A Systematic Review of Digital Competence Evaluation in Higher Education

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Abstract: University students' digital skills depend significantly on educators' proficiency, necessitating regular assessments. Tools like DigComp and the TPACK model are provided in this technological context. A systematic review, following PRISMA criteria, aims to evaluate digital competencies through globally used tools. DigCompEdu is prominent, with Spain leading the research, while unvalidated instruments from Asia highlight global disparities. This review will identify key tools and expose geographical and validation gaps, stressing the need for standardized assessments. Understanding the predominance of DigCompEdu and seeing the variation that is generated in Asia highlights the poor ability to transmit self-perceived competencies to learners.

Keywords: higher education; teacher evaluation; information technology; ICT; digital literacy

1. Introduction

With the appearance of technology and computers, a great revolution in society was generated, as they have changed the nature of people, since a large part of everyday activities such as leisure, conversations or even obtaining basic needs such as work is carried out through an electronic device [1]. Specifically, it is important to mention Generation Z, which is conceived as a digital native generation, as this generation includes people born between the mid-1990s and the mid-2000s [2]. It is understood that this generation and the following ones are within the generations of digital natives, and it is assumed that they are accustomed to the use of technology.

Faced with this reality, where the new generations should be more accustomed to the use of technology, it is shown how, with the passage of time and the development of digital tools, the problems associated with them increase. Thus, problems such as sexting have arisen [3]. Therefore, despite the fact that these generations are considered digital natives, it is necessary to generate specific knowledge about digital competence and the digital competence that teachers have to train their students [4].

1.1. Most Common Tools for the Analysis of Digital Competence

Thus, a need has emerged that extends beyond the current technological landscape and can no longer be explained solely by teachers' preferences or concerns. There is now a necessity for teacher training to include specific instruction in technological and pedagogical development through ICT, along with the ability to effectively convey this knowledge.

As a result, numerous theoretical studies have been conducted, focusing on identifying which digital competencies exist, how they should be addressed, and how teachers should approach them.

One of the reference models on digital teaching competencies is the TPACK model [5]. This model bases its construction and theoretical identity on three key components, which are the crossings that occur during the management of the teaching–learning process. Thus, the model starts with the technological knowledge that generates interaction, together

with the knowledge of the contents of the subject and pedagogical knowledge [6]. This model, comprising three fundamental elements that are intertwined, has the advantage that each of the elements can be evaluated independently, with each of the elements being able to evaluate the limitations of each of the teachers and able to make individualized adaptations [7].

This model has been particularly relevant in higher education, as university instructors generally possess knowledge of the course content they are expected to teach. However, their knowledge of technological development and even pedagogical content is often limited, presenting both a challenge and an opportunity for improvement [8]. This model is considered one of the most comprehensive theoretical frameworks, as it addresses all the key aspects in designing a teaching program for a course. However, the main issue with this model is the absence of an instrument that evaluates each area separately, which poses a limitation when using the model in research. As a result, various organizations have focused on creating and validating instruments that assess each element individually. This research, in particular, will focus on the area of digital competencies.

To assess teachers' digital competencies, we begin by highlighting the DigComp instrument, which focuses on evaluating digital competencies within society and outlines the skills to be acquired at a general level. DigCompEdu, on the other hand, is specifically tailored for teachers [9]. This instrument was developed by the European Joint Research Center (JRC) and has been widely used across European Union countries, demonstrating its effectiveness in evaluating both current and future teachers [10].

However, the instrument has not been limited to use within the European Union. Several studies conducted in Latin America have also employed this tool. Its translation into Spanish has facilitated its application in Spanish-speaking countries, as evidenced in works such as [11–13].

Within the instrument itself, six constructs are generated:

1. Professional Commitment.
2. Digital Resources.
3. Teaching and Learning.
4. Evaluation and Feedback.
5. Student Empowerment.
6. Facilitating learners' digital competence.

According to the theoretical framework of reference, these are grouped into technological competencies, comprising dimensions 1 and 2; pedagogical dimensions, comprising 2, 3, 4 and 5; and a last grouping referring to the ability to transmit knowledge and to train students at different points, with dimensions 5 and 6 belonging to this category.

However, these two theoretical frameworks have inspired the development of national reference frameworks through their adaptation in various countries. In Spain, the INTEF (part of the Spanish Ministry of Education) created the Common Framework for Digital Competence for Teachers, which is a translation and adaptation of the DigCompEdu framework. In Colombia, the framework takes on a more holistic approach, encompassing knowledge, classroom management, and research.

The final instrument to be highlighted in this section is the NETS-T, a reference framework developed in Chile. It shares many similarities with the previously mentioned instruments, particularly the Colombian framework [14]. However, this framework emphasizes a crucial aspect of digital competencies: professional responsibility. It underscores the idea that the training of students and the responsible use of technology are not solely individual matters. Instead, teachers must be committed to providing quality training and ensuring the appropriate use of technology.

1.2. Background Information

In relation to the present research, it is important to note that most studies are primarily focused on investigating teaching competencies rather than digital competencies [7,8,14–16].

This means that in reviews on teachers' digital competencies, there is always mention of different questionable aspects of the different investigations. Thus, Ref. [17] looks for articles that have raised the idea of improving digital competencies through interventions, although the study itself mentions the idea of not being able to compare the results because each of the studies presents a different tool without having established a specific time frame.

Similar findings are reported by [18], who focus on analyzing the influence of research on the topic through a comparative study between countries. Their results highlight two key points that are particularly relevant to the present study.

Firstly, they note that Spain has the highest level of production in this area, and thus exerts the greatest influence. This influence is especially significant given that most of the research centers around the DigCompEdu framework. After its translation, Latin American countries have adopted this framework as a reference, further demonstrating Spain's scientific impact. However, despite this, the review also identifies a major issue: the lack of a standardized tool for assessing digital competencies, which complicates cross-country comparisons.

Seeing how research on the subject is being developed, this revision aims to conduct a specific search for teacher evaluation tools. In particular, we focus on university teachers, as, in the context of education, where teachers themselves are the educational researchers, this is considered a valuable first approach to establishing new research.

RQ1. *How many articles have been published in WOS and SCOPUS that assess the digital competences of higher education teachers?*

RQ2. *Which are the journals with the most publications on the subject and which are the most cited authors?*

RQ3. *What evaluation systems are being used to assess the digital competences of university teachers?*

RQ4. *What is the most common tool for the assessment of teachers' digital competences?*

RQ5. *Which aspects of digital competences are less developed in higher education teaching staff?*

2. Materials and Methods

For the development of the systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) systematic review guide was used, in which 27 indicative points are generated [19], thus establishing a replicable research methodology through a checklist in which, if the steps introduced are followed systematically, they generate knowledge based on evidence and with great transparency from questions explicitly written in the articles selected [20].

2.1. Eligibility Criteria

For the present review we focus on the assessment of the digital competence of teachers in higher education institutions worldwide. For this purpose, and with the intention of carrying out scientifically relevant research, the review is carried out in the Web of Science and Scopus databases due to their relevance at a scientific level. Specifically, a search equation is used in which three key terms are used, Higher Education, Teaching assessment and Digital competences, collecting the terms in the ERIC Thesaurus, the European Education Thesaurus and the UNESCO Thesaurus, resulting in the following formula: ("Higher Education" OR "Higher Education Institutions" OR "College Curriculum" OR "College Programs" OR "Universities" OR "Graduate Study") AND ("Digital Literacy" OR "Computer Literacy" OR "21st Century Skills" OR "educational technology" OR "technology" OR "computer" OR "media technology" OR "new technologies" OR "technological education") AND ("Teacher Competencies" OR "Competencies" OR "Competency based" OR "Competency Based Teacher Education" OR "Teaching Skills" OR "Teacher Competency Testing" OR "Teacher Evaluation") (Tables 1 and 2).

Table 1. Keywords and key terms.

Key Term	Thesaurus Keywords
Higher Education:	"Higher Education" OR "Higher Education Institutions" OR "College Curriculum" OR "College Programs" OR "Universities" OR "Graduate Study"
Teacher evaluation	"Digital Literacy" OR "Computer Literacy" OR "21st Century Skills" OR "educational technology" OR "technology" OR "computer" OR "media technology" OR "new technologies" OR "technological education"
Digital Competencies	"Teacher Competencies" OR Competencies OR "Competency based" OR "Competency Based Teacher Education" OR "Teaching Skills" OR "Teacher Competency Testing" OR "Teacher Evaluation"

Table 2. Table of inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria	Justification
Subject area Educational Research in WOS and Social Sciences in Scopus	Any other area collected within the databases	This criterion is established because the aim is to conduct research focused within the educational context. Therefore, articles outside of these disciplines are not included, as studies focused on digital competencies from a more technical or technological perspective are excluded.
Publications since 2019	Publications before 2019	The year 2019 is established as a reference year because during this year, DigCompEdu began to collect samples from all over Europe for the validation of the instrument and its subsequent publication. In 2020, the publication of DigCompEdu was established, followed by the validation publication in 2022. Therefore, 2019 is a key year to observe how research develops, highlighting the importance of this tool within a European and global context.
Articles	Conference, symposium, book, book chapter, etc.	Articles are currently the most relevant type of publication, which is why, due to the databases selected for their scientific impact, it is understood that the present research has high-quality references.
Included in open access journals	Not included in open access journals	To ensure the reproducibility of the article, this criterion is established in a way that there are no limitations on access to the articles.
English and Spanish	Articles that are not published in English or Spanish.	The authors are fluent in both Spanish and English, languages of great scientific interest. Therefore, with the inclusion of this criterion, it is understood that the scope of the research is narrowed, ensuring that the studies can be properly treated and analyzed.
Digital competence in university teaching must be assessed	Articles with a theoretical focus such as bibliometric reviews, systematic reviews or meta-analyses or studies conducted outside higher education.	Assessing digital competence in university teaching is vital for ensuring effective integration of technology in education. This criterion focuses the review, allowing for thorough analysis and meaningful insights into the role of digital skills in enhancing teaching practices and student outcomes.

Once the articles had been filtered by the four researchers, the 55 articles found were fully read. With this in-depth reading and using the six exclusion criteria, 8 more articles were excluded, and 47 articles were finally included in the review (Figure 1).
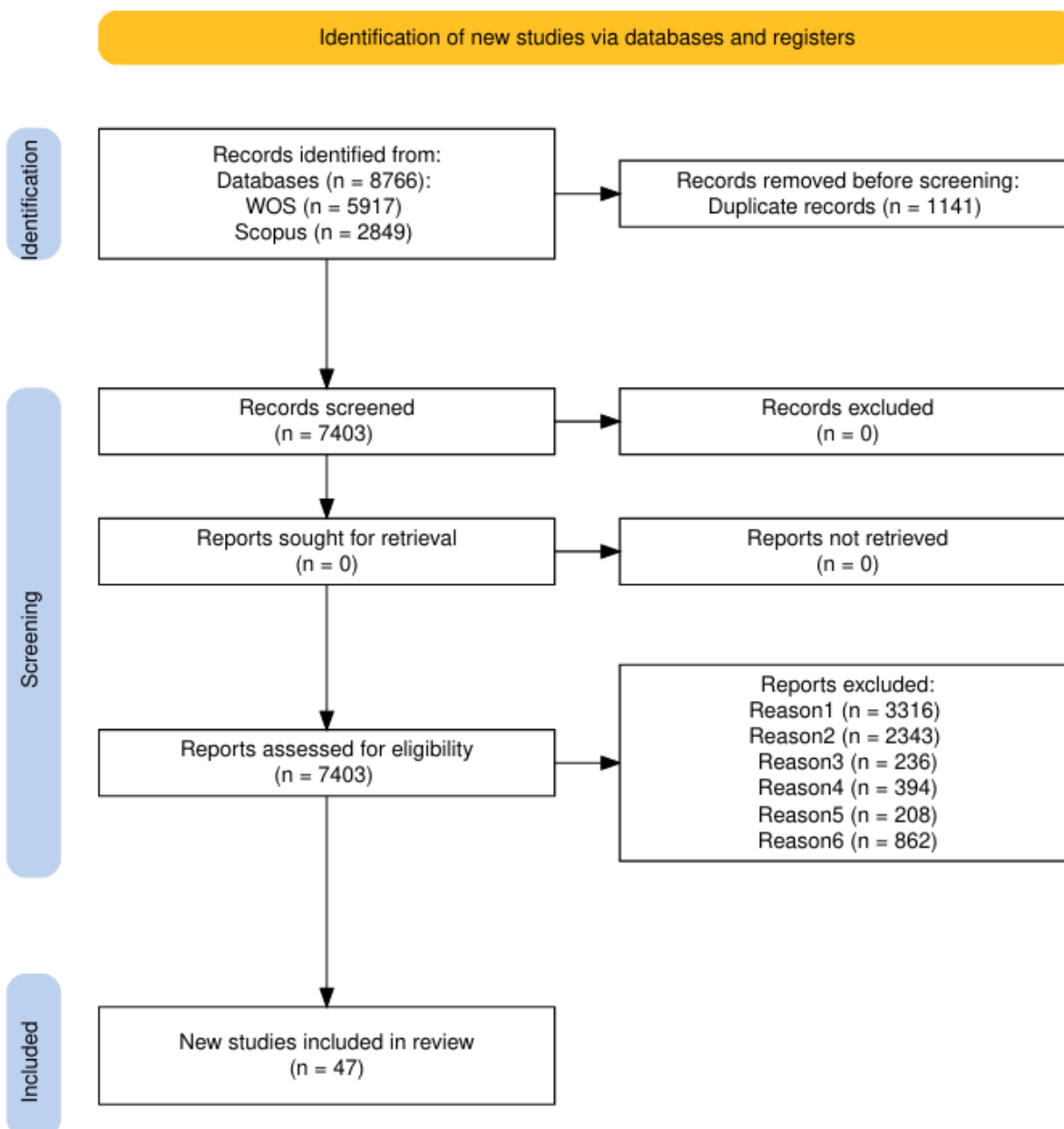
Figure 1. Flowchart for final inclusion of articles.

2.2. Risk Bias

To avoid both publication and article selection bias, the four authors of the present review have filtered the articles individually. After the individual filtering of each of the authors, the records found were pooled and evaluated in such a way that for the final inclusion of each of the articles they all had to be in agreement. The selection criteria were based on the criteria established by the template and the tool provided by [21]. By using this tool, we ensure that the scientific articles found have a minimum quality criterion as well as rigor and validity, eliminating selection bias.

3. Results

3.1. RQ 1 How Many Articles Have Been Published in WOS or SCOPUS That Assess the Digital Competences of Higher Education Teachers?

A total of 47 articles were found that focus on the evaluation of the digital competences of Higher Education teachers. Table 3 specifies both the references of the articles and the geographical location where the research was carried out, taking as a reference the countries

in which they were developed. The publications are ordered from most recent to oldest, so research from 2023 is at the top, and within the publications of the same year, they are ordered alphabetically (Figure 2).

Table 3. Records included.

| Reference	Country	Tool
Alonso-García, S., Victoria-Maldonado, J.J., García-Sempere, P.J., and Lara-Lara, F. (2023) [22]	Spain	DigCompEdu
Anna-Lisa, M., Sarah, L., and Holger, W. (2023) [23]	Germany	TPACK
Debre, O., Vakulenko, N., Savchenko, A., Lysenko, L., Kondor, M., and Kis, A. (2023) [24]	Ukraine	Cualitative
Devaul, D., Burrell, A., Lyles, K., Reulet, B., Cole, K., Reulet, C.L., Dear, C., Gordy, X.Z. (2023) [25]	EEUU	Cualitative
Fernández-Cerero, J., and Román Graván, P. (2023) [26]	Spain	Other validated questionnaires
Gaber, S.A., Shahat, H.A., Alkhateeb, I.A., Al Hasan, S.A., Alqatam, M.A., Almughyirah S.M., and Kamel, M.K. (2023) [27]	Saudi Arabia	Other validated questionnaires
García-Delgado, M.A., Rodríguez-Cano, S., Delgado-Benito, V., and Di Giusto-Valle, C. (2023) [28]	Spain	DigCompEdu
Pérez-López, E., and Tosina, R.Y. (2023) [29]	Spain	DigCompEdu
Sanz-Benito, I., Lázaro-Cantabrana, J. L., Grimalt-Álvaro, C., and Usart-Rodríguez, M. (2023) [30]	Spain	Non-validated questionnaires
Suwanroj, T., Saeung, O., Leekitchwatana, P., and Kaewkamjan, K. (2023) [31]	Thailand	Non-validated questionnaires
Vergara, D., Antón-Sancho, A., and Fernández-Arias, P. (2023) [32]	Latin America: (Argentina, Bolivia, Brazil, Colombia, Ecuador, Mexico, Nicaragua, Peru, Puerto Rico and Dominican Republic).	Interventions
Al-Awaid, A. (2022) [33]	Saudi Arabia	Other validated questionnaires
Almulla, M.A. (2022) [34]	Saudi Arabia	Other validated questionnaires
Bariu, T., Chun, X., and Boudouaia, A. (2022) [35]	Kenya	Other validated questionnaires
Cañete, M.D., Torres, C.A., Lagunes, A., and Gómez, M. (2022) [36]	Paraguay	Other validated questionnaires
Cao, C.D., Phan, L.T., and Nguyen, T.T. (2022) [37].	Vietnam	
Hernández-Vergel, V. K., Amaya-Mancilla, M.A., and Prada-Núñez, R. (2022) [38]	Spain	Non-validated questionnaires
Oanh, D.T.K., Tuan, N.A., Duong, P.B., Triet, N. M., and Phuc, T.Q. (2022) [39]	Vietnam	Non-validated questionnaires
Karahanoğlu, A. (2022) [40]	Netherlands	Interventions
Kulakhmet, M., Hajrullina, A., Oleksiuk, N., Tvrdon, M., Protas O., and Ragozina, V. (2022) [41]	Ukraine	Cualitative/Non-validated questionnaires
Martín, L., Llorente, C., and Barroso, J. (2022) [42]	Peru	DigCompEdu

Table 3. *Cont.*

Reference	Country	Tool
Mesa, J., Pardo, M.E., and Cedeño, M., Gardenia, E. (2022) [43]	Cuba	Non-validated questionnaires
Nithitakkharanon, P., and Nuangchalerm, P. (2022) [44]	Thailand	TPACK
Riquelme-Plaza, I., Cabero-Almenara, J., and Marín-Díaz, V. (2022) [45]	Chile	DigCompEdu
Silva, J. E., Cerda, C., Fernández-Sánchez, M. R., and León, M. (2022) [46]	Chile	Other validated questionnaires
Susanti, N., Hadiyanto, and Mukminin, A. (2022) [47]	Indonesia	TPACK
Torres, L., Martínez, A., Jaén, A., and Hermosilla, J.M. (2022) [48]	Spain	DigCompEdu
Xue, S., Wang, C., and Yang, Y. (2022) [49]	China	Cualitative
Yuting, Z., Adams, D. and Lee, K.C.S. (2022) [50]	China	Non-validated questionnaires
Zhibeka, I., Sadenova, A., Gulnaz, M., Almakul, S., Shyryn, A., and Gulnazyra, M. (2022) [51]	Kazanjian	DigCompEdu
Hbaci, I., Ku, HY. and Abdunabi, R. (2021) [52]	Libya	Non-validated questionnaires
Jorge-Vazquez, J., Náñez, S.L., Fierro, W.R., and Pacheco, S. (2021) [53]	Ecuador	Non-validated questionnaires
Rodríguez-Hoyos, C., Gutierrez, A.F., and Artime, I.H. (2021) [54]	Spain	DigCompEdu
Simsek, I., Kucuk, S., Kose, S., and Can, T. (2021) [55]	Türkiye	Non-validated questionnaires
Sonnenberg, L., Onan, A., and Archibald, D. (2021) [56]	Canada	Cualitative
Cabero-Almenara, J., Barroso-Osuna, J., Palacios-Rodríguez, A., and Llorente-Cejudo, C. (2020 a) [57]	Spain	Other validated questionnaires
Cabero-Almenara, J., Gutiérrez-Castillo, J-J., Palacios-Rodríguez, A., and Barroso-Osuna, J. (2020 b) [58]	Spain	DigCompEdu
Zárate, A., Gurieva, N., and Jiménez, V. H. (2020) [59]	Mexico	Cualitative/Non-validated questionnaires
Fabian, K., Clayes, E., and Kelly, L. (2019) [60]	Scotland	TPACK
Garita-González, G., Gutierrez-Durán, J.-E., and Godoy-Sandoval, V. (2019) [61]	Costa Rica	Cualitative
Jwaifell, M., Kraishan, O.M. Waswas, D., and Salah, R.O. (2019) [62]	Jordan	Non-validated questionnaires
Miralles-Martínez, P., Gómez-Carrasco, C.J., Arias-González, A.B. Fontal-Merillas, O. (2019) [63]	Spain/England	TPACK
Piñón, L. C., Sapién, A. L., and Gutiérrez, M. D. C. (2019) [64]	Mexico	Non-validated questionnaires
Villarreal-Villa, S., García-Guliany, J., Hernández-Palma, H., and Steffens-Sanabria, E. (2019) [65]	Colombia	DigCompEdu
Román-Graván, P., Fernández-Cerero, J., Montenegro-Rueda, M., and Reyes-Rebollo, M. (2024) [66]	Spain	Other validated questionnaires
Khanal, B., Devkota, K.R., Acharya, K.P., Chapai, K.P.S., and Joshi, D.R. (2024) [67]	Nepal	TPACK
Hieu, H.L., Thanh, H.P.T., and Luong, D.H. (2024) [68]	Vietnam	TPACK
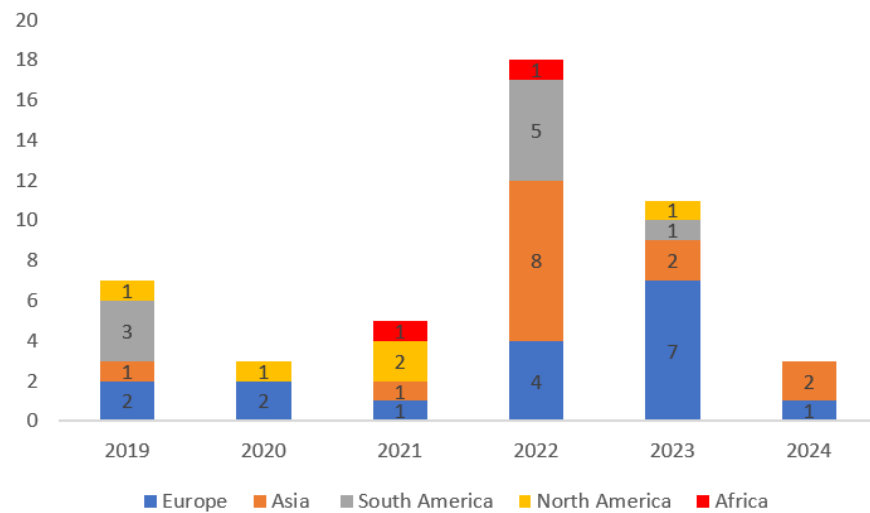
Figure 2. List of publications by year and region.

With the selected criteria, it can be seen that the research trend on the subject is on the rise. In 2020, the topic was in decline, but with the pandemic as a key event, as well as the publication of the DigCompEdu data, the number of publications rises.

Therefore, the list of articles with the countries studied, taking into account that international research involves more than one country, is distributed as shown in Figure 3.
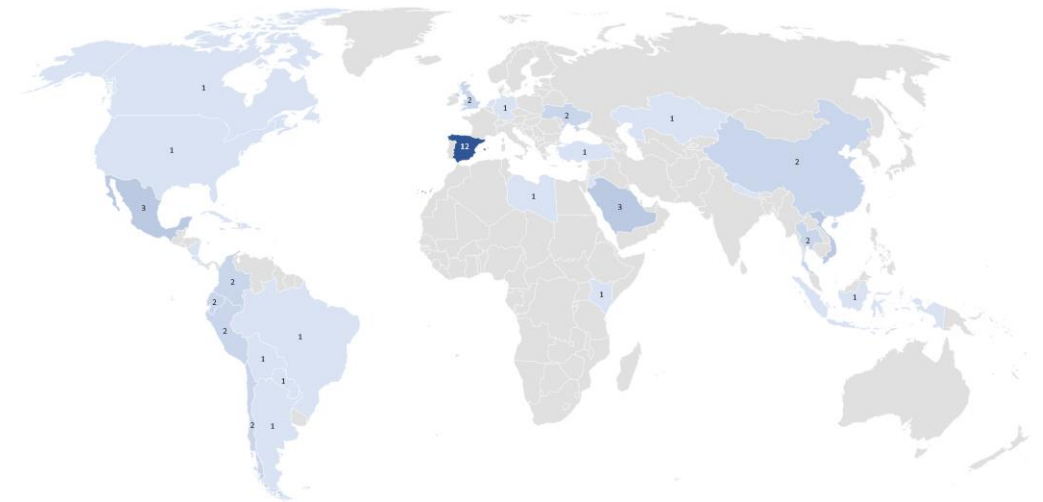

Figure 3. World map with list of countries and number of items found. Note: The colorimetry scale is adapted according to the amount of research carried out in the country being the number the indicator (in case of being carried out in more than one country they will be counted in both).

3.2. Which Journals Have the Most Publications on the Subject and Which Are the Most Cited Articles?

Once the date and place where the research was carried out had been analyzed, a review was carried out in order to understand the publication trend of the articles related to the subject. To carry this out, we selected the articles with the most citations, the keywords that have been included in two or more of the articles, and the journals where they have been published, thus generating Figure 4 with the number of citations, the reference, the keywords that appear in more than one reference, and the journal where they have been published.
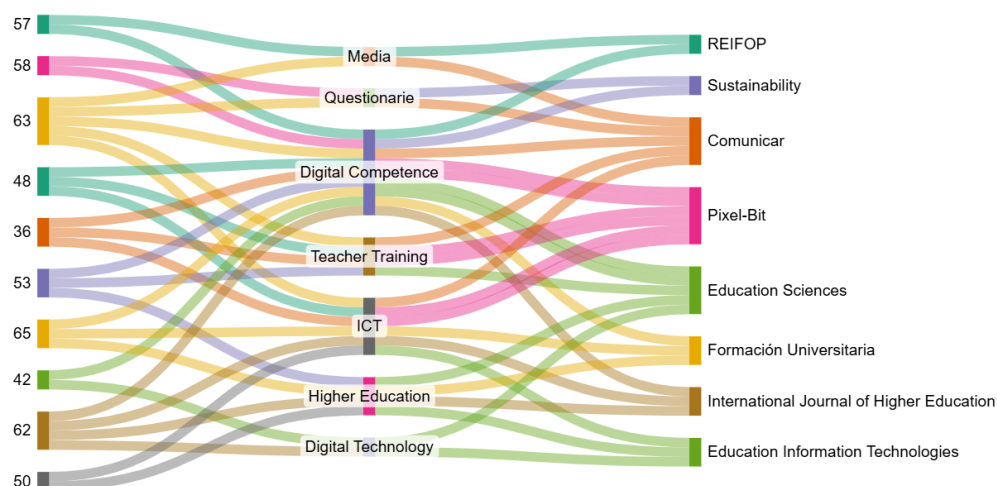
Figure 4. Linking articles with their citations, keywords and journals.

3.3. What Evaluation Systems Are Being Used to Assess the Digital Competences of University Teachers?

The assessment of e-skills can be performed in different ways. Firstly, it is worth mentioning that the competences can be self-assessed or assessed by an external person. It is also important to mention that the assessment can be carried out through questionnaires (more suitable for self-assessment) and through some tasks and/or exercises that serve to demonstrate knowledge (more suitable for external assessment).

On the other hand, it is important to highlight that, depending on the geographical disposition of the items, they have common sections, as, for example, in Europe, the DigComp reference framework or its version DigCompEdu are the reference frameworks proposed by the European Union and the Joint Research Centre (JRC).

Therefore, the articles are divided according to their geographical arrangement by continent.

3.3.1. African Research

The continents are sorted alphabetically. Thus, starting with Africa, there are only two articles. This may be due to the lack of higher education institutions, as well as a lack of social and economic development that would allow or encourage publications on the subject.

In the study developed by [35], a quantitative self-assessment is made by means of a questionnaire. This questionnaire is focused on how different particular, educational, and psychological variables directly influence the assessment of one's own digital competences, as well as their influence on the use of technology in the higher education classroom.

On the other hand, ref. [52] also employ an unvalidated tool focused on the assessment of basic computer operation and issues; advanced computer operation; use of Internet resources; and use of peripheral information and communication technology.

3.3.2. North American Research

Significantly more articles appear in North America than in Africa, although it is worth noting that despite being one of the most digitized regions, the United States has only one article that assesses the digital competence of university professors.

Thus, the articles found in this continent are [25,56,59,61,64].

Here, we find both quantitative and qualitative, as well as mixed, evaluations. Therefore, now and with the remaining continents, the research will be presented in the following order: quantitative, qualitative and mixed.

From the quantitative approach, due to the fact that the United States has multiple legislations and different regulations, there is no questionnaire that is used by the majority,

and the inclusion of the different countries that are included in North America means that there is no base questionnaire for the entire continent.

On the other hand, ref. [64] also generated a Likert scale questionnaire with questions from 0 to 5. However, the 38 questions they develop in this questionnaire are included within the following areas: Instructional Design Competence; Characteristics; Technological Competence and Services and Support. Therefore, due to the difference in countries and legislations, no common framework is established to allow the comparison of the two documents.

Also due to the importance of language in Latin American countries, the study by [61] relies on the Common Framework for Digital Competence in Teaching proposed in Spain in 2017, which consists of a total of six areas to design a questionnaire that they use to assess the self-perception of students.

From a qualitative perspective, a focus group has been used in which different figures in the field of education have discussed the skills and competences that higher education teachers should have in a generic way, on the understanding that the levels will not be similar, as more or less is necessary depending on the academic branch [56].

Finally, from the mixed perspective, firstly, the questionnaires are focused on measuring the digital competences of teachers, having used the T-PACK [25] and/or their own questionnaires based on some reference framework [59]. Subsequently, interviews are carried out that, although not directly focused on the assessment of digital competences as such, fulfil the function of explaining the factors that explain these results.

3.3.3. South American Research

Within this continent, we find research by [32,36,42,45,46,65].

The research in South America has quite similar characteristics, and the importance of language and the impact that Spain has on this region can be seen.

In Spain and due to its situation within the European Union, DigCompEdu is used and validated. On the other hand, other questionnaires have also been validated in this context. Thus, in South America, many studies are based on the questionnaires that have been used in Spain or DigCompEdu itself for validation in the corresponding countries.

On the other hand, there are digital competence questionnaires that have been validated for these contexts. Thus, all the research carried out in South America is framed in a quantitative perspective and in the development of the two lines explained above.

3.3.4. Asian Research

The Asian continent is the continent with the second most publications on this topic, partly explained by the high digitization of its member countries. The articles included in this continent are [27,31,33,34,37,39,44,47,49–51,55,62].

Within the quantitative studies, most of them opt for questionnaires, which they use as a tool for assessing digital competences. Within these questionnaires, there is a great variety and, in most studies, different questionnaires are mixed.

Due to the regulations as well as the conditions that are set in Asia, as well as the lack of international commitment, there is no questionnaire that stands out from the rest. However, it is important to note how [44,47,67,68] propose as part of the assessment of digital competences the TPACK instrument, which gives it an international relevance.

The rest of the questionnaires are used and validated in the research itself [27,37,39]. These in turn are usually in combination with some other instrument such as the Artificial Intelligence Awareness Scale (AIAS) and Technological Acceptance Scale (TAS) proposed in [27], the Enjoyment (EP) instrument proposed in [34], or the technology acceptance questionnaire proposed in [37]. In all cases, the assessment is self-perceived.

From the qualitative perspective, two different research methods are used; on the one hand, ref. [49] proposes semi-structured interviews, in which teachers are the ones who evaluate their own digital competence, pointing out the most beneficial points and

highlighting some points in which their environment helps or hinders the development of the same.

Finally, ref. [31] provides an analysis of what Asia's evaluative frameworks are for teachers' digital competences. In doing so, the author proposes a study based on a document review, focus groups, the use of confirmatory analysis to validate the factors of digital competences, and finally training based on these elements for digital competences.

3.3.5. European Research

Europe is the region with the greatest contribution in reference to this subject, especially due to the publication carried out in Spain, as it is the country that provides the most scientific data on the subject.

Europe is a continent where a quantitative research approach is prioritized, so most of the studies are included in this type. However, while in Asia, questionnaires were proposed that were validated during the research itself or were only used in the research itself, in Europe, priority is given to the possibility that the study can be extrapolated to other contexts. Therefore, there are two studies that use the TPACK model for the assessment of digital competences [23,63]. These two studies can be replicated internationally.

On the other hand, in Europe, the Joint European Research Centre (JRC) has developed a reference framework on digital competences and its version for educators, namely DigComp and DigCompEdu. This has a great influence on the research carried out, as the application of the questionnaire itself or the adaptations that arise from it, with the example of Spain, where INTEF adapts it to create the common framework of digital competence for teachers.

In this context, we find multiple investigations, such as [22,26,28,29,48,54,57,58,66], the latter being the student body's external assessment of the teaching staff.

There are also different questionnaires and instruments that focus on other aspects such as opinions, the competences themselves, and even the creation of different tasks making an assessment of digital competences with a pre-test, intervention, and post-test to evaluate the different aspects of digital competence in teaching. Among these studies that talk about digital competence in teaching but do not assess it with a standardized questionnaire are the articles [38,40,63,66].

From the qualitative and mixed approach, there are also different options that provide a broader view of digital competences, as well as the difficulties and possibilities that are generated and the assessment of teachers.

Within these studies, which are generated from a qualitative and mixed perspective, it is necessary to focus on the qualitative section, as the quantitative section has been developed previously in a more extensive way. For the qualitative section, different data collection strategies have been used, such as focus groups, interviews, or questionnaires [41].

The qualitative section focused on different aspects [41], focusing on making their own critical evaluation of their own digital competence and how to improve it and in which aspects they should improve. On the other hand, ref. [30], in its qualitative section, analyses the needs that teachers have in terms of digital competences. Finally, ref. [24], defines what quality education is based on technological tools.

3.4. Which Instruments Are Being Used for the Assessment of Teachers' Digital Competences?

With the rise of digital skills, different validated instruments have been developed that focus on the assessment of digital skills. However, not all studies assess digital competences from a validated instrument, although one of them is usually taken as a reference. Therefore, the following table shows all the instruments that are used and which articles use them. Due to the large number of documents that are included in the research, only the DOI of the documents will be indicated in order to refer to them (Table 4) (Figure 5).

**Table 4.** Relationship of the instrument to the article.

Instrument	Research DOI
DigCompEdu (or instruments based on this)	[45] http://dx.doi.org/10.6018/red.540121 [48] https://doi.org/10.12795/pixelbit.91943 [45] https://doi.org/10.15359/ree.26-1.9 [22] https://doi.org/10.3389/feduc.2022.1069245 [42] https://doi.org/10.3390/educsci12080574 [28] https://doi.org/10.3390/educsci13060581 [58] https://doi.org/10.3390/su12156094 [54] https://doi.org/10.12795/pixelbit.86305
TPACK (or instruments based on this)	[44] https://doi.org/10.11591/ijere.v11i3.22181 [23] https://doi.org/10.1111/bjet.13324 [60] https://doi.org/10.25304/rlt.v27.2296 [47] https://doi.org/10.33423/jhetp.v22i2.5041 [63] https://doi.org/10.3916/C61-2019-04 [68] https://doi.org/10.1016/j.dib.2024.110551 [67] https://doi.org/10.1080/2331186X.2024.2360854
Qualitative research (also mixed that do not focus on the quantitative part or have basic statistics such as mean, mode and standard deviation)	[41] https://doi.org/10.52547/johepal.3.2.53 [49] https://doi.org/10.1016/j.learninstruc.2022.101665 [56] https://doi.org/10.21432/cjlt27943 [61] https://doi.org/10.22458/caes.v10i1.2181 [25] https://doi.org/10.3390/educsci13080833 [24] https://doi.org/10.5430/jct.v12n2p83 [59] https://doi.org/10.7764/PEL.57.1.2020.10
Interventions	[32] https://doi.org/10.1007/s10639-023-12110-y [40] https://doi.org/10.1007/s10798-021-09712-3
Other validated questionnaires	[26] https://doi.org/10.21556/edutec.2023.83.2759 [52] https://doi.org/10.5430/wjel.v12n2p82 [36] https://doi.org/10.12795/pixelbit.91049 [46] https://doi.org/10.47553/rifop.v97i36.1.90221 [35] https://doi.org/10.1155/2022/1370052 [27] https://doi.org/10.26803/ijlter.22.7.25 [34] https://doi.org/10.3390/su14095455 [57] https://doi.org/10.6018/reifop.413601 [66] https://doi.org/10.1007/s10639-023-12314-2
Generate new forms of assessment of digital competencies and non-validated questionnaires.	[31] https://doi.org/10.18178/ijiet.2023.13.2.1804 [39] https://doi.org/10.20448/jeelr.v10i3.4885 [43] http://dx.doi.org/10.4067/S0718-07052022000200103 [38] https://doi.org/10.52080/rvgluz.27.99.20 [30] https://doi.org/10.5944/ried.26.2.35791 [41] https://dx.doi.org/10.52547/johepal.3.2.53 [50] https://doi.org/10.1007/s10639-022-11037-0 [52] https://doi.org/10.1007/s12528-020-09261-z [53] https://doi.org/10.3390/educsci11100637 [55] https://doi.org/10.5944/openpraxis.13.2.137 [59] https://doi.org/10.7764/PEL.57.1.2020.10 [62] https://doi.org/10.5430/ijhe.v8n6p267 [64] https://doi.org/10.30827/publicaciones.v49i5.8318

Most of the research has as a questionnaire for the assessment of digital competences and unvalidated questionnaires or new forms of assessment. This is largely because much research such as that conducted in Asia is nationally developed and does not claim to be relevant outside its context. There is also a significant amount of research that focuses on the validation of questionnaires and tools for research purposes, generating new ideas for e-skills research.

On the other hand, the Dig Comp Edu is the reference framework with the highest score, as the TPACK has less influence than this for the assessment of digital competences

of university students, although there are multiple validated instruments that also have a high percentage of use in research.

Finally, it is worth mentioning that qualitative studies are in the minority and the interventions that are carried out are scarce. This is due to the fact that this research requires a greater amount of human and monetary resources.
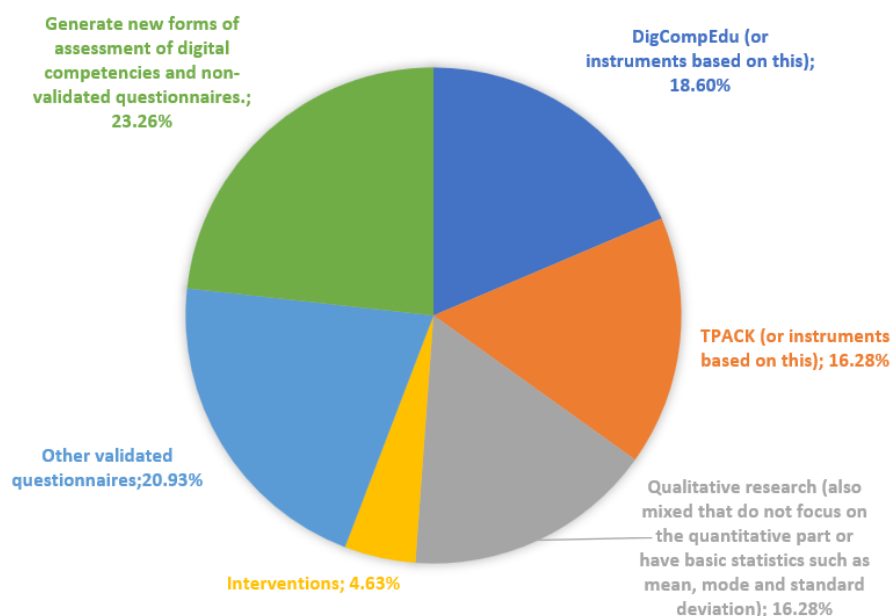
Figure 5. Percentage of articles according to the type of instrument used.

3.5. Which Aspects of Digital Competences Are Less Developed in Higher Education Teaching Staff?

In order to answer this question, we will once again segment the results of the different research projects by continent, emphasizing which aspect is the least developed.

3.5.1. African Research

Starting with the studies conducted in Africa, it is important to note that the continent has little infrastructure, so the research focuses on teachers' basic skills. This shows that when teachers have a higher level of digital skills development, there is an increase in usage, and the more they use computers, the more they develop digital skills. However, despite the fact that in their daily work with computers and with regard to their knowledge of the use of the Internet, the use of software for different tasks such as content creation, evaluation, cooperation and others is deficient [35,52].

3.5.2. North American Research

A first line of results that emerged in North America and that was repeated in different international studies is that of a lack of digital competence to develop digital content. This skill is especially salient for teachers who have to teach online classes on a regular basis and was highly visible during COVID-19 [25,59,64]. Ref. [61] carries out research that continues along the lines indicated above, as although very positive points are made about the digital competences of university teachers who teach online, the creation of content is lower along with that of collaboration.

Ref. [56] point out that the reference frameworks that are constructed according to the position of higher education educators are deficient, as with the construction of these, teachers are able to develop different skills, but despite the fact that areas of collaboration are included, real digital collaboration networks are not created, which is why specific spaces should be generated, together with the reference frameworks for their development, which is the least developed area.

3.5.3. South American Research

For the most part, the digital competence of teachers is insufficient. It is understood that teachers' digital competences should be quite advanced, especially in certain degrees such as engineering. However, according to teachers themselves, their skills are not sufficient [36], especially in the area of developing pedagogical skills with technology [32,36].

Continuing with the trend established in North America, it is understood that there are no spaces or opportunities to demonstrate all digital competences, so content creation and collaboration are the least worked on by higher education teachers [42,53,65]. In Chile's case, there is no reference framework for teachers' digital competence, so in this specific context, the results are lower than in the rest of the countries and it should be seen over time how the reality progresses in that country [45]. However, it is particularly significant how, while the research by [36] pointed to gender as a differential factor in favor of men, ref. [46] places it as a differential factor in favor of women.

3.5.4. Asia Research

For Asia, the results are similar, with a lower level of digital competence in content creation. However, it is noteworthy that if there is a better level of digital competence among teachers, artificial intelligence is proposed as a solution to this difficulty [27].

The level of digital development of university teachers depends on many factors such as age or the teacher's own interest. This makes it more difficult for people who are inexperienced in the use of technologies to gain new knowledge. Ref. [33], in particular, points out that, depending on age and interest, there is less knowledge of Internet access, which has repercussions in other areas such as the development of second languages.

In Asia, for the first time, the result appears that with regard to digital competences, university teachers have a low level of critical awareness and social participation through ICT, and the idea of content creation is eliminated as a point to be developed, as the problem is that there are no means for the development of community work, but there are alternatives for generating content [31,34,44].

Again, some studies mention that although digital competence may be generally acceptable in relation to self-use or leisure, the pedagogical skills of teachers need to be developed, as they do not have the capacity to demonstrate their own skills and to transmit them to students [37,39,49,50,55,62]. Work has already begun on this aspect, and the TPACK model is one response to this, generating new points for the development of ideas to generate pedagogical competences related to technologies [47].

3.5.5. Europe Research

As Europe is the region with the most available research according to the selected inclusion/exclusion criteria, more negative as well as positive characteristics appear.

Firstly, it is worth mentioning the comparative study of Spain and England by [63], in which it is pointed out that there are teachers who, despite being able to use technology as a means of developing the teaching–learning process, may still reject assessment through technology. This result is repeated in the research by [48], where assessment is the least developed section within teachers' digital competences.

On the other hand, it should be noted that if spaces for sharing information and collaborative work are created, teachers are capable of developing great work together. However, there is a lack of knowledge about the different technological tools and how to work with them, which makes it difficult to initiate good practices at first [23].

Among these results, two lines of inquiry focus on identifying the areas that need the most development. It is understood that skills related to information searching, basic actions such as surfing the Internet, using file management programs, and utilizing everyday applications to generate documents are well developed. However, studies suggest that university teaching staff do not effectively develop other digital competencies. Consequently, they do not excel in any other areas, neither positively nor negatively [26,38,58,66].

On the other hand, there are studies that, although they assess the level of teachers' digital competence as below the level they should have, also find that they have an intermediate level and could develop the skills themselves. However, they are not able to develop them in others, and the competence concerning content creation is especially bad, more specifically when programming is mentioned as an element of content creation [24,28,29,40,54].

4. Discussion

From the results shown, it can be seen that Spain is a country with a large production regarding the digital competences of teachers, establishing similar results to the study by [18], being the country with the highest production and the most high-impact articles.

The importance lies in how various ideas and outcomes stem from this idea. Firstly, it is worth mentioning that despite the United States being perceived as a highly digitized country with significant potential in digital competencies, the focus on teachers' digital competencies is not being addressed at a scientific level. This is reflected in a minor increase in teachers' digital competencies [18]. This extensive research on competencies has had repercussions both at the European and international levels, influencing South America [16]. Studies such as [36,42,45] can be found in this realm. These investigations are framed within competency frameworks proposed in Europe and have been internationalized through language and scientific production from Spain.

On the other hand, it is clear that in recent years Asia has been generating the production on teachers' digital competences. However, many of the articles that are generated do not come from validated instruments or are of no international relevance, so most of them are based on non-validated questionnaires [27,31,33,34,37,44,49–51,55,62].

Regarding the type of evaluations that are being made of teachers' digital competences, we can see that the majority tendency is towards the quantitative, with validated or non-validated instruments having a great weight over the rest; however, qualitative or mixed research is increasingly abundant. The research that is being carried out the least and that needs to be promoted is that carried out by [32,40], in which, regardless of how digital competences are assessed, interventions should be made to see the results and, above all, to encourage the real promotion of digital competences in teaching.

Within these predominantly quantitative studies, it is worth mentioning that DigCompEdu is the most widely used instrument for the assessment of teaching competences, although it is important to note that many of the uses of this instrument are based on variations made by other public institutions such as INTEF in Spain.

With regard to the competences most in need of reinforcement in higher education teachers, three specific terms can be made according to the region. In North and South America, there is a problem especially with evaluation, with pedagogical competences being the least developed. In Europe, the least developed competence is content creation, and in Asia it is collaboration. It is therefore necessary to generate training in all the competences included in these frameworks and to work specifically according to the area.

Finally, it is necessary to make an important point about the results of the study. Spain is the country with the most research on the subject; however, looking at the results in general, it can be seen that they do not stand out in terms of skills. In this regard, the present review has two essential utilities from which future lines of research can emerge. On the one hand, DigCompEdu is the most widely used instrument, and Spain is the country where most research is conducted. However, this does not seem to translate into a specific improvement in competencies, as pointed out by [69,70]. The results presented could have selection bias, although they seem to align with other reviews, such as [10,18,20].

5. Limitations

The main limitation of the research is language, as despite the use of two languages of great relevance in the research, Spanish and English, there are publications in other languages.

On the other hand, mention should be made of the limitation regarding the type of research, as although a description has been made of the international panorama of digital competences in teaching, no specific scientific knowledge has been provided on the context in which we find ourselves. In order to carry out studies that delve deeper into the specific context, other projects and calls for proposals with more funding could be carried out.

6. Future Research

From the above review, two lines of research are generated. On the one hand is the international comparison of the digital competences of teachers in higher education institutions with the same instrument, being able to make correlations according to different characteristics.

On the other hand, is the generation of practical and training experiences for trainee teachers on digital competences by trying to establish practical tasks to demonstrate the competences obtained.

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Data Availability Statement: Regarding the availability of data for the analysis of the present study, since it is a systematic review, all the documents used are available in the databases mentioned in the article. However, in the event of wishing to review the articles in a way that corresponds to the data provided, the inclusion criterion mentioned was the need for all the files to be open access, so there is no problem in accessing them.

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