online behaviors, such as knowing how to protect oneself and others from actions that can put the welfare of Internet users at risk (Onumo et al., 2017).

For this reason, it is necessary to expand the study dimensions of digital literacy to know and establish training strategies that allow people to have sufficient skills to identify latent threats in digital interaction scenarios. In this study, the concepts of literacy and digital security were analyzed to establish parameters to perform a systematic literature review that would allow us to investigate the characteristics of scientific production on the subject, and with this to know the contemporary and emerging research trends.

2. Materials and Methods

To inquire about the relationship between digital literacy and security in digital environments, a systematic literature review was carried out with the purpose of knowing the characteristics of scientific production on the subject during the period 2010-2020, and thus identify research trends, as well as emerging exploration areas (García-Peñalvo, 2017a; Sánchez-Mena & Martí-Parreño, 2017). The review considered the methodology designed by Petersen et al. (2008), which has been applied as a bibliometric-descriptive study by various authors in the area of social sciences (Cantú González et al., 2019; López-Meneses et al., 2015; Ramírez Montoya & García-Peñalvo, 2018). Figure 2 illustrates the phases through which the study was developed.

2.1 Definition of research questions

In the first phase, the questions that guided the research were defined, since the intention of this paper was to know the scientific production related to literacy and digital security in education. The following questions were proposed:

Q1 - How many scientific articles related to digital literacy and security have been published between 2010 and 2020?

Q2 - How is research on digital literacy and security produced geographically and in what languages?

Q3 - What kinds of scientific products have been published, and how is their accessibility to readers?

Q4 - What are the documents with the greatest international impact according to the number of citations?

Q5 - What lines of research have been developed around digital literacy and security?

Q6 - What are the lines of research that have set trends?

Q7 - What are the lines of research that can be considered as emerging?

2.2 Location of scientific production

The second phase consisted of searching the scientific production in the Scopus and Web of Science (WoS) databases, since they are the main sources of peer-reviewed academic information (Delgado & Repiso, 2013). The terms used were digital literacy as the main search element and digital safety or digital security as contextual elements. To delimit the search, the first filter was applied, and the results were located in the disciplinary area of the social sciences (social sciences in Scopus; education scientific disciplines & social sciences interdisciplinary in WoS). Table 1 shows the general search string for Scopus and WoS.

2.3 Depuration of scientific production

Having defined the searching criteria, the first results were refined. Initially, 28 documents that appeared in both databases were excluded. The rejected documents were the following: articles in the preprint publication stage, without the author's name, with a corporate author, without an abstract available, and with misprints. Finally, a detailed reading of the summaries of the documents was made to eliminate false positives; that is, documents that did not address the subject of study of this research. Table 2 shows the progression to debug the documents.

2.4 Elaboration of the database for the SLR

Once the debugging was done, the next phase involved analyzing 106 documents. To do this, a database was developed in Microsoft Excel software considering the following fields: 1) author, 2) title of the publication, 3) abstract, 4) keywords, 5) year, 6) source data (name of the journal/book, volume, year, article number, pages, DOI, references, publisher), 7) country, 8), language, 9) type of document, and 10) access. Finally, each document was assigned a sequential numerical identifier.
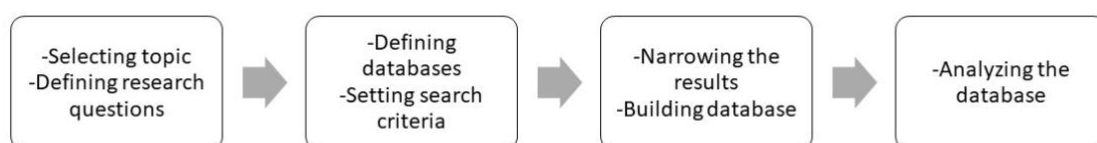

Figure 2 - Phases to perform the systematic review.

2.5 Database analysis

The information analysis was carried out in two stages. In the first stage, scientific production was quantified using as criteria the number of publications per year, language, country, type of document, access, and impact by number of citations. To carry out the second stage, the database was imported into the VOSViewer software, a tool that has been used in various investigations (Bornmann et al., 2016; Rodríguez-García et al., 2019) to extract the summaries of the selected documents, and with them create semantic maps to delimit the research trends.

Scopus
(TITLE-ABS-KEY (digital AND literacy) AND TITLE-ABS-KEY (digital AND security) OR TITLE-ABS-KEY (digital AND safety)) AND (LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO (PUBYEAR, 2011) OR LIMIT-TO (PUBYEAR, 2010)) AND (LIMIT-TO (SUBJAREA, "SOCI")) AND (EXCLUDE (SUBJAREA, "MEDI") OR EXCLUDE (SUBJAREA, "NURS"))
Web of Science
((digital literacy AND (Digital security OR Digital safety)) Refined by: WEB OF SCIENCE CATEGORIES: (EDUCATION EDUCATIONAL RESEARCH OR COMPUTER SCIENCE INTERDISCIPLINARY APPLICATIONS OR COMMUNICATION OR SOCIOLOGY OR PSYCHOLOGY EDUCATIONAL OR EDUCATION SCIENTIFIC DISCIPLINES OR SCIENCE INFORMATION SCIENCE LIBRARY OR SCIENCE INFORMATION SCIENCE LIBRARY OR COMPUTER SCIENCE THEORY METHODS OR SOCIAL SCIENCES INTERDISCIPLINARY OR COMPUTER SCIENCE INFORMATION SYSTEMS) AND [excluding] TYPES OF DOCUMENTS: (EARLY ACCESS) Time period: 2010-2020 Indices: SCI-EXPANDED, SSCI, A & HCI, CPCI-S, CPCI -SSH, BKCI-S, BKCI-SSH, ESCI.

Table 1 - Original search string.

Exclusion criteria	Scopus	WoS	Total
Original string	184	109	293
Duplicates	184	81	265
Preprints	29	11	225
No Author Name/Corporate Author	12	5	208
No summary	6	2	200
Editorials/misprints	3	1	196
False positives	49	41	106
Total	85	21	106

Table 2 - Depuration of scientific production.

3. Results

Q1 - Scientific production between 2010 and 2020

The evolution of scientific publications has increased in recent years. In particular, in 2016, there were thirteen published papers (12.26%); while in 2017 twelve (11.32%); in 2018 seventeen (16.04%), and in 2019 twenty-three (21.70%). Figure 3 shows the diachronic trend in Scopus and WoS. It is necessary to mention that although the research considered publications from 2020, at the end of this project, the year had not yet concluded, so the number of documents that addressed the subject cannot be specified with precision.
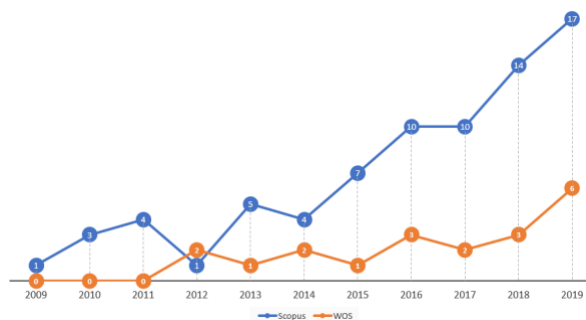

Figure 3 - Growth of scientific production in WoS and Scopus.

Q2 - Geographical distribution and languages in which research is produced

Figure 4 shows the geographical distribution of scientific production, which comes largely from the United States of America with 20 publications (18.87%), followed by the United Kingdom with 8 (7.55%), and Canada and Russia with 7 (6.60%). This means that these four countries have produced more than a quarter (39.62%) of world publications. Spain is the Iberoamerican country that has produced the most papers with 6 (5.66%).
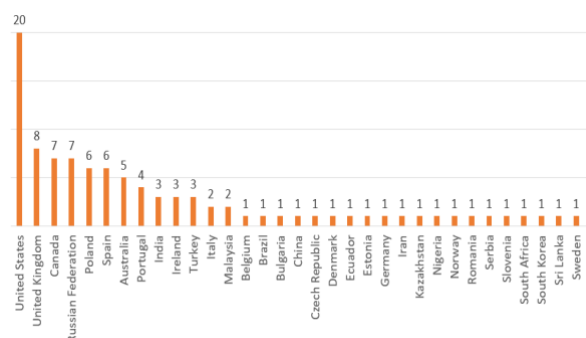

Figure 4 - Scientific production by country.

Table 3 lists the number of documents by language, in which English is the most widely used idiom with a predominance of 96 publications (90.57%), followed by Spanish with 5 (4.72%). There are two documents in

25

Russian, and one in Bosnian, Portuguese and Ukrainian. Regarding the impact of citations by country, the United States of America tops the list with 218 citations followed by the United Kingdom that counts 199, Canada 82, Norway 40, Australia 38, and Spain with 33. Table 4 shows the distribution by country, as well as the quotes between publications.

Language	Total	Percentage	Publication No.
English	96	90.57%	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20. 21, 22, 23, 24, 25, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 78, 79, 80, 82, 83, 84, 85, 86, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106.
Spanish	5	4.72%	26, 28, 77, 81
Russian	2	1.89%	5, 87
Bosnian	1	0.95%	60
Portuguese	1	0.95%	27
Ukrainian	1	0.95%	4

Table 3 - Documents by language.

Q3 - Types of scientific product and access

The documents were organized as follows: journal articles, book chapters, books, editorials, reviews, and conference papers (international papers). In Table 5, the distribution can be observed highlighting that the articles in magazines have a greater diffusion with 62 publications (58.49%).
The open access and restricted journals with the highest number of publications were identified. The balance regarding the type of access favors publications of the closed or paid type with 82 (77.34%), while those in open format are 24 (22.64%). In Table 6, the archives are categorized according to the restrictions for their full text consultation.

Q4 - Documents with the greatest international impact according to the number of citations

Table 7 shows the journals with the higher international impact in relation to the topic of literacy and digital security. The journal with the greatest impact is *Children*

and Society with 191 citations corresponding to the article *On the rapid rise of social networking sites: New findings and policy implications,* followed by *New Media & Society* with 82 citations (22 in Scopus and 60 in WoS) linked with the publication *"Personal data literacies": A critical literacies approach to enhancing understandings of personal digital data*. The journal *Learning, Media and Technology* counts 72 citations grouped in the articles *Listening to excluded young people's experiences of e-safety and risk* (16) and *Digital literacy and informal learning environments: An introduction* (56). The best-placed Iberoamerican magazine in the ranking is *RED Revista de Educación a Distancia*, having 60 citations for the document *Assessing the digital-safety competences of students in Basic Education*. The data in Table 8 indicate the impact by the author.

Country	Documents	Quotes
United States	20	218
United Kingdom	8	199
Canada	7	80
Russian Federation	7	14
Poland	6	4
Spain	6	33
Australia	5	38
Portugal	4	6
India	3	4
Ireland	3	18
Turkey	3	0
Italy	2	7
Malaysia	2	2
Belgium	1	9
Brazil	1	0
Bulgaria	1	0
China	1	0
Czech Republic	1	0
Denmark	1	0
Ecuador	1	6
Estonia	1	7
Germany	1	2
Iran	1	2
Kazakhstan	1	0
Nigeria	1	0
Norway	1	40
Romania	1	0
Serbia	1	0
Slovenia	1	0
South Africa	1	0
South Korea	1	8
Sri Lanka	1	0
Sweden	1	0
Thailand	1	0

Table 4 - Number of citations per country/total documents.

Document	Total	Percentage	Publications
Articles	62	58.49%	3, 4, 5, 6, 7, 9, 10, 11, 15, 16, 17, 20, 22, 23, 24, 25, 26, 28, 32, 33, 34, 36, 39, 42, 46, 48, 49, 54, 56, 57, 60, 63, 64, 65, 67, 68, 69, 70, 71, 72, 73, 75, 76, 79, 80, 81, 83, 84, 85, 87, 89, 92, 93, 94, 95, 97, 98, 99, 100, 102, 104, 106.
Chapters of the book	9	8.49%	21, 35, 45, 55, 74, 82, 86, 91, 103.
Editorial	1	0.95%	62
Reviews	25	23.58%	12,13, 14, 27, 29, 31, 37, 40, 41, 43, 44, 47, 51, 52, 53, 58, 59, 61, 66, 77, 78, 88, 90, 96, 105.
Conference documents	9	8.49%	1, 2, 8, 18, 19, 30, 38, 50, 101.

Table 5 - Documents by type of publication.

Access	Total	Percentage	Publications
Closed	82	78.30%	1, 2, 3, 4, 7, 8, 10, 12, 13, 14, 15, 16, 18, 19, 20. 21, 22, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 40, 41, 43, 44, 45, 47, 49, 50, 51, 52, 53, 54, 55, 59, 61, 62, 63, 64, 65, 66, 67, 68, 70, 72, 74, 76, 78, 79, 80, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 99, 101, 102, 103, 104, 105, 106.
Open	24	21.70%	5, 6, 9, 11, 17, 23, 24, 33, 39, 42, 46, 48, 56, 57, 58, 60, 69, 71, 73, 75, 77, 81, 98, 100.

Table 6 - Documents by type of access.

Rank	Source title	Number of quotes	Source	Impact index	H index
1	Children and Society	191	Scopus	Q1	54
2	New Media & Society	82	Scopus & WoS	Q1	99
3	Learning, Media and Technology	72	Scopus	Q1	42
4	RED Revista de Educación a Distancia	60	WoS	-	19
5	Discourse Context & Media	58	Scopus & WoS	Q1	16
6	Egitim Ve Bilim-Education and Science	50	Scopus & WoS	Q3	18
7	Journal of Information Technology Research	47	Scopus & WoS	Q3	10
8	International Journal of Game-Based Learning	40	WoS	Q2	15
9	Computers in the Schools	39	Scopus & WoS	Q2	23
10	IJERI-International Journal of Educational Research and Innovation	37	WoS	-	14
11	Social Media & Society	35	Scopus & WoS	Q1	2. 3
12	IEEE Access	21	Scopus	Q1	86
13	IEEE Computer	17	Scopus	Q1	161
14	Education Sciences	16	Scopus	Q3	7
15	Information Technologies and Learning Tools	15	WoS	-	9
16	International Communication Gazette	13	Scopus	Q1	34
17	Education and Information Technologies	12	Scopus & WoS	Q1	36
18	Cyberpsychology	9	Scopus	Q1	19
19	Language, Learning and Technology	8	Scopus	Q1	69
20	Italian Journal of Sociology of Education	7	Scopus	Q3	3

Table 7 - Magazines with the greatest international impact about digital literacy and security.

The person with the highest number of citations is Sonia Livingstone who brings together a total of 198 citations grouped in the articles *On the rapid rise of social networking sites: New findings and policy implications* (191) and *Girls 'and boys' experiences of online risk and safety* (7). The Italian Luci Pangrazio has 117 quotes for the documents *"It's Not Like It's Life or Death or Whatever": Young People's Understandings of Social Media Data* (6), *'Personal data literacies': A critical literacies approach to enhancing understandings of personal digital data* (22), *Beyond cybersafety: The need to develop social media literacies in pre-teens* (29), and *Towards a school-based "critical data education"* (60). The best ranked Spanish-speaking author is Ana García-Valcárcel with 60 citations obtained by the publication of the document *Evaluación de las competencias digitales sobre seguridad de los estudiantes de Educación Básica,* followed by Mario Grande de Prado with 37 quotes for *Seguridad digital, ¿cómo se perciben los docentes en formación?* On the other hand, Tomczyk has written the largest number of documents on the subject (5) with a total of 25 citations.

Rank	First author	Documents	Citations	Language
1	Livingstone, S.	2	198	English
2	Pangrazio, L.	4	117	English
3	Meyers, E.	1	72	English
4	Garcia, A.	1	60	Spanish
5	Velghe, F.	1	58	English
6	Çebi, A.	2	50	English
7	Rodríguez de Dios, I.	2	48	English
8	Costa, C.	4	46	English
9	Siddiq, F.	1	40	English
10	Grande de Prado, M.	1	37	Spanish
11	McNicol, S.	1	37	English
12	Chatzipetrou, N.	1	32	English
13	Sincar, M.	1	25	English
14	Tomczyk, Ł.	5	25	English
15	Andersson, D.	2	24	English
16	Heartfield, R.	1	21	English
17	Jagalur, P.	2	19	English
18	Hemerly, J.	1	17	English
19	Fraile, M.	1	16	English
20	Bondarenko, I.	2	16	Ukrainian

Table 8 - Authors with the highest number of citations.

Figure 5 illustrates that most of the co-citation between authors favors Sonia Livingston; that is, the two documents that she has published on the subject have been cited 198 times by other authors, and co-cited 93 times, with a binding strength of 100.

Q5 - Research lines on digital literacy and security

The analysis of the lines of research was done in two stages, first the keywords of the 106 selected documents were examined, with this information it was possible to infer what are the current trends in the study of the subject. Table 9 shows the keywords with the most co-occurrences (number of times a term is repeated): digital literacy (36), security (10), education and social media (9), Internet (8) and media literacy (7). Regarding the total link strength, Figure 6 graphically shows that digital literacy leads the relationship of proximity of two or more terms in the keywords.

Keyword	Occurrences	Total link strength
digital literacy	36	44
security	10	20
education	9	18
social media	9	18
Internet	8	21
media literacy	7	8
digital competence	6	3
digital citizenship	6	7
cybersecurity	6	14
information technology	5	7
Internet safety	5	8
literacy	5	9
teaching	5	9
students	5	10
digital storage	5	13
privacy	5	14
children	5	20
online safety	5	20
digital skills	4	4
personal data	4	6
e-learning	4	7
information literacy	4	7
youth	4	11

Table 9 - Keyword occurrences and total link strength.

In the second stage, the abstracts and in some cases complete documents were reviewed. It was observed that there are two lines of research: the first counts 83 documents (78.30%), and represents the most developed research trends, and the second one, an emerging line

with 23 documents (21.70 %). Table 10 specifies the set of lines of research identified.

Type	Line	Documents	Total
Trends in research	Protection of information	1, 2, 4, 5, 8, 10, 16, 17, 20, 21, 22, 24, 26, 27, 28, 31, 33, 37, 38, 40, 41, 43, 46, 47, 48, 50, 52, 53, 54, 55, 60, 61, 62, 63, 65, 66, 67, 71, 73, 74, 76, 81, 83, 85, 88, 89, 90, 92, 94, 95, 96, 99, 101, 102, 105, 106.	56
	Digital citizenship	6, 7, 25, 30, 35, 36, 39, 51, 56, 77, 84, 91	12
	Media culture	9, 29, 57, 59, 69, 75, 80, 82	8
	Cyberbullying	3, 79, 86, 87, 97, 100, 104	7
	Safety in social networks and gender studies	18, 42, 44, 45, 70. 98	6
	Skills for digital security	32, 49, 58, 78, 93, 103	6
Emerging lines	Digital identity	12, 13, 14, 15, 23	5
	Frameworks	11, 34, 68, 72	4
	Digital emotional intelligence	19, 64	2

Table 10 - Research in consolidation and emerging lines.

Figure 7 shows the strength of the link among the words identified in the abstracts. In other words, is the number of times that the words appear in the articles regarding the total of all documents. The most common terms are technology (73), risk (43), communication (34), parent (27), and privacy (24).

Q6 - Research trends

Research trends refer mainly to studies related to people's abilities to protect their personal information in different virtual interaction scenarios, such as the use of email, password management on computer platforms, as well as the development of strategies to maintain secure Internet connections during the development of training activities (56 documents; 52.83%). To a lesser degree, research has been carried out that analyzes the scope of strategies to promote digital citizenship (12 documents; 11.32%), sociocultural approaches regarding the media in different contexts (8 documents; 7.55%), and school practices related to cyberbullying (7 documents; 6.60%).

Q7 - Emerging lines of research

Among the emerging lines, the following trends can be identified: the security metrics in social networks from the perspective of gender studies (6 documents; 5.66%), the observation of skills to maintain digital security (6 documents; 5.66%), the analysis of digital identity and the appropriation of digital rights (five documents; 4.72%), the development of public policies regarding digital security and ethical attitudes in virtual cooperation environments from the approach of various frames of reference (four documents; 3.77%), and finally digital intelligence manifesting itself as the sum of social, emotional and cognitive skills to confidently face new school challenges (two documents; 1.89%).

4. Discussion

In this research, 106 documents published in the period between 2010 and 2020 were recovered regarding the link between digital literacy and digital security. The most prolific year was 2019 with 23 papers and recently there is a rising trend in academic production on the subject. The study of literacy and digital security in the educational field has been constant, especially due to the growing appearance of new technological tools that use the Internet and are integrated into educational practice (Tomczyk, 2019).

The production by country is led by the United States of America, followed by the United Kingdom, Canada and Russia, also, their works are constantly quoted. On the other hand, Spain has the most scientific production in Iberoamerica, however, their articles are rarely cited. The above constitutes an invitation to work on lines of research in other languages that address the issue of digital literacy from the perspective of the construction of strategies, methods and models that analyze the different aspects of security in virtual spaces, especially for non English speaking countries.

In addition, journal articles and reviews represent the main types of documents related to the topic. Although most of the publications are characterized as paid type, there is a trend towards open access. This is consistent with the information opening movements that are being developed in recent years (García-Peñalvo, 2017b).

By analyzing the keywords, abstracts, and in some cases the full text it was possible to identify variables related to the study trends, which can guide the researchers about what are the niches of inquiry for future articles. Also, the use of VOSviewer software allows to build semantic maps to visually identify the prevailing ideas on which the analysis of digital literacy and security is based. By applying grouping techniques, it was possible to identify groups of publications, authors or documents (van Eck & Waltman, 2017), to know the trends in the study of digital security.

Five lines of research appeared, the first was oriented to various literacies such as digital, media and information. The second line was focused on the educational context
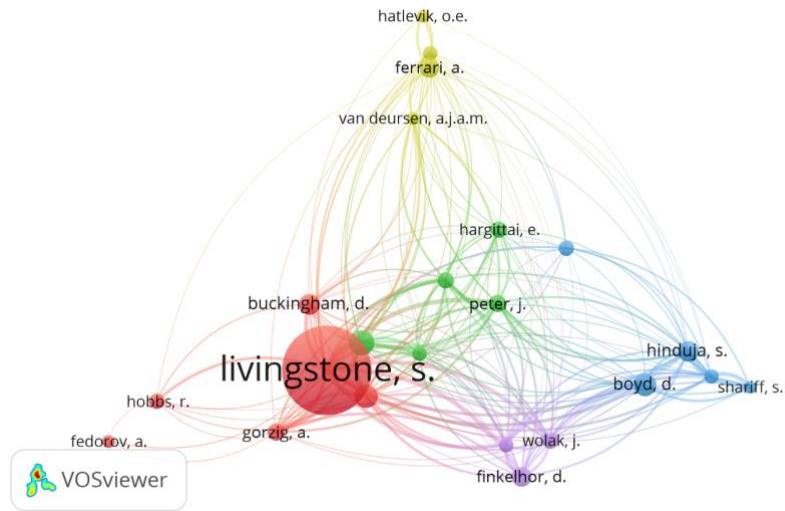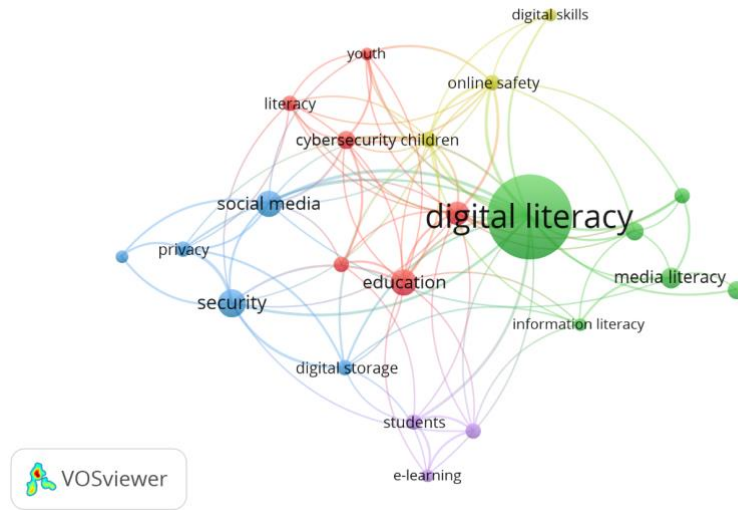
Figure 5 - Co-citation by the first author.
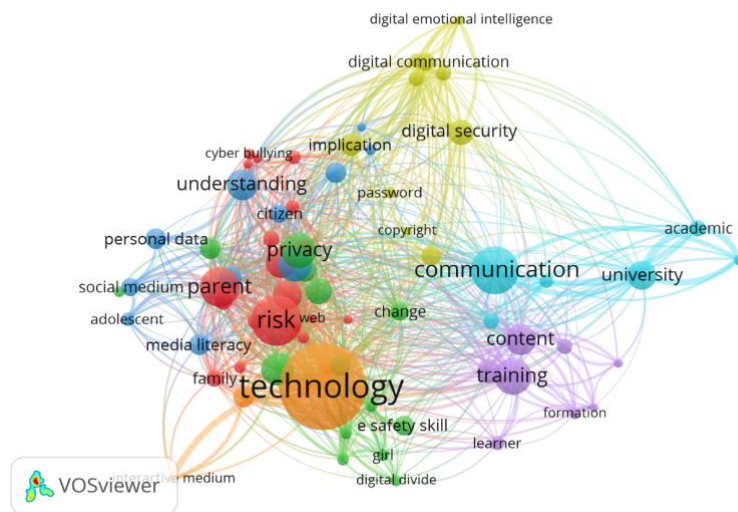

Figure 6 - Keyword analysis.

Figure 7 - Words with the highest strength link in the abstracts.

was aimed at children, seeking to promote digital skills and online safety. The fourth was oriented on security in social networks, digital storage and privacy. The last line was focused on online learning for students. The foregoing coincides with the integrative nature of digital literacy (Leaning, 2019), but at the same time, demonstrates how digital security issues are being incorporated in various areas in the last years.

In the research trends show up the related to protection of information, digital citizenship, media culture and cyberbullying. While the emerging lines of research were safety in social networks and gender studies, skills for digital security, digital identity, frameworks and digital emotional intelligence.

5. Conclusions

Since 2010, publications referring to digital literacy and security have remained constant, and they have increased in recent years. Research is taking place around the world, where more than half are from English-speaking countries, and publications are predominantly distributed in English-language journals. From the analysis of the documents, it can be deduced that lately, threats related to the use of the Internet increasingly challenge people's digital security; therefore, those who use the technologies must be able to recognize and address potential risks (Vitak et al., 2018). People should be educated about the dangers of digital threats, and ethical behaviors and responsibility when accessing the Internet should be encouraged and supported (Na-Nan et al., 2019).

It is necessary to be aware that any activity done in cyberspace must reduce the risks present in the network (Ibarra Rius et al., 2018). Knowledge about online threats is one of the key competences in the modern world, and that is why it is very important to develop digital security literacy, focused on the prevention of risky behaviors and the acquisition of skills to respond to critical situations (Kopecky & Szotkowski, 2017).

The practical implications of this study may be relevant for researchers who wish to delve into the subject. In matters of literature review, future research could include other databases and focus on studies outside the academic field to have a broader panorama of this phenomenon, since the issue of digital security has not received enough attention in the literature (Tomczyk, 2019).

References

Area Moreira, M. (2015). La alfabetización digital y la formación de la ciudadanía del siglo XXI. *Revista Integra Educativa, 7*(3), 21-33. http://www.scielo.org.bo/scielo.php?script=sci_artte xt&pid=S1997-40432014000300002

Bhatt, I., & Mackenzie, A. (2019). Just Google it! Digital literacy and the epistemology of ignorance. *Teaching in Higher Education*, *24*(3), 302–317. https://doi.org/10.1080/13562517.2018.1547276

Bornmann, L., Thor, A., Marx, W., & Schier, H. (2016). The application of bibliometrics to research evaluation in the humanities and social sciences: An exploratory study using normalized Google Scholar data for the publications of a research institute. *Journal of the Association for Information Science and Technology*, 67 (11), 2778-2789. http://dx.doi.org/10.1002/asi.23627

Cabero, J., & Fernández, B. (2018). Las tecnologías digitales emergentes entran en la Universidad: RA y RV. *RIED. Revista Iberoamericana de Educación a Distancia, 21*(2), 119-138. https://doi.org/10.5944/ried.21.2.20094

Cantú González, V.; Glasserman Morales, L. D.; Ramírez Montoya M. S. (2019). Comportamiento métrico sobre evaluación de la educación en emprendimiento. *Investigación Bibliote-cológica: archivonomía, bibliotecología e información 33*(79), 99-117. http://dx.doi.org/10.22201/iibi.24488321xe.2019.79 .57902

Delgado, E. & Repiso, R. (2013). El impacto de las revistas de comunicación: comparando Google Scholar Metrics, Web of Science y Scopus. *Comunicar, 41*, 45-52. https://doi.org/10.3916/C41-2013-04

Demoiny, S., & Ferraras-Stone, J. (2018). Critical literacy in elementary social studies: Juxtaposing historical master and counter narratives in picture books. *The Social Studies, 109*(2), 64-73. https://doi.org/10.1080/00377996.2018.1451981

García-Peñalvo, F. J. (2017a). *Revisión sistemática de literatura en los Trabajos de Final de Máster y en las Tesis Doctorales*. Salamanca, España: Grupo GRIAL. http://doi.org/10.5281/zenodo.399302

García-Peñalvo, F. J. (2017b). Mitos y realidades del acceso abierto. *Education in the Knowledge Society*, *18*(1), 7-20. http://dx.doi.org/10.14201/eks2017181720

Gértrudix, F., Gálvez, M., Said, E., & Duran, J. (2016). Alfabetización digital, competencias mediáticas y Open Data. *RELATEC Revista Latinoamericana de Tecnología Educativa, 15*(2), 113-121. http://dehesa.unex.es/handle/10662/5775

Ghafir, I., Saleem, J., Hammoudeh, M., Faour, H., Prenosil, V., Jaf, S., Jabbar, S., & Baker, T. (2018). Security threats to critical infrastructure: the human factor. *The Journal of Supercomputing, 74*(10), 4986-5002. https://doi.org/10.1007/s11227-018-2337-2

Gilster, P. (1997). *Digital literacy*. Estados Unidos: John Wiley & Sons.

Gutiérrez, J., Cabero, J., & Estrada, L. (2016). Diseño y validación de un instrumento de evaluación de la competencia digital del estudiante universitario. *Espacios*, *38*(10), 16-38. https://www.revistaespacios.com/a17v38n10/17381018.html

Harati, A., Rahmatizadeh, S., & Valizadeh-Haghi, S. (2018). Allied medical sciences students' experiences with technology: are they digitally literate? *Library Philosophy and Practice (e-journal)*, 2040, 1-21. http://digitalcommons.unl.edu/libphilprac/2040

Holladay, S. (2018). *Communication Literacy*. The International Encyclopedia of Strategic Communication, 1-5. https://doi.org/10.1002/9781119010722.iesc0032

Ibarra Rius, N., Ballester Roca, J., & Marín, F. (2018). Encrucijadas de la competencia mediática y la ciudadanía: uso y consumo de aplicaciones educativas. *Prisma Social*, (20), 92-113. https://revistaprismasocial.es/article/view/2311

Kopecky, K., & Szotkowski, R. (2017). Cyberbullying, cyber aggression and their impact on the victim–The teacher. *Telematics and Informatics*, *34*(2), 506–517. https://doi.org/10.1016/j.tele.2016.08.014

Leaning, M. (2019). An Approach to Digital Literacy through the Integration of Media and Information Literacy. *Media and Communication, 7*(2), 4-13. http://dx.doi.org/10.17645/mac.v7i2.1931

López-Meneses, E., Vázquez-Cano, E., & Román-Graván, P. (2015). Análisis e implicaciones del impacto del movimiento MOOC en la comunidad científica: JCR y Scopus (2010-13). C*omunicar: Revista científica iberoamericana de comunicación y educación*, (44), 73-80. http://dx.doi.org/10.3916/C44-2015-08

Moreno Rodríguez, M. D., Gabarda Méndez, V., & Rodríguez Martín, A. M. (2018). Alfabetización informacional y competencia digital en estudiantes de magisterio. *Profesorado, Revista de currículum y formación del profesorado*, *22*(3), 253-270. https://doi.org/10.30827/profesorado.v22i3.8001

Na-Nan, K., Roopleam, T., & Wongsuwan, N. (2019). Validation of a digital intelligence quotient questionnaire for employee of small and medium-sized Thai enterprises using exploratory and confirmatory factor analysis. *Kybernetes, 49*(5), 1465-1483. https://doi.org/10.1108/K-01-2019-0053

Nichols, T., & Stornaiuolo, A. (2019). Assembling "digital literacies": Contingent pasts, possible futures. *Media and Communication*, *7*(2), 14. https://doi.org/10.17645/mac.v7i2.1946

Onumo, A., Cullen, A., & Ullah, I. (2017). An empirical study of cultural dimensions and cybersecurity development. *2017 IEEE 5th International Conference on Future Internet of Things and Cloud*. https://doi.org/10.1109/FiCloud.2017.41

Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008). Systematic Mapping Studies in Software Engineering. *Proceedings of the 12th International Conference on Evaluation and Assessment in Software Engineering*, 68–77. https://www.researchgate.net/publication/228350426_Systematic_Mapping_Studies_in_Software_Engineering

Pulak, I., & Wieczorek-Tomaszewska, M. (2015). Students' competencies to educational activity in digital environment. *International Journal of Continuing Engineering Education and Life Long Learning*, *25*(4), 450-465. https://doi.org/10.1504/IJCEELL.2015.074232

Ramírez-Montoya, M. S., & García-Peñalvo, F. J. (2018). Co-creación e innovación abierta: Revisión sistemática de literatura. *Comunicar*, *26*(54), 9-18. https://doi.org/10.3916/C54-2018-01

Rodríguez de Dios, I., & Igartua, J. (2015). Alfabetización digital como herramienta de protección frente a los riesgos de la red. In F. J. Durán & E. Said (Eds.), *TIC y sociedad digital: educación, infancia y derecho* (pp. 151-161). Granada: Comares Editorial, Universidad de Granada.

Rodríguez de Dios, I., & Igartua, J. (2016). Skills of digital literacy to address the risk of interactive communication. *Journal of Information Technology Research, 9*(1), 54-64. https://doi.org/10.1145/3012430.3012648

Rodríguez-García, A. M., Raso Sanchez, F. & Ruiz-Palmero, J. R. (2019). Competencia digital, educación superior y formación del profesorado: un estudio de meta-análisis en la Web of Science. *Píxel-Bit. Revista de Medios de Comunicación,* (54), 65-81. https://doi.org/10.12795/pixelbit.2019.i54.04

Sánchez-Mena A., Martí-Parreño J. (2017). Teachers´ Acceptance of Educational Video Games: a Comprehensive Literature Review. *Journal of e-Learning and Knowledge Society, 13*(2), 47-63. http://doi.org/10.20368/1971-8829/1319

Shafirova, L. (2018). Aprender una lengua extranjera en línea. En D. Hernández, D. Cassany & R. López, *Háblame de TIC 5: Prácticas de lectura y escritura en la era digital,* (p. 171-192). México: Brujas.

Shin, S. K. (2015). Teaching critical, ethical, and safe use of ICT in pre-service teacher education.

Language Learning & Technology, *19*(1), 181–197. http://llt.msu.edu/issues/february2015/shin.pdf

Sonck, N., Livingstone, S., Kuiper, E., & de Haan, J. (2011). Digital literacy and safety skills. *EU Kids Online, London School of Economics & Political Science*. London, UK. http://eprints.lse.ac.uk/33733/

Terreni, L., Vilanova, G., & Varas, J. (2019). Desarrollo de competencias digitales en propuestas pedagógicas en ambientes mediados. *Informes Científicos Técnicos-UNPA, 11*(3), 61-87. http://doi.org/10.22305/ict-unpa.v11.n3.797

Tomczyk (2019). What do teachers know about digital safety? *Computers in the Schools. 36*(3), 167-187. https://doi.org/10.1080/07380569.2019.1642728

van Eck, J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics. 111*(2), 1053-1070. http://dx.doi.org/10.100/s11192-017-2300-7

Vitak, J., Liao, Y., Subramaniam, M., & Kumar, P. (2018). 'I Knew It Was Too Good to Be True" The Challenges Economically Disadvantaged Internet Users Face in Assessing Trustworthiness, Avoiding Scams, and Developing Self-Efficacy Online. *Proceedings of the ACM on Human-Computer Interaction*, *2*(CSCW), 1-25. https://doi.org/10.1145/3274445