Digital Competencies and Research Skills in Graduate Students: A Bibliometric Study

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Abstract

The objective of this study was to perform a bibliometric analysis of digital competencies and research skills in graduate students between 2003 and 2023. To analyze the academic production, the research method was based on bibliometric analysis. A total of 378 publications were selected from Scopus for the study based on their relevance and the keywords in English (Digital AND competencies, research AND skills). The results show that the most significant increase in scientific productivity occurred between 2016 and 2023 (n=341; 90.2%). In addition, the United States was the country with the highest scientific output (10.3%), the main publication sources were Education Sciences and Sustainability Switzerland (n=9 each), while Falloon, G. was the most referenced author (228 citations; 2 papers). Scientific articles accounted for 87% of the total, with 44% being research papers in the social sciences and 15% in computer science. It is concluded that the thematic diversity, authorship, sources and available resources have been progressively advancing with respect to digital competencies and research skills in graduate students. Thus, this bibliometric analysis can serve as a basis for further studies.

Keywords: *Digital Competencies, Research, Students, Bibliometric.*

INTRODUCTION

Today's world is constantly changing in all areas, and education is no exception. Thus, universities have an important responsibility to enhance the integration of research as an essential component of learning processes in higher education (Montalvo et al., 2022; Oseda et al, 2021); consequently, to carry out this task, students must not only understand the academic content of their field of study or the fundamental methods of research, but be competent in the use of technological tools that allow them to find, choose, order and evaluate the data necessary to manage their knowledge-generating activities (George & Salado, 2019).

In that order of ideas, information and communication technologies (ICT) are in constant development and drastically alter the teaching methodology of higher education, which require the attention of teachers, in addition to the ministry's own training strategies (Arellano, & Andrade, 2020; Cabero-Almenara et al., 2020). In this sense, it is crucial that university students master digital skills (García et al., 2021); for this, they must prepare themselves since they are digital immigrants who must adapt to the changes demanded by the modern world (Laurente-Cárdenas et al., 2022).

On the other hand, Paz-Enrique et al. (2022) state that digital competence is described as the use of information society technologies critically and safely for communication, work, business, and leisure. The use of digital media requires a certain set of skills, knowledge, methods and attitudes. Likewise, one of the greatest challenges facing this set of professionals is to help graduate students develop their digital competencies, given that they must enhance their research skills (Vega & Vega-Olivos, 2023).

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Thus, research capabilities are essential in the higher education process of students and must be adapted to the needs of each profession, as well as to their professional profiles (Díaz-García et al., 2020). Consequently, the improvement of digital capabilities in the training of students influences both the economic growth of each nation and the professional and social research development of students (Peinado, 2023).

In addition, research on the research skills and digital competencies of graduate students has increased in recent decades because it facilitates the safe and effective use of ICT to collect data and develop new ideas or knowledge through data (Romero, 2023; Urrea-Solano et al., 2022). In any case, the study of bibliometrics focuses on measuring the production of academic papers and other publications, helping academics to follow the expansion of intellectual production and to evaluate the importance of publications (Caló, 2022; Leyva et al., 2022).

Therefore, before databases can be used for the identification of scientific background, they must accurately capture the facts of the research (Sanz, 2022). Consequently, to construct bibliometric indicators, the total number of papers published on the topic and those closely related to it are quantitatively counted and examined (García-Villar & García-Santos, 2021; Llerena & Arévalo, 2021).

Likewise, it is essential to collect data on digital competencies and research skills in students using a bibliometric framework to study and understand. Several indicators are taken into account in the evaluation of papers, such as year of publication, country of origin, type of work, authorship and type. Therefore, it is proposed as a research objective: to perform a bibliometric analysis of digital competencies and research skills in graduate students between the years 2003 to 2023.

METHODOLOGY

Bibliometric methodologies were used to evaluate the current body of research on digital competencies and research skills in graduate students. Since this study requires the collection of a large amount of data, bibliometrics is fundamental (Salinas and García, 2022). The search was also conducted between the years 2003-2023 using the well-known Scopus database, which examines academic papers from all over the world.

To delimit the research, Boolean search terms were used with the following combinations: digital AND competencies, research AND skills, with this method 609 academic publications were obtained. However, once the data were collected and cleaned, 378 peer-reviewed scientific publications were selected for further analysis. In addition, to assist in the data filtering procedure, the exclusion criteria listed below were also described: (1) studies conducted before 2003 or after 2023, (2) duplicate publications, and (3) research that was not directly related to the current study.

On the other hand, the total contribution of 378 papers in the field of digital competencies and research skills in students was evaluated using bibliometric criteria (Florez-Fernández & Aguilera-Eguía, 2020). The following indicators were taken into account: academic discipline, affiliated institutions, country, authors, journals and date of publication. In addition, Excel was used for the processing and analysis of all data, and descriptive statistics and count data were also included in the study. The keyword co-occurrence map was generated using VOSviewer V_1.6.19.

RESULTS

The following bibliometric research included scholarly publications published between 2003 and 2023. This study on digital competencies and research skills among graduate students included 378 publications in total. Figure 1 shows the most recent global papers indexed by Scopus. In addition, between 2016 and 2023, an average of 341 new scientific papers were published, representing 90.2% of all publications worldwide.
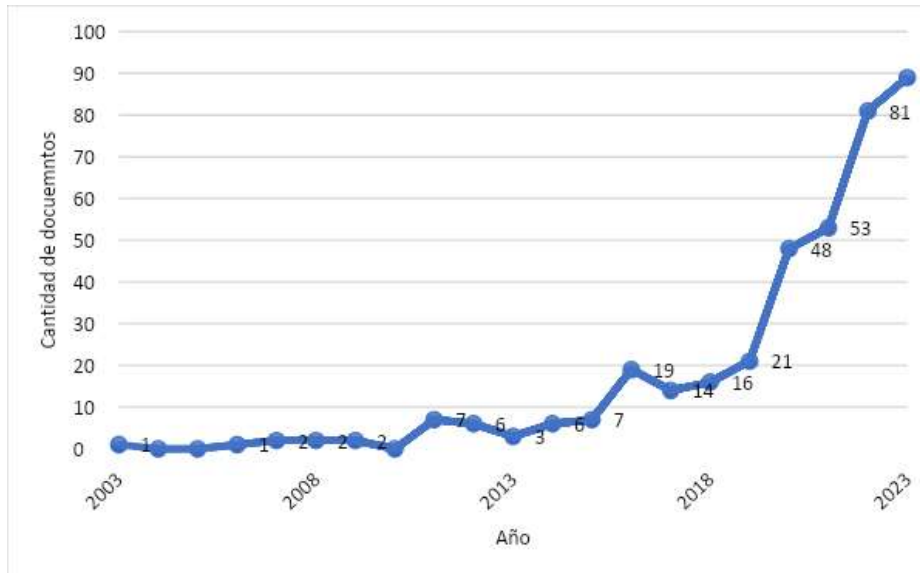
Figure 1. Documents published by year.

Source: Scopus data (2023).

Table 2 presents the analysis of the publications by country of origin (79 in total). The countries that have made exceptional efforts in this regard are highlighted. The top three nations in terms of scientific production are the United States (10.3%), Spain (7.7%) and the Russian Federation (7%). In addition, most of the papers (93.1%) were written in English, and 5.6% and 1.3% in Spanish and Portuguese, respectively.

Table 1. Publication of documents by country.

N°	Country	Number of documents	%	N°	Country	Number of documents	%
1	United States	47	10.3%	17	Saudi Arabia	8	1.8%
2	Spain	35	7.7%	18	South Africa	8	1.8%
3	Russian Federation	32	7.0%	19	Turkey	8	1.8%
4	Germany	22	4.8%	20	Ukraine	8	1.8%
5	Indonesia	19	4.2%	21	United Arab Emirates	7	1.5%
6	Mexico	17	3.7%	22	Brazil	6	1.3%
7	United Kingdom	17	3.7%	23	India	6	1.3%
8	Australia	14	3.1%	24	Portugal	6	1.3%
9	Thailand	12	2.6%	25	China	5	1.1%
10	Poland	10	2.2%	26	Czech Republic	5	1.1%
11	Malaysia	9	2.0%	27	Kenya	5	1.1%
12	Peru	9	2.0%	28	Pakistan	5	1.1%
13	Ecuador	8	1.8%	29	Canada	4	0.9%
14	Greece	8	1.8%	30	Denmark	4	0.9%
15	Italy	8	1.8%	31	Indefinite	95	20.9%
16	Kazakhstan	8	1.8%	Total countries		79	

Source: Scopus data (2023).

This evaluation was based on 141 academic sources. Table 2 provides a summary of all the data collected for this research. In addition, it shows the number of papers published in various sources or journals such as: Education Sciences and Sustainability Switzerland standing out with 9 publications each, Education and Information Technologies with two published papers and in third place with six papers respectively are the journals European Journal of Contemporary Education and Frontiers in Education. Likewise, these sources occupy outstanding positions in their respective disciplines according to their impact factors.

Table 2. Publication of documents by source or journal.

Source or Magazine	Number of documents	Source or Magazine	Number of documents	Source or Magazine	Number of documents
Education Sciences	9	Information Switzerland	3	British Journal of Educational Technology	2
Sustainability Switzerland	9	International Journal of Educational Management	3	Call Ej	2
Education and Information Technologies	7	International Journal of Learning Teaching and Educational Research	3	Computers and Education	2
European Journal of Contemporary Education	6	International Journal on Interactive Design and Manufacturing	3	Edutec	2
Frontiers in Education	6	Journal of Information Technology Education Research	3	Electronic Journal of E Learning	2
BMC Medical Education	5	Journal of Technical Education and Training	3	University Formation	2
Cogent Education	5	Library Philosophy and Practice	3	Interactive Learning Environments	2
International Journal of Information and Education Technology	4	Libri	3	International Journal of Continuing Engineering Education and Life Long Learning	2
Lecture Notes in Networks and Systems	4	Obrazovanie I Nauka	3	International Journal of Educational Technology in Higher Education	2
Perspektivy Nauki I Obrazovania	4	Risti Iberian Journal of Information Systems and Technologies	3	International Journal of Emerging Technologies in Learning	2
Electronic Library	3	Technology Knowledge and Learning	3	Internet and Higher Education	2
Heliyon	3	Turkish Online Journal of Educational Technology	3	Indefinite	116
Human Review International	3	Advances in Science Technology and Innovation	2	Total magazines	141

These 378 papers represent the collaborative efforts of researchers from more than 145 different universities. Figure 2 shows the universities with the highest number of papers published throughout the study period. These include Tecnológico de Monterrey (n=11), Kazan Federal University (n=8), Uniwersytet Pedagogiczny im. Komisji Edukacji Narodowej (n=6) and Universidad Complutense de Madrid (n=5).
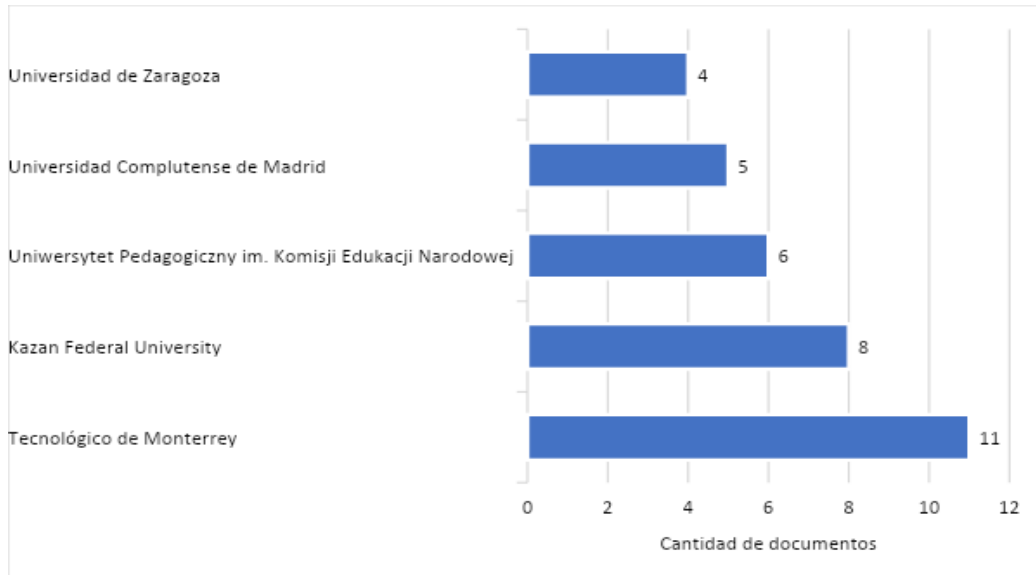
**Figure 2. Documents published by institution.**

The authors of the selected academic papers were 151. According to Table 3, of all the authors, Falloon, G. received the highest number of citations (228; n = 2 papers). He was followed by Blau, I., with two publications and 194 citations. Escobar Díaz, C.A. and Hernández-de-Menéndez, M. (n = 2; 109 citations each) were in third place.

Table 3. Published papers by author.

By author	Quantity	Total citations	By author	Quantity	Total citations
Herrmann-Werner, A.	3	27	Hernandez-de-Menendez, M.	2	109
Blau, I.	2	194	Janchai, W.	2	41
Blummer, B.	2	13	Kalogiannakis, M.	2	14
Brabazon, T.	2	38	Kanaki, K.	2	14
Chaudhary, K.	2	7	Kostagiolas, P.	2	1
Escobar Diaz, C.A.	2	109	Mah, D.K.	2	106
Falloon, G.	2	228	Mamaeva, E.A.	2	3
Hagerman, M.S.	2	28	Milenkova, V.	2	33

Table 3 summarizes the academic studies conducted between 2003 and 2023 on the research skills and digital competencies of graduate students. The fields of social sciences (44%), computer science (15%) and engineering (6%) have contributed the most to the growth of scientific knowledge on this topic. Similarly, if the overall production is divided by type of document, scientific articles represent 87%, book chapters 11% and books 2%.
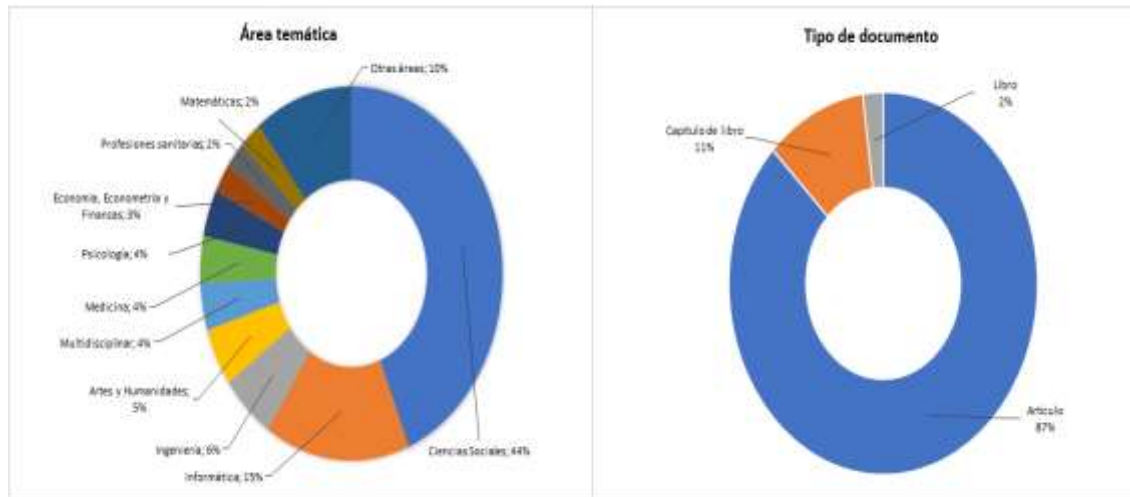
Figure 3. Publication of documents by thematic area and type.

Source: Scopus data (2023).

Figure 4 shows the terms identified in the abstracts, keyword lists, and titles of the papers examined. The use of colors in VOSviewer to indicate the strength of links between concepts facilitates the examination of groupings of words that share a certain relationship.

Red cluster. "digital competences" (n=43 occurrences), groups the following words: university students, digital divide, digital literacy, digitalization, online education, computer literacy, blended learning, assessment, communication, engineering education, staff training, information and communication, collaboration, media literacy, information literacy.

Green cluster. "competencies" (n=31 occurrences), groups the following words: interpersonal competencies, digital information, digital competence, digital competence, skills, itc, university, student, online learning, digital tools, educational computing, technology, teacher training, computational thinking.

Blue cluster. "learning" (n=23 occurrences), groups the following words: students, psychology, procedures, skill, adult, controlled study, perception, motivation, competence, simulation, clinical competence, qualitative research.

Most of the most commonly used terms have their origin in the subject matter, as demonstrated by this grouping technique.
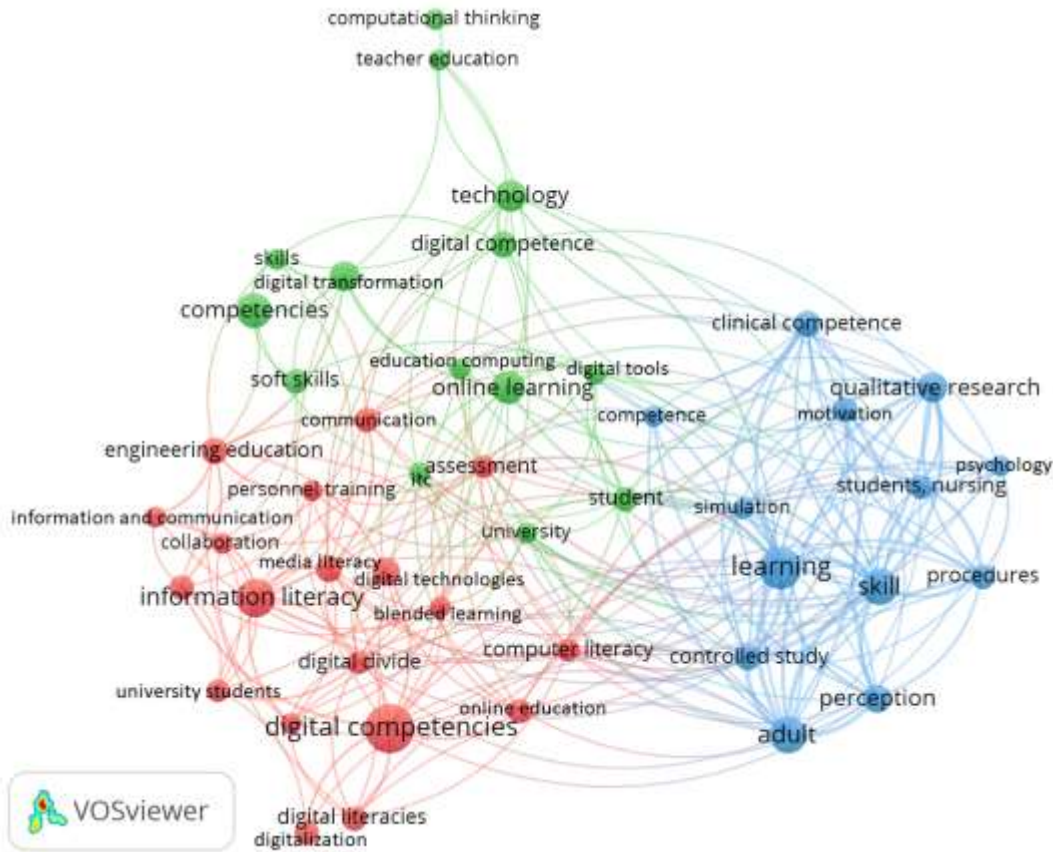
Figure 4. Map of keyword co-occurrence.

Source: Results in VOSviewer (2023).

DISCUSSION

This study includes papers between the years 2003 to 2023. According to the statistical data, most of the research papers on digital competencies and research skills in graduate students were published between 2016 and 2023.

This study analyzes research concerning digital competencies and research skills in graduate students. According to Viteri et al. (2020), in order for students to do research, higher education institutions must have adequate infrastructure, the necessary technological resources and digital skills. Similarly, Castro and Silva (2023) state that digital skills are more common in social environments, such as universities, and can guarantee better results, where it is crucial that teachers are trained in research techniques, as well as in how to use technology to carry out their teaching and learning activities.

Likewise, Atalaya (2022) agrees that the use of digital competencies favors the growth of research skills, encouraging the use of the scientific method in the administration of activities to enhance in students the growth of the process of inquiry and exploration of information in all its components, which favors the advancement of scientific bases.

In any case, research training and the application of digital competencies are closely related, since this is the only way for students to acquire research skills; consequently, it is important to train them in digital competencies (Torres et al., 2021).

In addition, Huauya et al. (2021) state that students who master these skills will find it easier to do scientific work and share the conclusions of their studies; this activity will not only help them to obtain good academic

results, but also to create and update knowledge in their field of study, in addition to combining university research.

Likewise, Balanta and Vivero (2023) highlight the importance of developing digital competencies to train citizens for this new environment, which the digital revolution has already completely transformed and which, combined with research skills, will make it possible to train individuals who will benefit society. In this sense, Daker et al. (2022), agree that training university students to do research should become a cross-cutting issue in their professional growth, which will allow teachers to design courses that require students to skillfully use digital technologies, and not only in an explanatory way, but also applicable to research based on the development of research skills in their students.

CONCLUSION

According to the stated objective of the study, the number of research conducted on digital competencies and research skills in graduate students increased from 2003 to 2023. According to the bibliometric study of all publications indexed in Scopus, there is an increase of 90.2% (n=341) between 2016 and 2023. Among the 79 nations examined, the United States contributes 10.3% (n=47) of the global output, and English is used in more than 93.1% (n=352) of the publications in this field. In addition, Falloon, G. received 228 citations, making him the most cited author. Also, Sustainability Switzerland and Education Sciences, both with nine publications, are among the most relevant sources.

In addition, social sciences (44%), computer science (15%) and engineering (6%) accounted for most of the published articles (87%) that were scientific in nature. The keyword analysis performed by VOSviewer showed that the term "digital competences" had an occurrence of 43, while the terms "competencies" and "learning" are also relevant concepts.

On the other hand, the 378 papers reviewed emphasize how crucial it is for graduate students to have research and digital skills, stating that it is relevant for students to employ techniques to develop their research skills, as a result of which knowledge of digital skills is also enhanced.

Finally, it is concluded that digital competencies and research skills in graduate students have progressively advanced along with the range of topics addressed, authors, sources and accessible resources. As a result, the study provides a solid framework for the construction of future research.

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