HUMAN REVIEW | 2022 | ISSN 2695-9623
International Humanities Review / Revista Internacional de Humanidades
https://doi.org/10.37467/revhuman.v11.4083

DIGITAL COMPETENCIES AND SKILLS AS A DETERMINANT FACTOR IN HIGHER EDUCATION

A bibliometric analysis

Competencias y habilidades digitales como factor determinante en educación superior: un estudio bibliométrico

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KEYWORDS

Digital Competences
Digital skills
Higher Education
University students
New Education Development Area
Professional Area
Future Trends

ABSTRACT

This paper focuses on contributing to a better understanding of the study of Digital Competencies, Digital Skills in Higher Education. First, we have developed a descriptive analysis of journals and authors to understand the meaning of digital competencies and skills and their development in Higher Education. Secondly, we have analysed the conceptual knowledge using Web of Science; its use is growing rapidly in the research of articles or topics, being considered a topic to investigate and explore due to its importance and relevance.

PALABRAS CLAVE

Competencias Digitales
Habilidades Digitales
Educación Superior
Estudiantes Universitarios
Nueva área de Desarrollo educativo
Área profesional
Tendencias de futuro

RESUMEN

Este trabajo se centra en contribuir a una mejor comprensión del estudio de las Competencias Digitales, Habilidades Digitales en la Educación Superior. En primer lugar, hemos desarrollado un análisis descriptivo de revistas y autores para comprender el significado de las competencias y habilidades digitales y su desarrollo en la Educación Superior. En segundo lugar, hemos analizado el conocimiento conceptual utilizando Web of Science; su uso está creciendo rápidamente en la investigación de artículos o temas, considerándose un tema a investigar y explorar debido a su importancia y relevancia.

Recibido: 02/ 07 / 2022
Aceptado: 10/ 09 / 2022

1. Introduction

Developing the digital skills of the population is the most important task for the country when moving towards digital and smart technologies, citizen and cities. (Vuorikari, Punie, S., & Van den Brande, 2016). The younger generation can develop by the necessary skills themselves, for example, with self-learning, self –development programs and / or they can acquire the necessary knowledge, skills and abilities in establishments of higher education during educational period. (Persada, Ivanovski, & Miraja, 2020).

The dynamics of the society in which we live forces our education systems to adopt a new approach to training our future professionals: an approach that takes into account global economic development and the requirements of an increasingly volatile job market. The traditional model based on the transmission and communication of knowledge must be replaced by other methodologies allowing students to acquire knowledge, skills and attitudes in a work environment and real and relevant them.(López_Meneses, Sirignano, Vázquez-Cano, & Ramírez-Hurtado, 2020).

In recent years, one of themes to review is the argument that digital competencies and digital skills were used during university years, because a fast globalization need to train these abilities, knowledge, to be employed in the future job. The concept of digital competencies and digital skills are used both of them, because the authors use one concept or the other to identify the skills in the digital environment. Students of century XXI need competencies to adapt new world. Digital skills related to high education is a topic that has started to generate interest in the research community. Several previous studies have explored previous digital skills and competences research and their relation to university period.

Digital Competence is a concept that has started attracting the interest of the research community "what kinds of skills and knowing people should have in knowledge" (IIomäki, Paavola, & Lakkala, 2016). Several previous studies have explored the previous research about digital competencies. Hossain et al. (2016) (Salilul & Hossain, 2016) and Zhang, Hua and Yuan (2018) find that digital competencies are a new paradigm that is in the first stages of development.

The content highlights the definition of digital skills given by the European Framework of Digital skills (DIGCOMP, 2014) reflects the following: "the set of knowledge, skills, attitudes, strategies and awareness (areas of learning) that theuse of ICT and Digital media require (tools) to perform tasks, solve problems, communicate, manage information, collaborate, create and share content and generate knowledge (areas of competence) in an effective, efficient, adequate, critical, autonomous, flexible, and ethical way. reflexive (modalities) for work, leisure, participation, learning, socialization, consumption and empowerment(objective)".

Alvarez, Núñez, & Rodríguez, (2017) discusses and shows that there is an asynchronous distance in relation to this aspect respecting to university students, finding that there is a clear lack of digital skills that has restricted interactivity at the digital level, so they have missed development opportunities. The key competencies of university students will be information and data literacy,communication and collaboration, digital content creation, safety, problem solving. (Commission, 2016).

A distinction is made between *computer competences* (the set of knowledge, skills, dispositions and behaviors that enable individuals to know how ICT works, what they are for and how they can be used to achieve specific objectives) and *information skills* (the set of knowledge, skills, dispositions, and behaviors that enable individuals to recognize when they need information, where to locate it, how to evaluate it, and how to use it appropriately based on their problems), we are used the information skills and the way that students use them. They are considered to be transversal in nature, as they are supposedly common to all disciplines, learning environments, and levels of education. (DIGCOMP, 2014).

By promoting the autonomy of users, it also favors the acquisition of information search skills, analyzing and selecting it efficiently, as well as organizing and using itto communicate, according to ethical and legal parameters, with the intention of building knowledge. In particular, Aguaded, Marín-Gutiérrez and Díaz-Pareja (2015), or Cózar-Gutiérrez et al. (2016), among others, refer to a third group of *digital pedagogical or teaching competences* (CDD) (Quiroz, Miranda, Gisbert, Morales, & Onetto, 2016).

Other way of students is required to be active and autonomous in monitoringand managing the studying process, particularly in online courses, self-regulated learning can be the best strategy. Students have a specific digital competence due to the informal participation in social media, this ability can affect their learning activities and outcomes. Many international institutions have designed digital competence framework as a required standard for effective socialparticipation and efficient learning. The e-students' success in Higher Education depends on the readiness of learners to engage in online learning environments. (Cilliers, 2017).

The overall of this strategy is to give Higher Education's students, the opportunity to develop the ability to use and create with digital technology, as well as, to understand how digitalization affects the individual and society. Being the most important topic for universities to ensure employability by using transferable digital skills to strengthen the possibility of finding a job and adapting to job developments, highlighting the discrepancies of what is in demand in the labour market and what is taught in the classroom, thus, there are tendencies to adapt, modify or reduce training in higher education. Emphasizing the importance of this study and the need to analyze

which digital competences should be developed in the classroom, which is what we will see later on. (Galindo, Ruiz, & Ruiz, 2017).

The dynamics of the society in which we live forces our education systems to adopt a new approach to training our future professionals: an approach that takes into account global economic development and the requirements of an increasingly volatile job market. (European, 2016). The key competencies of university students will be information and data literacy,communication and collaboration, digital content creation, safety, problem solving. (Commission, 2016).

Arranz, Blanco, & Ruiz, (2017) said that in the coming years, the urgency of developing digital competences may face an educational dilemma at a higher level, since these proposals are oriented according to the novel labor proposals. (Galindo, Ruiz, & Ruiz, 2017). Several previous studies have expired the previous research about Digital Skills, Digital competences and Higher Education find digital skills and Higher Education a new area to development.

One of the first biblio-metric studies related to the concept of digital competence is made by Spante, Sylvana Sofkova, & Mona Lundinand, (2018), this study is related to the concept of digital competence, using this systematic review:

1. "digital competenc*" AND "higher education"
2. "digital literac*" AND "higher education"

The searches were conducted in September 2017 shows clearly the more recent use of the term digital competence starting in 2010. From 2010 onwards, the number of publications grows for both concepts, with an exceptional raise in numbers in 2013 and 2016 for digital literacy. Most publications where digital competence is defined originate from Continental Europe, dominated by Spain, Italy and Scandinavia, and also from South America.

Most of the studies aimed to change individual capacities (both student's and teacher's) based on the concept of digital competence. Studies with the aim to change HE (both small-scale and broad change) were primarily based on the concept of digital literacy. A majority of the papers aimed to develop the competencies of students at micro levels (individual, course, program) regardless of whether they used the term digital literacy (79%) or digital competence (62%).

Publications aimed at the micro level more often referred to the concept of digital competence whereas research aimed at meso- and macro levels more often used the concept of digital literacy. Digital competence dominates in teacher education, economics and to a small extent also in language and informatics. Digital literacy is exclusively used in health and artistic education. Future research in HE addressing digital literacy or digital competence needs to pay more attention to the origin of definitions.

The second bibliometric study highlights the concept of digital skills, this topic is developed by Rodríguez-García, Cáceres-Reche, & Alonso-García, (2018), one of the questions to be defined, in more detail, is if the concept of digital competence is a competence, is a skill, is an attitude, or is an ability, to define correctly what are the areas that make up digital competence.

The instructions of INTEF (2017), as well as the DIGCOMP project (Ferrari, 2013), indicate that the main areas that comprise the digital competence would be five: information and informational literacy; communication and collaboration; creation of digital content; safety and problems resolution; three of these digital competencies, are going to be the digital competencies that we are going to work on in the following chapters.

This second searching date, started in September 2017 and finished in October 2017, moment in which a second search was made to guarantee the inclusion of those results that, because of any casuistry, hadn't been present in the initial research. Three different searches were made joint together with the connector "and": "digital competence" and "teacher training"; "digital skills and "teacher training" and "digital literacy" and "teacher training".

At this point, it should be noted that no similar studies on this topic have been conducted, but the one presented here follows the line of other similar studies. The different tendency lines that show us the evolution of the research on the digital competence of the future teacher, affirm the existence of a research field totally in boom 2014-2017. It is, therefore, established as a powerful research line that concentrates the greatest number of its works in the last three years. In this line, it is worth mentioning the notable impulse that this research showed from the year 2009, when the published works began to multiply. Something that is not surprising, if we consider that in the year 2008 it was published the first instrument measuring digital competence by UNESCO, (2008) and only three years after, the indications given by Europe in its Recommendation 2006/962.

It is, therefore, not surprising that the citizens' digital competence, in general, and of the future teachers, in particular, has become an issue that has attracted the interest of several international agencies. In fact, the latest Horizon report (Adams et al., 2017) continues to mention digital competence as one of the outstanding topics in the field of Higher Education. Moreover, this scarce digital competence of the future professionals of different fields, affects and hinders the adoption of new challenges to adopt technology in the classrooms and in

the teaching-learning processes. Therefore, it is necessary to implement, in turn, methodologies that promote the acquisition of this series of competences. (Mingorance Estrada, Trujillo Torres, & Cáceres Reche, 2017).

The third bibliographic analysis is based on analyzing the relationship between digital competencies, teacher training and Higher Education. (Rodríguez-García, Aznar Díaz, Cáceres Reche, & Gómez García, 2019) , at the same time, in an attempt to define and clarify what was understood by digital competence, what were its indicators and in what areas was it composed. The DIGCOMP Project was launched by the European Union in 2010 (Ferrari, 2013). As a result, a European frame of reference for the development of citizen digital competence was born.

For this reason, when a teacher introduces himself to his students, he/she has a great responsibility, because his/her knowledge will become the reference element of the new generations to be trained in digital skills and competences. For this, a rigorous process of systematic review of the literature found in Scopus has been used from its creation until the year 2017. In this way, four different studies were established: "Digital competence " and " teacher training" (DCTT); "Digital skills " and " teacher training" (DSTT); "Digital competence " and " higher education "(DCHE); and "Digital skills " and " higher education "(DSHE). The year that has received the most scientific production on digital competence has been 2016, concentrating 30.36% of the publications analyzed. In turn, 2014 and 2015 stand out, and are in the second and third place. Thus, we note that most research production is concentrated in this area, especially in the period comprising the years 2014-2016, representing 63.4% of all research this subject.

The study of digital competence has become a landmark today, worrying national and international agencies. In fact, in the latest Horizon (Adams Becker, Cummins, Freeman, Hall Giesinger, & Ananthanarayanan, 2017) reported the formation of citizenship in this competence, as one of the challenges to solve for full integration and utilization of technological potential in the field of education, both for skills improvement of future and current teachers (Torres-Coronas & Vidal-Blanco, 2015) and for the implementation of new active learning methodologies based on the use of ICT (Aznar, Hinojo, & Romero, 2017); (Mingorance Estrada, Trujillo Torres, & Cáceres Reche, 2017).

The fourth bibliometric analysis is based on analyzing the need for new generations to become increasingly proficient with digital media, and education has been conceived as a main way to achieve this. It is therefore necessary to provide our future teachers, with the best possible training for the exercise of responsible citizenship in the education of today's people for the development of future digital competence, as pointed out by (Rodríguez-García, Martínez, & Raso, 2017) or (Spiteri & Chang Rundgren, 2017)

In order to carry out the research, first of all, four key words were delimited through ERIC Thesaurus that responded to our research objective: "digital competence" and "digital skills", as the crucial concept in this search, as well as "higher education", becoming the context of our research and, finally, "teacher training", as the specific concept that refers to future teachers.

The largest number of references retrieved came from the combination of "digital competence" and "Higher Education", followed by those references obtained through the combination of "digital skills" and "Higher Education". On the other hand, the combined search that yielded the fewest results corresponds to the descriptors "digital skills" and "teacher training."

On the other hand, the evolution of research on digital competence is represented in the following graph, in which we can see how the largest number of publications is concentrated in recent years, experiencing a significant growth from 2010 onwards.

The interest of this type of studies to generate a precise knowledge about the impact of a specific concept, process or term in the international scientific community, giving specific dyes to generate new research proposals related to this topic and becoming a relevant document for those others who wish to start in the research on digital competence in higher education and, more specifically, in the projection of the same with respect to future teachers. **(Table** 1).

Table 1. Previous papers about the state of digital competences and skills and Techniques in high education.

Authors	Research Questions	Techniques and temporal scope
(Spante, Sylvana Sofkova, & Mona Lundinand, 2018)	(1) How have the concepts digital competence and digital literacy been defined and used in HE research? (2) What are the implications of these concepts 'definitions and use for HE research?	Systematic literature review from 1997-2017
(Rodríguez-García, Cáceres-Reche, & Alonso-García, 2018)	What impact is the research about the digital competence of the future teacher having in the scientific world?, Who are the authors, institutions and countries studying this topic?, Is it a productive research line?, what language are the results published in?...	Bibliometric analysis from 2003-2017

(Rodríguez-García, Aznar Díaz, Cáceres Reche, & Gómez García, 2019)	In what year did one begin to study the digital competence? Has the study of this field grown? Is it a powerful research line? Who is investigating it? Where do they investigate it? What institutions seem specialized in this research topic?	A Bibliometric study through 2017
(Rodríguez-García, Trujillo Torres, & Sánchez Rodríguez, 2019)	What is the current panorama of research on digital competence in Higher Education? on digital competence in Higher Education, where are the main focuses of interest, has a focus of scientific interest been generated in knowing the digital competence of future teachers, is it a powerful line of research?	Bibliometric analysis from 2005-2017

Source: Own Elaboration.

One of the GAP that stands out is that most of the studies, are based on the development of digital skills training at the level of the teacher, and not from the point of view of the student, this GAP we developed. Another GAP found is that only digital literacy is based on arts and health education, and not on Higher Education. We analyze as main areas, the three digital competences that will be studied later. It is detected that there is a low digital competence of future professionals in different fields and how this fact affects and hinders the adoption of new challenges to adopt technology in the classroom and in the teaching-learning processes. The challenges to be solved for the full integration and use of the technological potential in the field of education, both for the improvement of the skills of future and current teachers.

One of the GAP that is discovered is, if the research on digital competence is being done on the future teacher and not on that future professional who will need to develop these competencies in their school, to apply them in their daily professional work. And the proposed this paper, is look for the methods that teacher will use to develop digital competencies for the future employers that they are students now.

The aim of this paper is to add the analysis of the digital competences or digital skills, only, related in Higher Education research proposing research questions:

1. In which knowledge areas have studies on Digital Competences/Digital Skills been conducted?
2. What are the most studied themes and what are their relationships to other themes?
3. What are the future Digital Competences have to developed in the future?
4. Are the digital skills of information and communication, collaborative work and digital content creation the skills that every student must master in order to apply them in the world of work?
5. Are these competencies developed during college?
6. Do the digital competencies developed in class encourage student engagement in their own learning?

To answer the first question, we use a descriptive to identify the journals and relevant authors, that the areas of knowledge in which Digital Competences/ Skills and Higher Education was applied. To answer the second question, we analyze the conceptual of the domain, creating a scientific map to detect different themes treated in the digital skills/competences and Higher Education. To this end, we use the bibliometric technique of co-words which allows us to reveal the main treatises in the field and helps us to discover to describe the interactions between the different fields of scientific research to show the main implications of the results of this research of that paper to digital competences/skills and their relation with University ecosystem agents.

2. Methodology

In order to proceed with the literature review, a detailed search of databases, standard documents and search criteria suitable for our study was carried out. **Table 2** shows the databases of selected data of the Web of Science (WoS), the type of documents and the search criteria that we have considered, we used three keywords to search all available in WoS until 2021. Once the search was completed, the sample was filtered to exclude publications that did not address our topic. The following keywords were selected in English and Spanish: “digital competences” and “higher education” or “digital skills”.

The search criteria established were original articles, and review articles in the period 1900-2021, for example, in journals like Mathematics or Literature, the “digital competence or digital skill “ that appear in the keywords articles published in the journal, refers to other issues not relates to subject review, a sample of 843 articles was remained.

The final sample consisted of 1.144 articles; in a first time, a descriptive analysis was for the main areas of knowledge, the journals and authors. Subsequently, an analysis of the co-words was using the bibliometric software VOSviewer to identify the studied themes. If we compare this program with others, we can highlight that it is used in the elaboration of bibliographic maps, and also, that program pays attention to a graphical representation of them therefore its functionality is the most useful to show easily and quickly the interpretation of these biometric maps. (Van Eck & Waltman, 2010).

Table 2. Search protocol

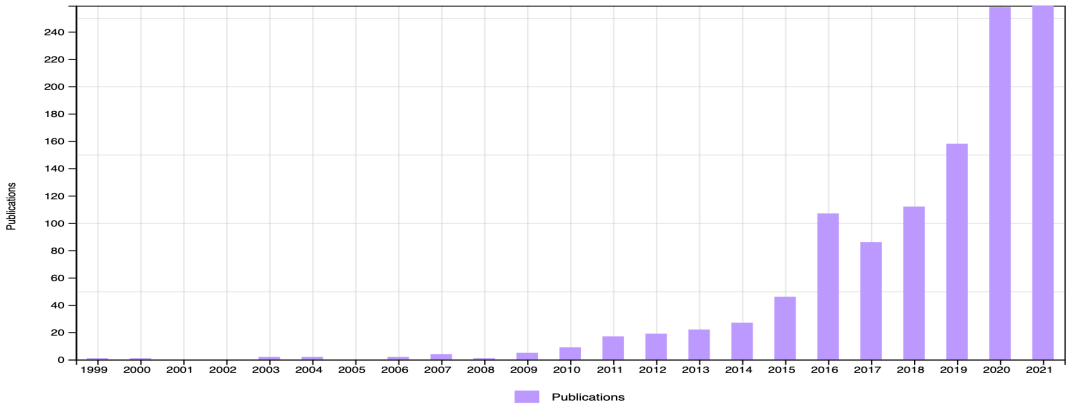
	Period	Type of document	Search criteria	Keywords
Web of Science(WoS)	Through August 2021 (between 2017-2021)	Articles Review articles	Theme	"digit* competenc*", "digital skills" "higher education"

Source: Own Elaboration.

3. Results

Fig 1. shows a frequency analysis of the number of articles per year. The first article on this subject dates from 1999; from 1999 to 2009, the number of articles is low, 2010 to 2015, there is moderate growth, but in 2016, the number of articles increased, 107 articles were published, and finally, **between 2017 and August 2021**, the number of publications increases exponentially increases, with the highest ratio of publications being generated in the year 2021 (this sample was analyzed in August 2021).

Fig. 1. Number of publications per year



Source: Own Elaboration.

3.1. Journals and knowledge areas

The results show that the research on Digital Skills / Digital Competences and Higher Education is versatile. The proof in is the variety of journals that publish articles on Digital Skills / Digital Competences. **(Table 3).** The journal with the largest number of publications on the Information Communication Society (20 articles), the second is Computer & Education (18 articles).

On the basis of the Citation Journal Category (JCR) to which they belong, the majority of journals are in the field of Communication, Computer Science, and Education Educational Research.

Table 3. Journals, ranking JCR and Expertise Areas.

Journal	Ranking and Category, JCR	Knowledge Areas	Number of papers
Sustainability	Q2 (ENVIRONMENTAL SCIENCES- SCIE) Q2 (ENVIRONMENTAL STUDIES-SSCI) Q3 (GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY-SSCI)	Environmental Sciences Ecology/ Geography/ Sciences Technology Other Topics	36
Information Communication Society	Q1 (COMMUNICATION , SOCIOLOGY-SSCI)	Computer Science/Communication	20
Computer & Education	Q1 (COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS-SCIE) Q1 (EDUCATION & EDUCATIONAL RESEARCH-SSCI)	Education Educational Research/ Computer Science	18

Information Communication Society	Q3 (COMMUNICATION- SSCI)	Behavioral Sciences	13
Computers in Human Behaviour	Q1 (PSYCHOLOGY, EXPERIMENTAL- SSCI) Q1 (PSYCHOLOGY, MULTIDISCIPLINARY- SSCI)	Phychology	11
Telecommunication Policy	Q2 (COMMUNICATION- SSCI) Q2 (INFORMATION SCIENCE & LIBRARY SCIENCE- SCIE)	Information Science Library Science	8
Information Communication Society	Q1 (COMMUNICATION , SOCIOLOGY-SSCI)	Social Issues	8
Technology in Society	Q1 (SOCIAL ISSUES, SOCIAL SCIENCES, INTERDISCIPLINARY- SSCI)	Social Sciences Other Topics	6
Economics-The Open Access Open-Assessment E-Journal	Q4 (COMPUTER SCIENCE, ECONOMICS- SSCI)	Business Economics	4
Behaviour & Information Technology	Q2 (COMPUTER SCIENCE, CYBERNETICS - SCIE) Q2 (IERGONOMICS- SSCI)	Engineering	3

Source: Own Elaboration.

Table 4 lists the main authors and their expertise. Two of the authors with the largest number of articles are Van Deursen, Alexander J.A.M. with 18 articles and De Haan J., with 11 articles, and they belong to the area of Behavioral Sciences, Communication and Social Sciences.

Table 4. Authors and Expertise Areas.

Authors	Expertise Areas	Number of papers
Van Deursen, Alexander J.A.M.	Behavioral Sciences/ Communication/Social Sciences Other Topics	18
De Haan J.	Social Sciences Other Topics /Behavioral Sciences/ communication	11
Van Dijk Jan A.G.M.	Computer Science/Information Science Library Science/ Behavioral Sciences/ Education Educational Research	10
Eyron R.	Behavioral Sciences/ Comunication/ Education Educational Research/ Computer Science	9
Guillen-Gamez, F.D.	Education Educational Research/ Social Sciences Other Topics	9
Perez-Escoda, A.	Education Educational Research/ Communication	9
Cabero-Almenara, J.	Education Educational Research/	7
Claro, M.	Education Educational Research/Communication/Computer Science/Behavioral Sciences/	7
Vazquez-Cano, E.	Education Educational Research/Computer Science	7
Gisbert-Cervera, M.	Education Educational Research/ Psychology	6
Livingstone, falta inicial	Communication/Behavioral Sciences/ Social Sciences Other Topics/Computer Science	6
Muñoz-Repiso, Ana G.V.	Education Educational Research	6
Palacios-Rodriguez, A.	Education Educational Research	6

Van Laar, E.	Behavioral Sciences/Computer Science/ Psychology/ Social Sciences Other Topics	6
Belmonte J.L.	Education Educational Research/Information Science Library Science/Psychology	5
Garcia-Ruiz, R.	Education Educational Research/Communication/Social Sciences Other Topics	5
Helsper, E.J.	Communication/Behavioral Sciences/Computer Science/ Social Sciences Other Topics	5
Hinostroza, J.E.	Education Educational Research/Computer Science/Engineering	5
Labbe, C.	Education Educational Research/Computer Science/ Engineering/ Communication	5
Mayorga-Fernández, M.J.	Education Educational Research	5
Sanchez, S.P.	Education Educational Research	5
Aguaded, I.	Education Educational Research/ Communication	4
Blayone, T.J.B.	Education Educational Research/ Communication/Computer Science/ Engineering	4
Cabrera A.F.	Education Educational Research/ Information Science Library Science/Psychology	4
Correa T.	Communication/Behavioral Sciences/Social Sciences Other Topics	4

Source: Own Elaboration.

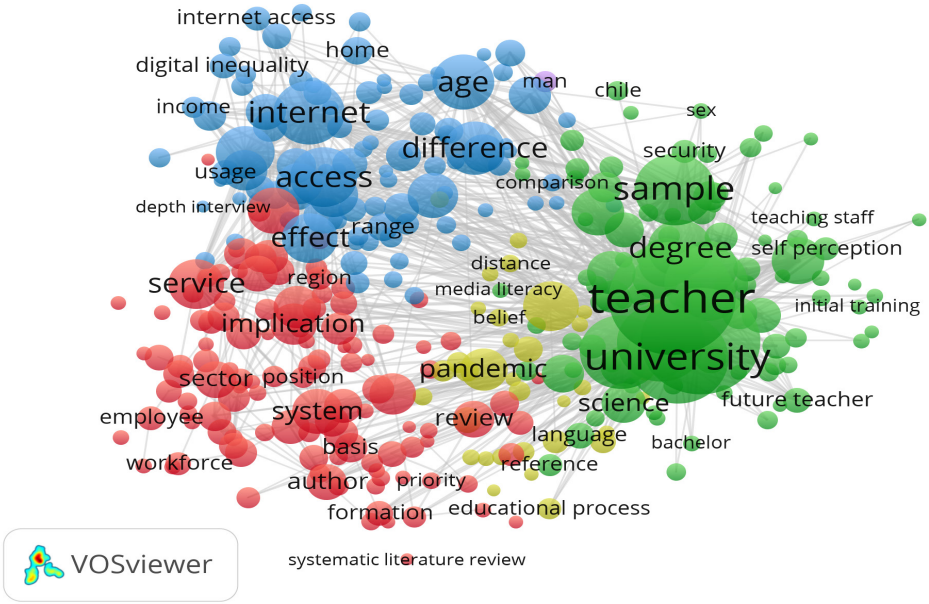
3.2. Themes in the literature on Digital Skills / Digital Competences

The analysis of co-word was used to analyze them with a minimum frequency of two. In addition, a matrix of co-occurrences and an index were calculated, the single centers algorithm has been applied to determine subgroups of keywords which present strong associations, this reflects the interest of the researchers.

On this basis, thematic networks have been established, density and their centrality have been calculated, and a strategy has been created which groups the themes into different typologies. In the figure, the size of the circle around a represents the number of articles that include that term.

Based on the results shown in **Fig. 2**, an analysis of the main themes was performed. Considering the typology of the literature on digital competence/digital skills and High Education, we grouped the themes into four cluster: main topics and knowledge areas **(Table 5)**.

Fig.2. Strategic Diagram for 1999-2021



Source: Vos Viewer. Own Elaboration.

Table 5. Proposed grouping of themes.

Main topics	Thematic Subnetwork- related themes	Number of papers
Teacher	digital competence, university, collaboration, instrument, teacher training, degree, sample, subject, questionnaire, variable, content creation, test, strength	248
Internet	access, difference, person, effect, population, engagement, individual, user, young people, age, home, internet use, risk, gender	319
Service	Understanding, theory, worker, employer, formation, literature, understanding, implication, system, gap, critical thinking, design methodology approach, organization.	65
COVID	Pandemic, reflection, distance, average, reflection, crisis, student perception, belief, necessary digital skills, principle, lesson.	89

Source: Own Elaboration.

4. Discussion

4.1. Expertise areas

Based on the descriptive analyzes, it can be seen that there are several areas of knowledge in which digital skills/competences and Higher Education studies have been conducted. In the areas of Educational Educational Research, Computer Science, Communication, Information Science Library Science, Psychology, Social Sciences Other Topics, the journals approach the topic of Digital Competences/ Digital Skills and Higher Education by proposing, among other aspects, analyze the existing research on digital competence in higher education settings (Zhao, Llorente, & Gómez, 2021).

The digitalization of Higher Education Institutions (HEI), due to the impossibility of face-to-face classes and tutoring, caused by COVID-19, evidenced the need to rethink opportunities and obstacles for the development of digital skills among students (Monteiro & Leite, 2021), therefore, Digital skills are thought to be a key competence of the twenty-first century.

With the rapid growth of internet and communication tool (ICT), usage among both students and teachers, (Heuling & Schulze, 2020), Digital competence is part of the competencies that characterize the current professional profile of Higher Education teachers (Cateriano-Chavez, Rodríguez-Rios, Patiño-Abrego, Araujo-Castillo, & Villalba-Condori, 2021).

Regarding journals in areas such as Business Economics Social Issues and Social Issues, various articles mention the relationship between digital skills/competences and their analysis on Higher Education Institutions and the situation of COVID-19.

The need to develop digital competences has long been emphasized, but only in the state of emergency due to COVID-19, it has become a real necessity (Mietule, Litavniece, Lonska, & Burova, 85-102); Higher Education Institutions (IES) are in the urgent need to transfigure their educational policies and their teaching - learning models (Casco López, 2018). College students are often assumed to be digitally fluent as they are digital natives, owing to their exposure to digital technologies from an early age. Furthermore, it is assumed that this digital competence is likely to prepare them for learning in college, (Kim, Hong, & Song, 2019).

4.2. Main Themes

The results obtained allow us to present a more complete strategic map from 1999 to 2021 with 49 themes by number of papers that show a more detailed picture of the research field. Additionally, a new grouping of themes is proposed that identifies four categories: **Teacher (colour green), internet (colour blue), service (colour red), and COVID (colour yellow),** (Table 5) that facilitates the analysis and interpretation of the results. And, for the main themes, subnetworks are analysed to identify the relationships between different themes **(Table 6).**

Table 6. Thematics subnetworks for the main topics

Main topics	Thematic Subnetwork- related themes
Teacher	digital competence (356), university (325), collaboration (76), instrument (63), teacher training (175), degree (114), sample (117), subject (63), questionnaire (175), variable (12), content creation (42), test (59), strength (7)
Internet	access (196), difference (21), person (18), effect (68), population (83), engagement (78), indiviadual (89), user (56), young people (76), age (164), home(54), internet use (217), risk (44), gender (113)
Service	Understanding (98), theory (64), worker (5), employer (6), formation (36), literature (99), implication (4), system (109), gap (79), critical thinking (25), design methodology approach (50), organization (27).
Covid	Pandemic (79), reflection (23), distance (48), average (32), crisis (23), student perception (22), belief (7), necessary digital skills (98), principle (3), lesson (4).

Source: Own Elaboration.

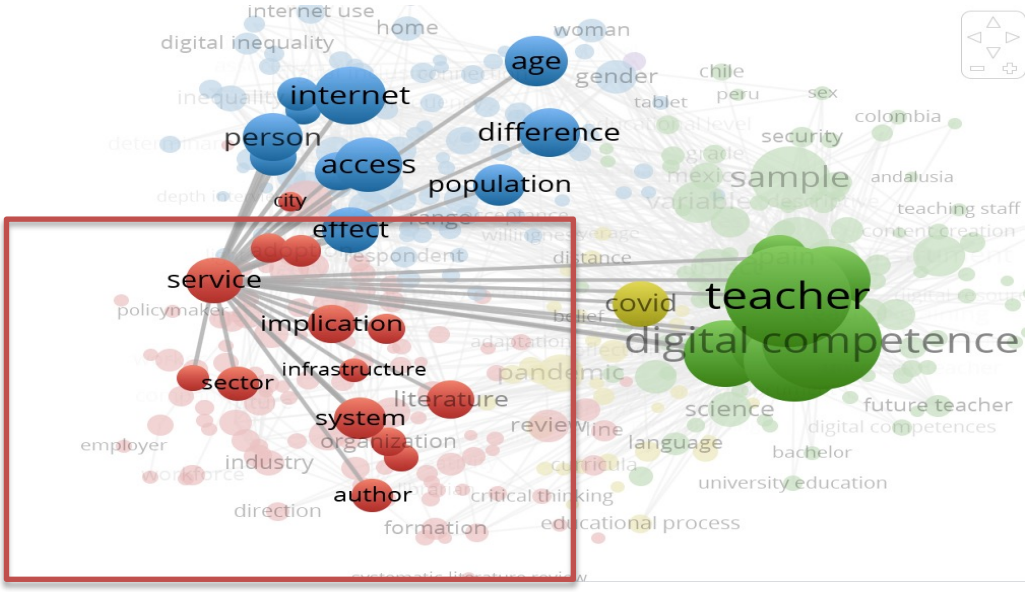
Some authors highlight the wider application of open to several disciplines, Tømte et al. (2015) uses the definition by Krumsvik (2011), to define digital competence as "the teachers' proficiency in using ICT in a professional context with good pedagogical-didactical judgement and his or her awareness of its implications for learning strategies and the digital Bildung of pupils and students. Scuotto & Morellato (2013) refer to Calvani, Cartelli, Fini, & Ranieri (2008) when defining digital competence as "the ability to explore and face new technological situations in a flexible way, to analyze, select and critically evaluate data and information, to exploit technological potentials to represent and solve problems and build shared and collaborative knowledge, while fostering awareness of one's own personal responsibilities and respect of reciprocal rights/obligations". Furthermore, Cazco, González, Abad, Altamirano, & Mazón,(2016) by referring to Porlán Gutiérrez (2011) defines digital competence as "values, beliefs, knowledge, capacity and attitudes to use technology in an adequate way, including computer as well as different programs and Internet, which allow for the possibility of research, access, organization and the use of information to produce knowledge".

In that sense, Antonio Rodriguez et Al, refer that the research of the greatest impact on digital competence of the **future teachers**, the study of the digital competence in this population has become a powerful research line today, given the need to train highly capable teachers with regards to digital issues (Rodríguez-García, Martínez, & Raso, 2017).

One the clusters or category is **Service**, refers to the results show deficiencies in the use and application of digital tools, and there are also areas of opportunity that allow the adequate incorporation of TIC in the educational program. (Hernández, G. Gómez Zermeño, & Zambrano Izquierdo, 2015). In Higher Education, students have the opportunity to build and develop various skills, including technological, (Rodrigues, Machado-Taylor, Cerdeira, & Alves, 2021), students make of the smartphone, their preferences regarding the use of the device for learning and the importance of the playful dimension of m-learning in the intention of adopting this model, an aspect that not many researches in the field highlight, but that - conveniently used by teachers - can be a great opportunity for its implementation (Dafonte-Gómez, Fabián Maina, & García-Crespo, 2021) use of ICT by students in the learning process, to establish their motivation for improving the skills of digital literacy, in order to enable them not only to raise their academic results, but also to provide students the opportunity to be successful in society without

lag behind the ever-changing demands of work and life. (e.g., Shopova, T, 2014), being an area to be analyzed in the future.

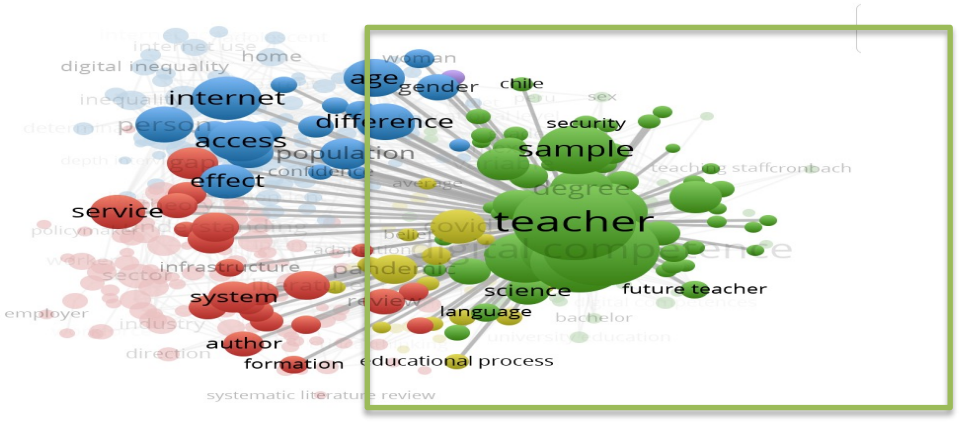
Fig. 3. Thematic network for the term "Service". (red colour)



Source: Vos Viewer. Own Elaboration.

Another cluster is the teacher, digital competence is part of the competencies that characterize the current professional profile of Higher Education teachers (Cateriano-Chavez, Rodríguez-Rios, Patiño-Abrego, Araujo-Castillo, & Villalba-Condori, 2021). The results point to the need to enhance the main aspects such as the digital competencies of the teacher, (Tejedor, Cervi, Pérez-Escoda, & Jumbo, 2020), the design and application of an instrument as a tool for self-evaluation of technological management in teachers, (Gómez, 2017) . The digital tools that teachers use, influence what we teach, how we teach and how our students learn; therefore, we can affirm that teachers help students to develop competencies by integrating knowledge, skills, abilities, skills, strategies, attitudes and values, (Bocconi, Chioccariello, Dettori, Ferrari, & Englehardt, 2016).

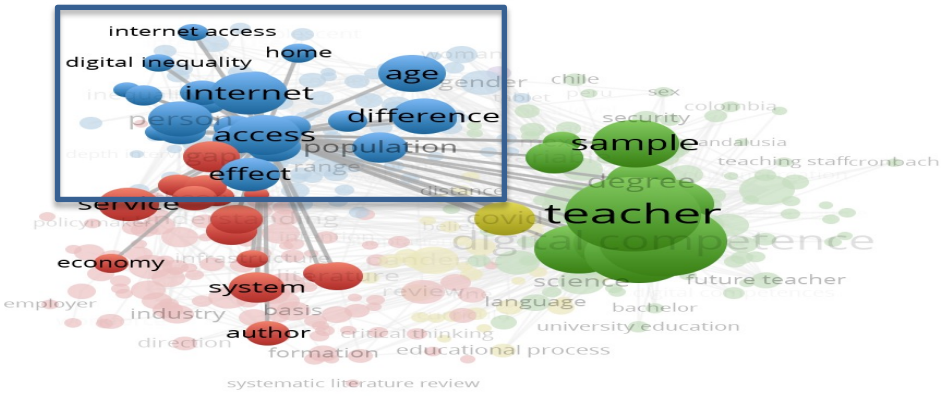
Fig. 4. Thematic network for the term "Teacher". (green colour9



Source: Vos Viewer. Own Elaboration.

The next cluster Internet refers to the factor that has given a definitive turn to all professions and society in general, this has led to the emergence of a hyperconnected society and a global economy. For the same reason, professionals have had to train their digital skills to be competitive in the new global era, (López & Catasús, 2015), related to this, when students arriving for the first time at the University, despite belonging to the digital era, have serious weaknesses in digital skills, in the use of internet tools analyzed (Liesa Orús, 2016), instead, young people use the internet and digital devices efficiently for entertainment and communication activities. In contrast, the digital skills developed with their peers are transformed and developed to a greater degree, when they participate in academic work, (González & García, 2017).

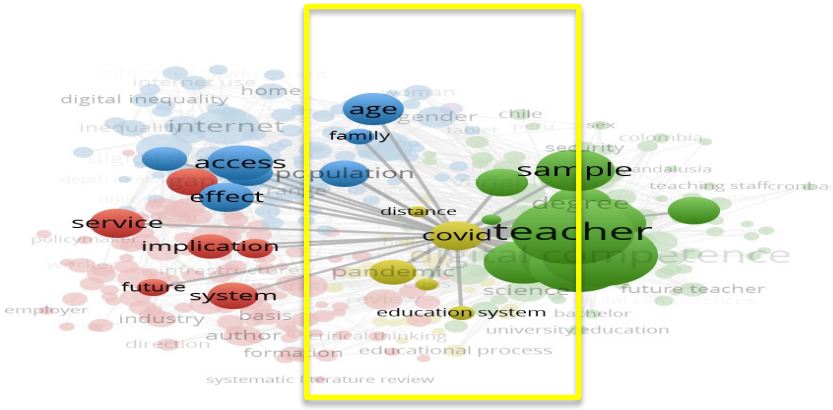
Fig. 5. Thematic network for the term "Internet". (blue colour)



Source: Vos Viewer. Own Elaboration.

The latest group the COVID-19 pandemic, the assessment of digital competence in Higher Education requires more attention, (Sillat, Tammets, & Laanpere, 2021); after the emergence of the Coronavirus (Covid-19) and with its huge impact on the education industry, the concern for digital competence has reached a new height, (Zhao, Llorente, & Gomez, 2021). Learning in higher education and reinforcement of the main topics for this digital transformation, mainly takes place through communication, teaching and digital competencies, During the COVID-19 crisis, it was found that digital informal learning is important for students' academic engagement during classes, (Heidari, Mehrvarz, Marzooghi, & Stoyanov, 2020) and it was found that the pandemic brought an acceleration in the digitization of education and forced teachers to adjust their teaching effectively and quickly. (Damsa, Langford, Uehara, & Scherer, 2021).

Fig. 6. Thematic network for the term "COVID". (Yellow colour)



Source: Vos Viewer. Own Elaboration.

5. Future trends

The preceding research has shown some future trends, for example, Rodríguez-García, Aznar Díaz, Cáceres Reche, & Gómez García, (2019) , show that the study of digital competence has become a milestone nowadays, pointing out the need to develop this competence in citizenship and its use of the technological in the field of education, both improving the skills of future and current teachers and implementing new active learning methodologies on the use of ICT for future students and professionals.

Digital competence predominates in teacher training, in economics studies and, to a lesser extent, also in language and computer science, being analyzed exponentially, in health and arts education. In this context, Spante, Sylvana Sofkova, & Mona Lundinand, (2018) find that most works are aimed at developing students' competencies at micro levels (individual, course, program), regardless of whether they use the term digital literacy (79%) or digital competence (62%).

Digital literacy is defined as the individual's capabilities to live, learn and work in a digital society; in addition, capabilities with respect to communication and collaboration; also, studying and learning to use digital tools and media to make informed decisions and achieve goals, all of them, is closely linked, according to the studies, to different perspectives, from technical "know-how", through cognitive skills, to social practices and proactive engagement with digital content in class; in addition, it is usually accompanied by other concepts such as: professional development, education, ICT, among others, (Rodríguez-García, Trujillo Torres, & Sánchez Rodríguez,

2019). This makes it a relevant document for those who wish to initiate research on digital competence in higher education and, more specifically, in the projection of the same with respect to future teachers and consequently, future students.

Education for sustainable development in the future, will not only have, to prepare students for international, interdisciplinary and digital environments, but will also have to meet the expectations of demanding and ambitious students and offer them bright career prospects. (Shanti Jagannathan, 2019) offer insights into the changing dynamics of the labor markets of the future and the importance of not only the content of skills development and training, but also the mechanisms that will be dispensed with to prepare a future-ready workforce. Key attributes possessed by that globally relevant talent pool for the workforce of the future include basic digital skills and literacy, learning skills, skills needed for the greening of economies, skills required to engage in Industry 4.0 occupations skills for infrastructure and service generation, skills for technology-driven manufacturing sectors, and general soft skills that help improve in the workplace, such as teamwork skills, problem solving, creativity design. All of these will have a major and far-reaching impact on the future directions of technical and vocational education and training in the region that policies and practitioners need to take into account.

In terms of the skills considered to be most needed to be developed in Higher Education in the future, "Adapt my search strategy to find the most appropriate information and content in digital environments", "Share information and content using a variety of digital tools" were highlighted, "Manipulate information to facilitate its organization, storage and retrieval", and "Use and select appropriate digital technologies to interact", students considered these technological competencies to be crucial in the digital world and in the labor market of the future (Rodrigues, Machado-Taylor, Cerdeira, & Alves, 2021). Technologies are useful at the organizational level, for time management, dissemination and promotion of knowledge and problem solving, and allow for increased efficiency, greater connectivity and communication, information management, remote work and adaptation to a constantly changing world. It is also important for HEIs at the organizational level, insofar as the digitization of teaching and learning is beginning to change the economics of Higher Education and the organization of academic work, as it is not simply a change in the way teaching is delivered from face-to-face to online or blended, but has the potential to transform Higher Education, the organization of academic work and the relationships between students, professors and their institutions.

One area to develop is to know what technological competencies students build and develop in Higher Education, the different needs and uses in the different areas of competence, in order to promote their balanced development in the future in each of the areas and to reflect on new ways of teaching and learning with quality in Higher Education.

Certainly, social distancing policies have forced students and professionals to rely more and more on digitally mediated communication. The fundamental technology-related attitudes and personal-cultural dispositions of those entering the workforce will have a profound influence on their adaptation to the "new normal." e.g., the use of collaborative robots, advanced human-machine interfaces, a variety of wearable devices, big data analytics applications, and augmented and virtual reality systems. In the short term, this may require some initiative and self-study, as even mainstream digital skills models, such as the EU digital skills framework (Lopez_Meneses, Sirignano, Vazquez-Cano, & Ramirez-Hurtado, 2020) have not yet considered the full force of these emerging technologies. Nor has it considered, a variety of basic and advanced technical skills that remain vital to worker readiness, such as enthusiasm for technology and interest in collaborative learning that must be recognized as key attitudes that support the continuous professional development requirements of dynamic, digitized work (Blayone, Usaca, Mykhailenko, & Romanets, 2020).

5.1. Theoretical and practical implications

The results show that the 21st century skills are broader than the digital skills, the list of mentioned is much more extensive. Moreover, unlike digital skills, the skills of the century are not necessarily underpinned by ICT. Seven core competencies have been identified: technical, information, communication, collaboration, creativity, critical thinking and problem solving. Five contextual skills were also identified: ethical awareness, cultural awareness, flexibility, self-direction and lifelong learning. ((Van Laar, Van Deursen, Van Dijk, & de Haan, 2017), determining detailed skill indices related to the differences in working professionals' digital skill levels.

Digital Skills and Digital Competence initiatives and discussion have been observed in new areas: Internet of Things(IoT), like IoT attitudes and material access as well as educational and income differences play an important role. Those with higher education and those with higher incomes have more positive attitudes. This also means that they are the first to develop the required skills and to engage in a diverse IoT use.

Potential determinants that can be influenced by stakeholders are also included, such as social support and training, 21st-century digital skill is explained by a different set of determinants, thereby requiring unique approaches for the development of each skill. (Van Laar, Ester, Van Deursen, Alexander J. A. M., van Dijk, Jan A. G. M., de Haan, Jos, 2019).

Examine the relationships between Internet skills and digital engagement (Helsper & Eynon, 2013) demonstrate that social structure remains an important factor in understanding patterns of uptake and outcomes of online learning, alongside an individual's agentic behaviors, (Eynon & Malmberg, 2021).

During the lockdown globally imposed for the COVID-19 pandemic, educational systems worldwide had to face many disruptive changes, the teacher's digital skills, sources for learning that may be adapted, communication between universities and students, and teaching methodologies that should be appropriate to the current context, may suggest rethinking Higher Education learning and reinforcing main issues for this transformation, mainly: communication, teaching, and digital competences (Tejedor, Cervi, Pérez-Escoda, & Jumbo, 2020).

The relation between communication and education are intertwined to offer specific contributions: communication addressed in the educational field, journalism in the classroom and transmedia skills, social networks as spaces for communication and education, for example, the use of Twitter and Instagram in an educational context, bots, misinformation, rumors and digital skills; new connected generations, and emerging actors in communication and education: youtubers, OTT platform gamers and family responsibility. (García-Ruiz & Pérez-Escoda, 2020).

6. Conclusions

Our results show that research interest in digital competencies and Higher Education is comparatively new, and that the topic has been studied in a wide variety of knowledge areas. In addition, we present a map of the main themes that have been grouped into three categories. The functions of competencies are extensive, but their multidisciplinary nature makes the context complex and diverse, which opens up many future avenues of research.

In that sense, the results of our article allow us to answer the research questions, such as the digital competencies that should be studied by students, the common themes that are developed and in which they can observe in the bibliometric study. These competencies that should be developed in the future are those related to future work and not only with the technological part but also, the area of continuous learning, or learnability, information and communication, collaborative work, and creating content based on critical thinking and problem solving. It is these competencies that must be developed in the classroom and teachers must use methodologies that imply a commitment to learning and further development of these skills in order to adapt to a new work environment.

The results of this article support the idea that digital / digital has enormous potential and benefits researchers, states, citizens, workers and other stakeholders.

The new need of the society that has been created in the digitalis era, where all citizens and, in particular, future teachers have to acquire a set of skills and abilities that allow them to actively and accurately develop in the knowledge society. It should be noted that some references are indexed in more than one field, although, as can be seen, research in Social Sciences predominates, followed by Computer Science.

Digital competence is at the center of several national papers and trends as a key competence and competence in a knowledge-intensive economy the digital transformation of society. (Sillat, Tammets, & Laanpere, 2021) explain that due to the pandemic of COVID-19, competence has become even more important to understand the use of digital in educational settings. In addition, we need to understand the digital competence of educators to support their professional development and, consequently, the quality of education migrating toward more online teaching and learning. Research has revealed that the relationship between emerging technologies and barriers faced by educators integrating technology is evident and requires further analysis.

The results also showed that students recognize the great importance of digital competencies and consider it very important to address future-oriented topics and content. Interestingly, students seemed skeptical of online course formats and the digitization of teaching, and clearly preferred the interactive classroom experience after the pandemic period (Bruderman, Aschemann, Füllsack, & Posch, 2019).

The study has some limitations: the scope of the research depends on the documents available in WoS, and to maintain rigor, we selected only journal articles. Future studies may use complementary bibliometric techniques (i.e., co-citation analysis, co-author analysis, and bibliographic linkage) and consider other databases (Scopus, Google Scholar...) to describe the intellectual structure of the research field.

7. Acknowledgements

I thank my doctoral directors; this article is part of the thesis Digital Competencies as a Determinant Factor in Higher Education.

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