GLOBAL RESEARCH TRENDS ON DIGITAL COMPETENCE: A BIBLIOMETRIC STUDY USING VOSviewer

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Abstract-
Purpose:
The purpose of this paper is to do a bibliometric analysis and study the global research trends on Digital Competence across countries using VOSviewer.
Design/Methodology/Approach:
The study was able to conduct a bibliometric analysis of 1,004 publication articles using the Scopus database, keyword approach and VOS viewer software to analyze author keywords, top journals, top sources, organizations and most productive countries.
Findings:
The results confirm to the findings of ongoing interest in digital competence across countries with annual publications of documents, research is focused on digital competencies, ICT, online learning, internet and so on, Spain is the country having maximum number of publications along with University of Seville, Spain having maximum documents with maximum citations. The key finding also includes the top ranked journal as Sustainability (Switzerland).
Research limitations/implications:
The major limitation of this study finding the most effective quantitative representations of complicated concepts like "quality," "impact," or "excellence" is the main issue of bibliometrics. The theoretical shortcomings of bibliometrics are one of its main issues. More particular, if the current crisis in construct validity is not resolved quickly, it will eventually topple the entire structure.
Practical implications:
Digital Competence is the collection of digital skills which includes use of ICT for work, leisure, entertainment and communication. This concept is nowadays been used extensively in every area i.e education, medical, retail etc. There is a need of enhancing digital skills and competencies especially because of the obvious changes as the world keeps evolving in different fields. This study will help researchers and academicians globally in identifying future trends in digital competence.
Originality/Value:
There have been less bibliometric studies on this concept and thus this study aims at addressing on the global research trends on Digital Competence. This study would be beneficial to researchers and academicians all around to understand the concept of digital competence and its development trends.

*Keywords***: Digital Competence, ICT, digital skills, Bibliometric, Scopus, VOS viewer.**

Introduction:
In recent years, the entire world has undergone a huge technological transformation that has spread all areas of society including education [Comi, S.L, 2017; Falck,O.,2018; Ghemawat.P, 2017].The incorporation of Information and Communications Technology has dramatically changed the entire process of teaching-learning into new reality.

Due to the emergence of today's digital world, every individual requires to be digitally competent to survive. Hence, digital literacy is very vital in today's world for every individual. The literature related to Information and Communications Technology and higher education shows lack of information regarding digital competencies. The definition of digital competence itself is different [Janssen, J, 2013]. Digital teaching competence is related to all those skills, attitudes and knowledge required by teachers in a digitalized world [Cabero-Almenara, J, 2017].

Academic scholars and policy texts have regularly researched and analysed digital competency, and it is becoming an increasing priority in higher education. The use of ICT has increased now that the teaching and learning environment has altered the learning process and is inextricably tied to academic achievement of both instructors and students [Gómez-Fernández, N., 2021]. Digital competence is a dynamic and transversal cognitive, attitudinal, and technological talent that aids in the alleviation of many of the difficulties and challenges that face today's knowledge society [Janssen, J, 2013]. In the context of education, digital competence is defined as the ability to apply the knowledge, attitudes, and skills required to plan, implement, evaluate, and continuously

review ICT-supported teaching and learning processes, along with a strong theoretical foundation, investigation, and experimentation [From, J, 2017]. For instructors, digital competence is knowing how to use ICT with a good pedagogical-didactic understanding and being aware of how this may affect students' learning styles and educational formation [Krumsvik, R.J, 2007]. It is well known that in this digital age, information and communication technologies (ICT) have altered every aspect of life, from how we work and communicate to how we educate our children. In essence, has grown to be a very significant component of the labour, leisure activities, and educational settings [Goriss-Hunter et al., 2022]. Several research on digital competency in university education during the COVID-19 era have been conducted recently. University students have improved their degree of digital competence throughout this epidemic, as have the teaching staff, according to studies like [Garca-Prieto et al., 2022], [Myyry et al., 2022].
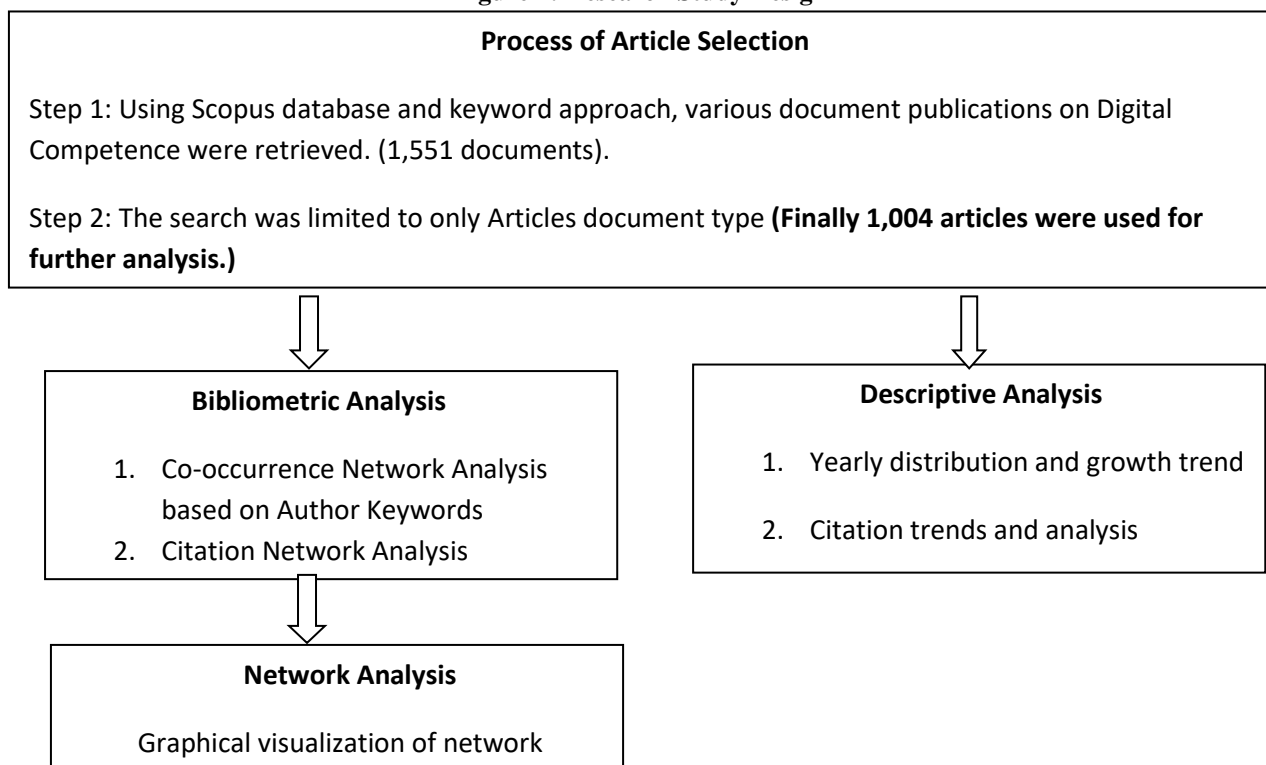
Today's pupils are known as digital natives because they grew up surrounded by modern technology [Prensky, M., 2007]. Students who can generate and manage material and information, handle communication technologies, and solve technological challenges can improve their capabilities and competitiveness in order to meet today's needs [Eger, L., 2018; Kwon, D., 2021]. To meet the new difficulties, students, as the primary participants in education, must be equipped with digital skills [Toquero, C.M., 2020]. However, the majority of students lack the necessary digital skills [Cabezas, M., 2017]. In both classroom and online learning, technology is still not adequately integrated. Although some surveys demonstrate that students are improving in some areas of digital competence, they still have a long way to go before they are totally capable [Liesa- Orús, M., 2016; Rodríguez, M.D.M., 2018; López- Meneses, E, 2020]

This study summarizes the research results globally regarding digital competence using scopus database.

Research Study Design and Methodology:

The research study design and methodology used is presented below:

Figure 1: Research Study Design

Process of Article Selection
Step 1: Using Scopus database and keyword approach, various document publications on Digital Competence were retrieved. (1,551 documents).
Step 2: The search was limited to only Articles document type **(Finally 1,004 articles were used for further analysis.)**

Bibliometric Analysis
1. Co-occurrence Network Analysis based on Author Keywords
2. Citation Network Analysis

Descriptive Analysis
1. Yearly distribution and growth trend
2. Citation trends and analysis

Network Analysis
Graphical visualization of network

Source: Author's Representation

Article Selection:

To conduct this study, a keyword search approach was used extensively in conducting the bibliometric analysis. A search based on keyword "Digital Competence" was conducted on the Scopus database through which 1,551 documents were retrieved. The search was further limited to document type (articles only) after which finally 1,004 articles were used for bibliometric analysis using VOS viewer software.

Methodology:

This study has been conducted using bibliometric analysis approach using the Scopus database which is one of the most prestigious and highly rated in the field of bibliometric studies.[Stopar, K.; Bartol, T, 2019; Sánchez-Caballé, A., 2020; Tibaná-Herrera, G, 2017; González-Zamar, M.D, 2020]. The bibliometric analysis identifies most relevant bibliometric aspects of the area to be analyzed such as co-citation, co-occurrence and coauthorship [Van Eck and Waltman, 2014].

To conduct bibliometric analysis, VOS viewer software tool was used. In this context, VOS viewer software version 1.6.17 was used for the analysis of the several themes of the current research.

Results & Discussions:

Yearly distribution and growth trend
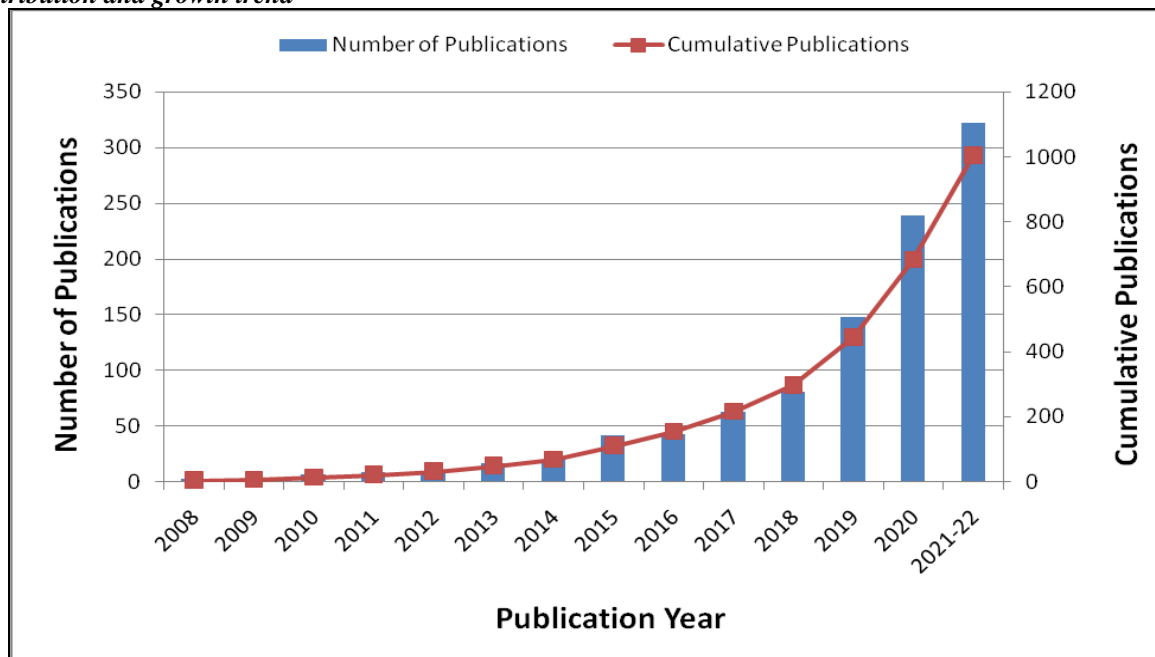
Figure 2: Yearly analysis of the number of publications and cumulative publications.

The above Figure 2 shows the plot of the number of publications and cumulative publications annually to analyze the research trend on Digital Competence. The analysis provides a reasonable estimate of the research trend in the near future to the academicians and researchers. The above graph depicts that the research on Digital competence began from 2008. Also from the above plot it is observed the total number of publications till 2011 were only 21 which is a clear indication that the researchers did not show interest in the said topic. At least 10 number of publications were published after 2011. Maximum number of publications (322) were published in 2021-22 (year). Since 2012, researchers worldwide have showed interest in the subject of digital competence as indicated in the above plot of cumulative publications. This can be derived from the sudden rise after the year 2011 in the number of cumulative publications.

Analysis Author Keywords

To explore the concept of "Digital Competence", Figure 3 shows the co-occurrence network of author keywords. In this study we can identify 5 clusters.

The cluster a (Digital Competence) includes keywords such as "teacher training", "professional development", "e-learning", "online learning" and so on. With the rise of digital technology, education sector has seen tremendous rise in online learning and therefore has led to the educators at workplace to be digitally competent. Further focus has increased dedicated to technology led teacher training that helps educators to improve their overall professional development and digital skills. Hence digital skills, knowledge and ICT have equally become important for employees at the workplace for their continuous growth in this digital world.

The cluster b (Digital Competencies and COVID 19) includes keywords such as "digital divide", "social networks", "digital skills", "higher education" and so on. The Corona virus pandemic has further pushed us into a digital world. With increase use of digital technologies, skills required to be digitally competent also became important. We could also witness how pandemic brought to fore the digital divide in many parts of the world and made education a privilege only a few can afford.

The cluster c (Educational Technology) includes keywords such as "information and communication", "teacher education", "primary education", technology integration in education has changed the education market.

The cluster d (ICT and education) includes "teachers training", "internet", "technology", "information technology", "competencies" and so on, information and communication technology in education enhances teaching and learning with improved teaching methods.

The cluster e (online learning) includes topics "teacher", "media literacy", "lifelong learning", online learning is the future of education globally which enables teachers to connect with students across the globe.

The Figure 3 clearly shows that digital technologies have clearly increased the need of digital skills required to be component enough. It has led to widespread professional development and teacher training. The use of online mode of education has also increased the use of ICT tools and internet.
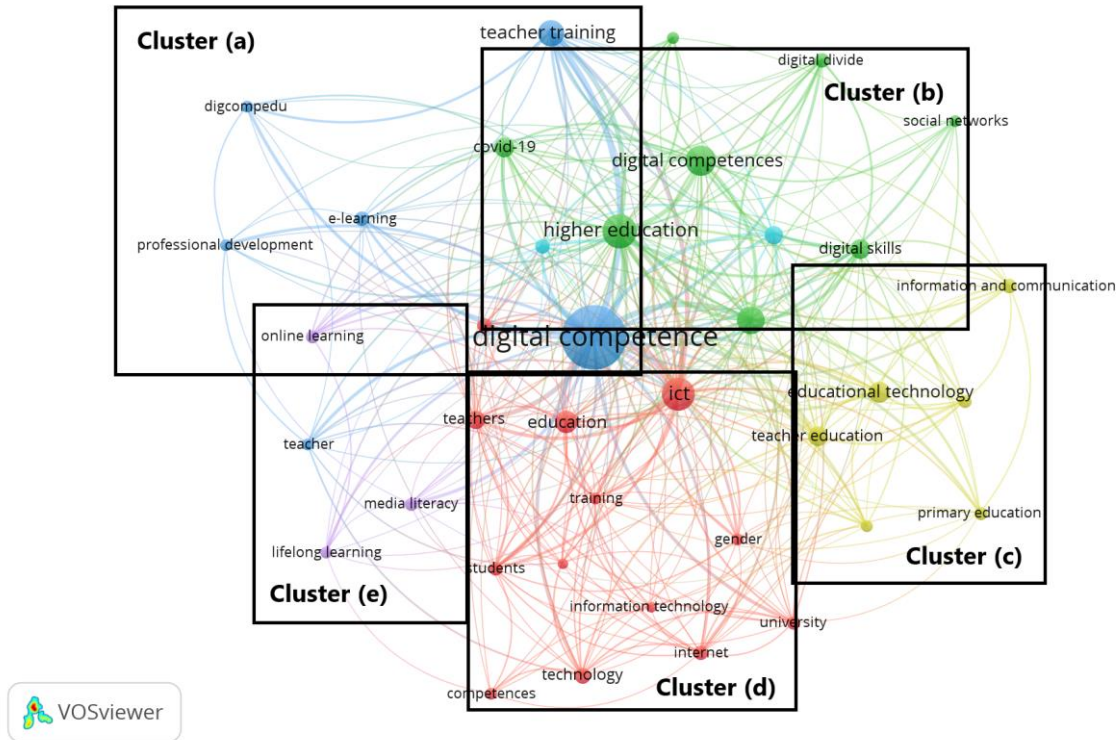
Figure 3: A map based on bibliographic keyword co-occurrence (author keywords)

Country level distribution of publications:
In Table 1, statistics of 42 countries have been provided. From these 42 countries, a total number of 1124 documents were published as it can be observed from Table 1. The highest number of publications (474 documents, 42.17% of the total documents) was from Spain which is followed by 62 publications (5.52%) from Norway. The Russian Federation took the third position with 51 publications (4.54%), Sweden took the fourth position with 41 publications (3.65%) and Italy took the fifth position with 34 publications (3.02%). There were nine countries that published ranging from 20 to 30 documents, nine countries that published ranging from 11 to 19 documents, ten countries that published ranging from 7 to 10 documents. Also four countries published six documents each as well as five countries published five documents each. 16 out of 42 countries had 20 or less nominal GDP Rank as given in the Table. So from the above analysis we can conclude that the need of digital competence and the skill sets needed to use digital technologies has been identified by the economically developed countries. Spain received the highest number of citations (3820) from the published 474 documents. Norway, Belgium, and Netherlands subsequently had an average of 20 or higher citations.

Table 1: Top countries that published more than five documents

Sl.No	Country	Documents	Percentage Of Documents	Citation	Avg citation per document	National GDP Rank	total link strength
1	Spain	474	42.17	3820	8.06	14	606
2	Norway	62	5.52	1406	22.68	31	364
3	russian federation	51	4.54	135	2.65	11	38
4	Sweden	41	3.65	459	11.20	24	131
5	Italy	34	3.02	364	10.71	8	75
6	Mexico	28	2.49	134	4.79	15	46
7	Portugal	26	2.31	94	3.62	49	54
8	united kingdom	25	2.22	302	12.08	5	33
9	equatorial guinea	24	2.14	87	3.63	147	63
10	Finland	24	2.14	267	11.13	44	45
11	Colombia	22	1.96	62	2.82	45	23

12	Poland	22	1.96	65	2.95	23	30
13	Germany	20	1.78	360	18	4	32
14	united states	20	1.78	278	13.9	1	32
15	Chile	16	1.42	97	6.06	43	55
16	Turkey	16	1.42	81	5.06	20	51
17	China	14	1.25	141	10.07	2	83
18	Peru	13	1.16	14	1.08	51	28
19	Canada	12	1.07	145	12.08	9	34
20	Ireland	12	1.07	113	9.42	29	31
21	Slovenia	12	1.07	56	4.67	84	20
22	Brazil	11	0.98	38	3.45	13	7
23	Greece	11	0.98	94	8.55	52	15
24	Australia	9	0.80	153	17	12	27
25	Belgium	9	0.80	267	29.67	25	63
26	Bulgaria	9	0.80	73	8.11	73	15
27	Croatia	9	0.80	14	1.56	81	0
28	Serbia	9	0.80	32	3.56	86	6
29	Ukraine	9	0.80	58	6.44	57	20
30	Hungary	8	0.71	25	3.13	56	7
31	Indonesia	8	0.71	9	1.13	16	3
32	Netherlands	8	0.71	186	23.25	17	80
33	Thailand	7	0.62	28	4	26	6
34	czech republic	6	0.53	17	2.83	48	14
35	India	6	0.53	64	10.67	6	6
36	Lithuania	6	0.53	22	3.67	83	1
37	Malaysia	6	0.53	8	1.33	38	8
38	Latvia	5	0.44	10	2	102	3
39	new Zealand	5	0.44	65	13	50	25
40	Romania	5	0.44	24	4.8	47	0
41	Slovakia	5	0.44	13	2.6	61	8
42	Switzerland	5	0.44	1	0.20	18	6

* Nominal GDP Rank as per the International Monetary Fund (2021 estimates)
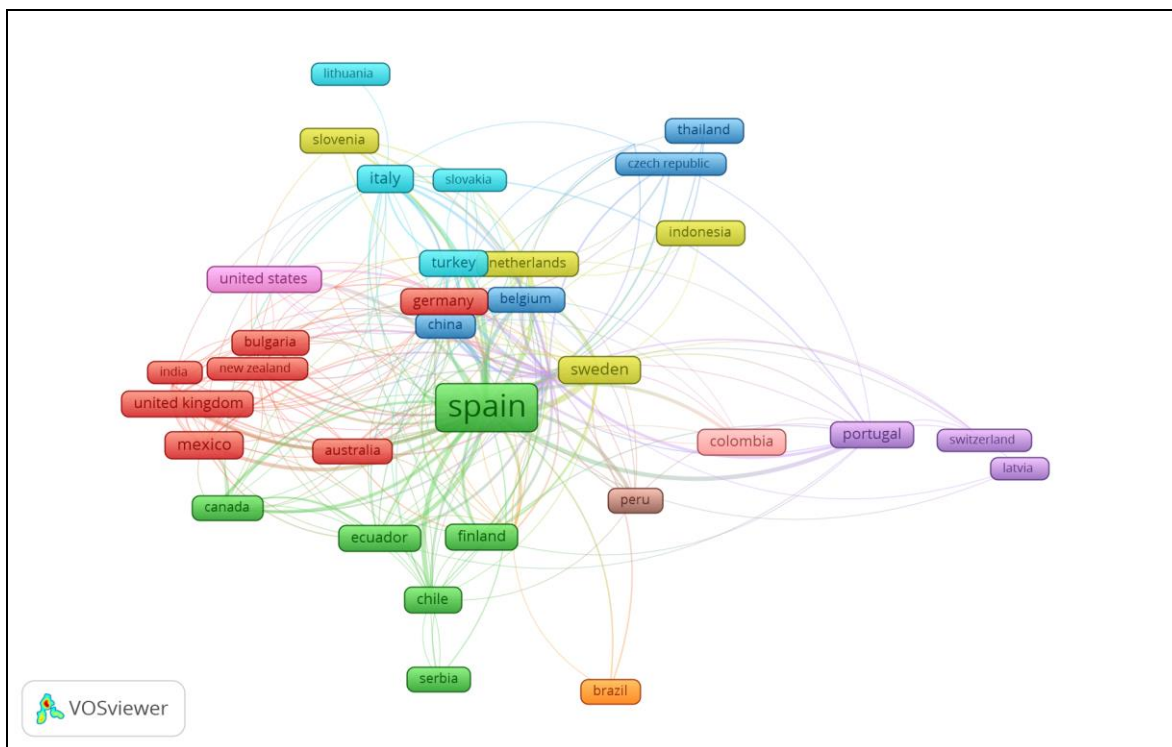
Figure 4: Country cooperation network on digital competence of countries that published minimum five documents.

The Total Link Strength (TLS) provides an estimation of collaborative research from one country to the other (Table 1). The TLS analysis shows that Spain is by far the highest performing country in terms of collaborative research with a TLS of 606. Spain was found to have issued documents with each of the 41 countries shown in Figure 4. In second place, Norway obtained a TLS of 364. Norway has published research papers with all 36 countries mentioned in Figure 4. With a TLS score of 131, Sweden occupied third place in collaborative research. Researchers from Sweden have published documents with researchers from each of the 21 countries listed in Figure 4. Based on the analysis of the TLS score and the country cooperation network map, it is clear that most countries work together on research with Spain and Norway.

Other major organizations were identified and published more than five documents in this area of research (Table 2). Bibliometric analysis showed that the University of Seville, Spain, had published 22 papers that could collect 162 citations. As a result, an average of 7.36 citations were provided for each document. Interestingly, it was found that Umea University, Sweden had published only 6 documents with 113 citations which clearly show that the documents are of good quality. As well, the average citation per document from Umea University is 18.83.

Table 2: Leading organizations that have published more than five papers.

Sl.No	Organization	Country	documents	Citation	Average citation per document
1	university of seville, spain	Spain	22	162	7.36
2	universidad de granada, spain	Spain	18	151	8.39
7	universidad internacional de valencia, spain	Spain	12	105	8.75
3	universidad de salamanca, spain	Spain	9	30	3.33
4	universidad complutense de madrid, spain	Spain	8	100	12.50
5	universidad de murcia, spain	Spain	8	8	1.00
6	universidad de oviedo, spain	Spain	7	54	7.71
8	umeå university, Sweden	Sweden	6	113	18.83
9	universidad internacional de la rioja, spain	Spain	6	65	10.83
10	universidad de cantabria, spain	Spain	5	22	4.40

Distribution and Co-citation relationship:

The relationship between sources and citations yields a list of the most prestigious and important journals in which authors like to publish their work. Table 3 lists the major journals that have published research papers on digital competence. Table 3 clearly shows that the writers' chosen option for publishing their research publications on digital competence was Sustainability (Switzerland). To date, 44 numbers of documents have been published in this journal. The journal received 291 citations as a result of these documents. Comunicar is in second place, having published 25 documents and receiving 871 citations. With 24 publications, Education and Information Technologies took third place. These research publications garnered 405 citations in the journal. But at the same time, we can see that Computers and Education published only 17 documents but received good amount of 721 citations. It should be noticed that the total link strength of these four journals was higher than that of other journals. The source-citation relationship map shows that these journals were heavily cited by documents published in other journals. The top three journals in terms of average citations per document were European journal of teacher education, Computers and education, and Comunicar. The average number of citations per document indicates that the papers published in journals are of high quality. Hence it can be said that European journal of teacher education, Computers and education and Comunicar are high quality journals.
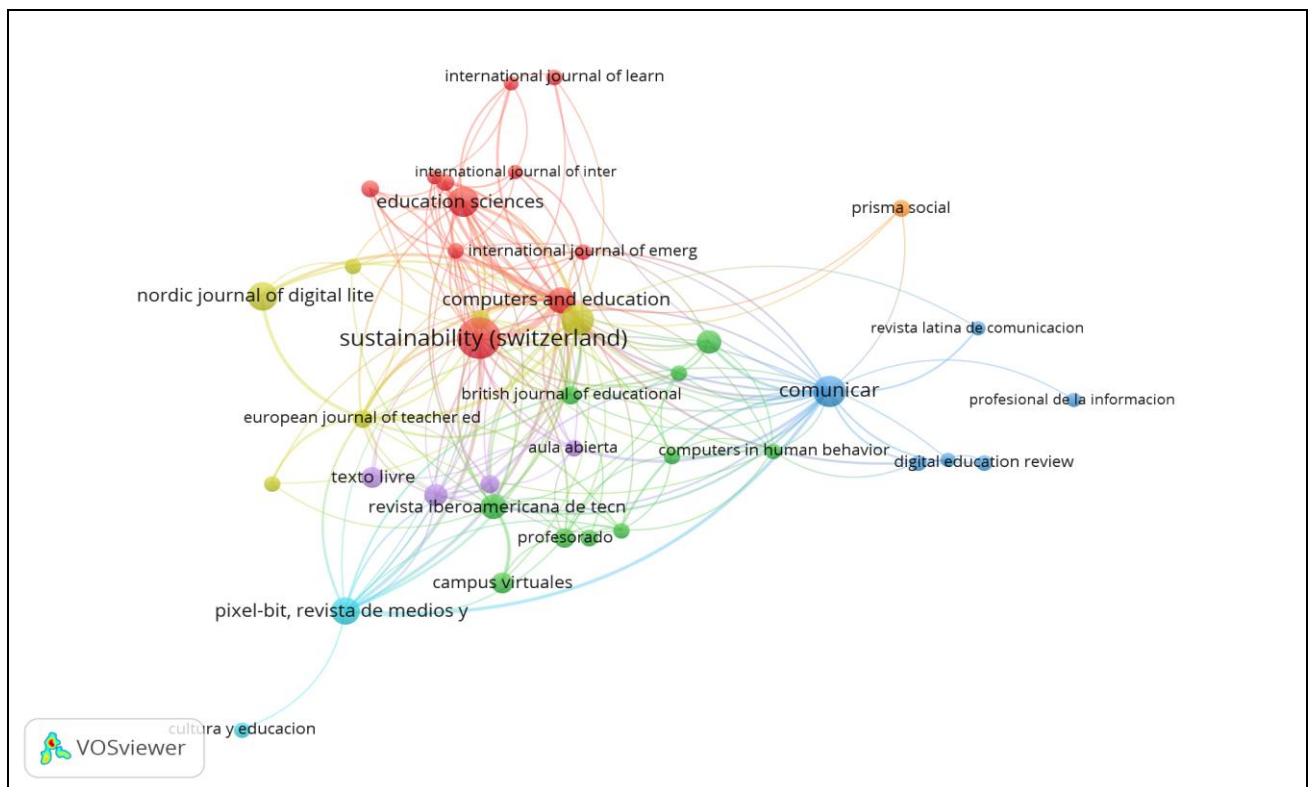

Figure 5: Source and citations relationship of the sources that published documents on digital competence. We looked at sources that had published at least five documents.

Table 3: Top journals with at least five articles published

Sl.No	Source	documents	citations	Average citations per document	Impact Factor	total link strength
1	sustainability (Switzerland)	44	291	6.61	3.48	65
2	Comunicar	25	871	34.84	3.375	63
3	education and information technologies	24	405	16.88	3.95	70
4	education sciences	23	105	4.57	2.15	35
5	nordic journal of digital literacy	21	151	7.19	1.39	15
6	pixel-bit, revista de medios y educacion	19	130	6.84	2.16	41
7	computers and education	17	721	42.41	8.538	110
8	revista iberoamericana de tecnologias del aprendizaje	16	32	2.00	1.383	31

9	risti - revista iberica de sistemas e tecnologias de informacao	14	19	1.36	2.809	13
10	revista de educacion a distancia	12	31	2.58	1.65	19
11	campus virtuales	11	33	3.00	2.3	8
12	texto livre	11	22	2.00	0.44	5
13	Profesorado	10	138	13.80	0.86	10
14	british journal of educational technology	9	167	18.56	2.951	26
15	european journal of teacher education	9	375	41.67	2.864	49
16	revista complutense de educacion	9	83	9.22	1.28	22
17	technology, knowledge and learning	9	115	12.78	3.353	28
18	international journal of environmental research and public health	8	14	1.75	3.39	9
19	Opcion	8	18	2.25	0.908	3
20	prisma social	8	37	4.63	0.64	3
21	aula abierta	7	39	5.57	2.07	17
22	international journal of educational technology in higher education	7	198	28.29	6.44	19
23	computers in human behavior	6	184	30.67	6.89	10
24	cultura y educacion	6	33	5.50	1.43	1
25	digital education review	6	22	3.67	1.45	3
26	education in the knowledge society	6	29	4.83	2.41	4
27	education inquiry	6	50	8.33	2.2	6
28	formacion universitaria	6	48	8.00	1.36	8
29	international journal of emerging technologies in learning	6	37	6.17	2.59	14
30	international journal of learning, teaching and educational research	6	15	2.50	0.59	4
31	journal of new approaches in educational research	6	107	17.83	4.76	25
32	Retos	6	18	3.00	1.36	9
33	revista de investigacion educative	6	105	17.50	2.435	13
34	technology, pedagogy and education	6	92	15.33	2.8	7
35	international journal of interactive mobile technologies	5	13	2.60	2.243	9
36	journal of e-learning and knowledge society	5	17	3.40	1.138	17
37	profesional de la informacion	5	13	2.60	2.15	1
38	revista electronica educare	5	14	2.80	0.69	6
39	revista eureka	5	27	5.40	0.79	6
40	revista latina de comunicacion social	5	9	1.80	1.69	3
41	universal journal of educational research	5	32	6.40	0.74	9

Conclusion:

Using bibliometric analysis approach, the research papers were analyzed from the scopus database. With the help of citations, annual publications, country wise, top organizations approach, the research papers of digital competence were analyzed. The key findings of this study were:

1. Annual publications of documents from 9 in 2011 to 322 in 2021-22 indicating an ongoing and continued interest in digital competence research across the globe

2. Most used author-provided keywords indicate that the research has focused on digital competencies, ICT, online learning, internet and so on.

3. The distribution of publications on a country level revealed that 42 countries published 1124 items in total. Spain had the most publications of any country, with 474 total.

4. The University of Seville, Spain, has the most documents (22) with 162 citations, according to an analysis of top organizations that released more than five publications.

5. Sustainability (Switzerland) is the top-ranked journal, with over five papers published. This journal has published 44 publications with 291 citations.

This study will help researchers and academicians globally in identifying future trends in digital competence.

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