

IMPLICATIONS OF THE DIGITAL DIVIDE: A SYSTEMATIC REVIEW OF ITS IMPACT IN THE EDUCATIONAL FIELD

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Abstract

Previous research has shown the consolidation of the digital divide as an object of study over the last two decades. The pandemic caused by COVID-19 has multiplied the consequences of digital exclusion, as well as the number of studies examining its effects in the educational field. Based on this current educational reality, we approach a proposal that examines in depth the existing literature on the digital divide in the educational context by using the systematic review as a research methodology. We present an analysis of relevant studies published in the last three years with the aim of answering the following questions: How did the digital divide affected e-learning and ICT implementation during the pandemic?; what methods were used to assess it? ; and what are the proposals to counteract its presence?. The results obtained in our study confirm the use of systematic reviewing which synthesize and accumulate the results of different primary studies. These results also serve to identify research gaps that point, in our case, towards future lines of work on the causes, persistence and interventions to mitigate the expansion of the digital divide in today's educational landscape.

Keywords – Education, Digital divide, Pandemic, ICTs, Virtual learning.

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1. Introduction

Information and Communication Technologies (ICT) have created a new context that makes it possible to access and process a large amount of information on a global scale and at an inconceivable speed, especially since the digital revolution started. This environment, known as the Information and Knowledge Society (IKS) is implementing notable transformations in the production and organization of work, in the media, or in the way of doing politics, or identifying the economic and social development of a country and in our ways of interacting. In short, as Cabero-Almenara and Ruiz-Palmero (2018) pointed out, it could be affirmed that mastery and knowledge of Information Technologies are essential to function in the 21st century society.

The changes, produced by the widespread use of ICTs, can guarantee that all citizens achieve mastery in this field, which implies transformations in the educational field linked to teaching-learning processes such as teacher training itself (OECD, 2022). Current studies on the inclusion of technological innovation in the educational field, coincide in emphasizing the need for educating in virtuality in order to entail new pedagogical methodologies that favour the incorporation of ICT in learning and teaching in a significant way (Cabero, 2015; Flórez, Aguilar, Hernández, Salazar, Pinillos & Pérez, 2017; González, Ojeda & Pinos, 2020). From this perspective, two of the great challenges that teacher training must face are indeed innovation in the pedagogical field and improvement of teaching-learning processes through the correct implementation of new technologies.

The difficulty lies in how to transform the information and communication instruments into active tools for knowledge and learning. Although it may look difficult, it is an unavoidable step in 21st-century classrooms, since it is evident that, although current education is led by students born in the digital age, “it does not seem a sufficient condition to assume that they have the digital competence that current society demands” (Rodicio-García, Ríos-de-Deus, Mosquera-González & Penado-Abilleira, 2020: page 107). Studies in this field clearly express that new technologies by themselves do not generate knowledge (Álvarez, 2019; Cabero & Barroso, 2015; Domínguez, Jaén & Ceballos, 2017) or improve educational practice. Therefore, the digital transition must necessarily go through a broad conception of ICTs raised as TLK (Technologies for Learning and Knowledge) but also as TEP (Technologies for Empowerment and Participation); As some experts in the field assure, the implementation of certain tools in the educational sphere facilitates the dissemination of knowledge and learning (González et al., 2020). For this reason, as Cabero-Almenara and Ruiz-Palmero (2018) pointed out, the implementation of these instruments must be oriented “towards more formative uses, both for teachers and students, with the aim of learning in a more meaningful and excellent way” Cabero-Almenara and Ruiz-Palmero (2018: pages 17-18). Only in this way, ICTs will be able to contribute to achieving a true transformation of current educational practices, which are increasingly inclusive and egalitarian.

As Rodicio-García et al. (2020) stated, even though governments took a long time to recognize the link between the digital divide and the situations of poverty and exclusion, it must be pointed out that in this post-pandemic time, unequal access to and use of ICTs have become a decisive factor in social exclusion, and an expression of the inequalities of the 21st century. In this way, it seems undeniable to approach the conceptualization of this notion by affirming that “the digital gap” has now become “a social gap” (Cabero, 2015: page 161).

1.1. Theoretical Contributions to the Digital Divide

The concept of *digital divide* arises from research on the incidence of ICTs on the social structure at the end of the 90s, alluding to the inequality between countries, institutions, societies or the distinction between people who integrate technological development into their daily routine and people who are left out. Such particularity may be motivated by economic, geographic, cultural, generational, and educational factors, among others (Olarte, 2017; Robinson, Cotten, Ono, Quan-Haase, Mesch, Chen et al., 2015; Somolinos, 2018; Varela, 2015). Time passing and social circumstances make it necessary to reformulate the conceptualization of the digital divide term, as Cabero-Almenara and Ruiz-Palmero (2018) pointed out, when it comes to its analysis it is necessary to consider three stages: the first one refers to the possibility or impossibility of access to technology for economic or ideological reasons; the second one focuses on the differences in access, use and control of ICTs; and finally the third one is linked to the diversity of uses with new technologies.

In recent decades, extensive research has been carried out on the digital divide, highlighting, in particular, the main reasons that cause this phenomenon. There are several studies that investigate the influence that the socio-economic and cultural conditions of the subjects have on their possibilities of using information and communication technologies (Calderón, 2019; Castaño & Webster, 2016; Van Dijk, 2017). Other researchers review the concept of the digital divide closely linked to that of digital literacy, raising the consequences of social exclusion that derive from the lack of digital literacy (Cañón, Grande & Cantón,

2016; Gómez-Trigueros, 2023; Pensky, 2011; Rogers, 2001; Roig-Vila, Mengual-Andrés & Quinto-Medrano, 2015) and highlighting how access to technological resources outside school, partly a consequence of the socio-economic level of families, is positively related to students' digital competence (Castañeda, 2019; Fernández-Mellizo & Manzano, 2018).

It is also worth noting the increase in work on the impact of the digital divide after the COVID-19 crisis. Several authors have highlighted how the confinement and the extraordinary health situation gave rise to exceptional moments. For them, that was a turning point in the conception of education and digital pedagogy on a global scale (Burgess & Sievertsen, 2020; Montiel & Gómez-Zermeño, 2022; Teräs, Suoranta, Teräs & Curcher, 2020). As some experts in the field state, the impact of the pandemic suddenly and unexpectedly changed the educational landscape, with technology acquiring an unquestionable role until then but in an unequal way (Lloyd, 2020; Moya-Otero & Hernández-Ortega, 2020; Tejedor, Cervi Tusa & Parola, 2020). All the aforementioned gave rise to a set of biases (socio-economic and pedagogical) which, as Dragulanescu (2002) and Varela (2015) pointed out, made the already existing digital divide more evident and a factor of social exclusion (García, Rivero & Ricis, 2020; González-Benito, Gutiérrez-de-Rozas & Otero-Mayer, 2022; Vivanco-Saraguro, 2020). In this regard, it is worth highlighting the exhaustive study carried out by Trujillo, Fernández, Montes, Segura, Alaminos & Postigo (2020), which collected the opinion of the entire educational community on the panorama that emerged in Spain after the pandemic. This research, which was carried out following a quantitative and qualitative methodology, gathered relevant conclusions and proposals for action, and pointed out that the new reality entailed issues such as “teachers' digital competence, students' digital competence (and even their families), the so-called digital divide and access to devices, connectivity, the availability of online platforms and resources, and the existence of a school digital project” (Trujillo et al., 2020: page 87).

In the same vein, some studies focused on the consequences of school closures, noting that the education gap widened at times of educational disruption, especially among children from families with different socio-economic backgrounds (Morgan, Melendez-Torres, Bond, Hawkins, Hewitt, Murphy et al., 2019). On the other hand, equally relevant are the works that considered the role of teachers during the pandemic which concluded that, in many ways, teachers were always ahead of the education administration in trying to provide meaningful learning opportunities for their students (Osmond-Johnson, Campbell & Pollock, 2020) and expanded the “e” of e-learning so that this vowel meant not only electronic but also efficient, exploratory and experimental (Zhou, Wu, Zhou & Li, 2020).

For all these reasons, we considered it necessary to carry out a bibliometric analysis of the scientific production of the last three years in relation to the phenomenon of the digital divide in the field of education, thus facilitating a first approach to the reality under investigation. The main objective of our research aims to fill a gap in the current literature as there is no systematic review around this concept closely linked to the educational reality that opened up after the COVID 19 crisis as the one addressed in our work (except for the analysis of the existing scientific literature around the digital divide and literacy in new technologies by De Benito-Castanedo in 2017).

The main objective of this study is subdivided into the following sub-objectives:

Ob1: To provide a bibliographic reference bank for an in-depth study of the “digital divide” and “digital competence” concepts by researchers and institutions in the last three years.

Ob2: Generate an updated repository, which answers the question on the effect of the digital divide on e-learning and the implementation of technologies during the pandemic in higher education.

Ob3: To show the publications of the last three years concerning methodological studies on the evaluation of technological resources and their inclusion in higher education as well as proposals designed to minimise their impact.

2. Methodology

Digital technology plays an essential role in education, especially in Higher Education learning processes linked to the outbreak of COVID 19. These are procedures in which the digital divide has only multiplied the consequences of social exclusion, as well as the works that examine its effects in the educational field. For this reason, this research takes advantage of the prolific studies published in the last three years in relation to the digital divide as a key factor to define certain problems and articulate measures that contribute to tackling them and compiling the scientific production generated by the analysis of the given topic at a global level. For the elaboration of this research, a systematic review has been applied. This methodology is considered one of the most convenient to select, identify and evaluate highly reliable research to answer the research questions of this study (Marín, 2022; Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow et al., 2021). In this sense, three questions were formulated to address the difficulties identified in the theoretical contributions on the digital divide, while also addressing the specific objectives of this research: (i) how did the digital divide affect virtual learning and ICTs implementation during the pandemic? (ii) What methods were used for its evaluation?, (iii) And what are the proposals to counteract its presence?

Based on the current educational reality described above, we propose a study that examines the existing scientific production on the digital divide. A systematic review of the literature applied to the educational field has been carried out such as that proposed by Redondo-Corcobado and Fuentes (2020) and Sánchez-Prieto (2020), used to respond to specific questions related to teaching innovation in the field of teaching and learning processes. For the design of our study, we have followed the recent protocol of the PRISMA 2020 declaration (Preferred Reporting Items for Systematic reviews and Meta-Analyses) that provides new standards to identify, select and evaluate studies more reliably (Page et al., 2021). With this methodology, applied to the field of education we attempt to present a more complete and reliable perspective of the issue addressed (Sánchez-Serrano, Pedraza-Navarro & Donoso-González, 2022). Thus, the following section will describe the eligibility criteria of the articles, sources of information and search strategies, the data selection and extraction processes, as well as the synthesis methods and those applied to assess the risk of bias.

2.1. Eligibility Criteria

In order to define the eligibility criteria, we should consider scientific articles that were published in open access and were indexed in the SCOPUS and Web of Science (WOS) databases. In accordance with this initial quality criterion, that is, those impact studies that were submitted to a peer review process, the inclusion criteria that responded to the specific objectives of this review were agreed upon. The determining exclusion criterion in this phase was determined by the type of document, eliminating those works whose typology was a book chapter, review, or conference proceedings. Table 1 specifies the criteria used to search the information sources.

Search strategy	Description of the strategy
Review objectives	The search string responded to the research objectives, then including “brecha digital” or “digital divide”; “aprendizaje virtual” or “virtual learning” or “TIC” o “ICT”; “educación superior” or “higher education” or “universidad” or “university”; and finally, “covid-19” or “covid” or “pandemia” or “pandemic”.
Publication dates	The date range was also specified, limiting the search to the last three years: 2020, 2021, and 2022; thus excluding papers published in 2023.
Languages	English or Spanish

Table 1. Search strategies for the selection of studies in WOS and SCOPUS

2.2. Selection Process and Data Extraction

The selection of articles was based on our search in the WOS and Scopus databases. This search was carried out in three phases, taking the research questions as a guide for the establishment of the

descriptors. In the first phase, the initial search, “digital divide” and “higher education” or “university” (both in Spanish and English) were included as criteria.

Because the objectives of this review were focused on the impact of the digital divide on virtual learning during the pandemic period, for the second phase of the selection, the descriptors “covid-19” or “covid” or “pandemic” (the latter in both languages) were incorporated, but “virtual learning” or “ICT” (also in both languages) were also added.

This extension of the search in the initial phase was completed in the last phase with the incorporation of specific exclusion criteria. For the present systematic review, works before 2020 and after 2022 were excluded; it was determined that the included works should have been published in open access; that the language of the studies would be Spanish or English; and, finally, that they would be exclusively scientific articles and not other types of publications. Figure 1 shows the number of results obtained in the different selection phases.

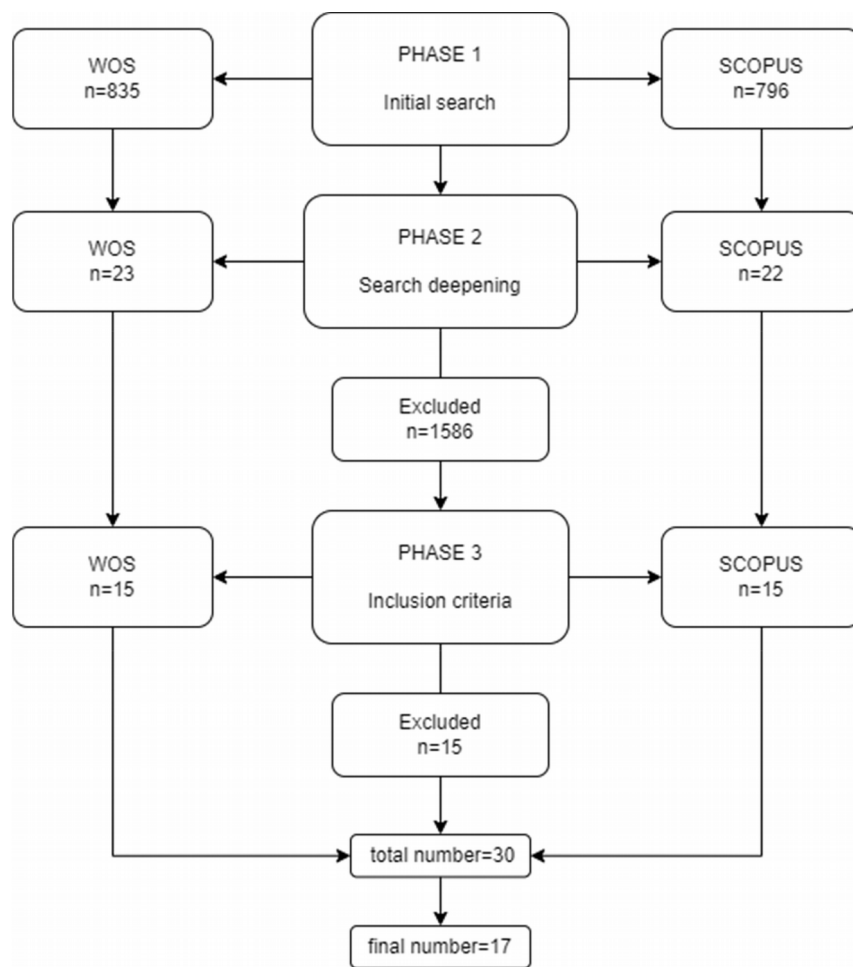


Figure 1. Flowchart (Sánchez-Serrano, Sánchez-Serrano, Pedraza-Navarro & Beltrán-Velasco, 2022)

After applying the inclusion criteria, duplicate results were discarded, that is, those that appeared in both databases. Lastly, each retrieved publication was screened in detail. Through the RefWorks bibliographic manager and the Rayyan application for systematic reviews, the results obtained were independently analyzed based on their title and abstract. The authors’ screening led to the additional exclusion of five papers, as they did not meet the review criteria (educational level and type of document). After the selection process, a total of twenty scientific articles were obtained for our systematic review analysis. Table 2 specifies the inclusion and exclusion criteria of the study.

Inclusion criteria	Exclusion criteria
Publications between 2020 and 2022	Publications prior to 2020
Language: English or Spanish	Different language from English or Spanish
Higher education Indexed in WOS or SCOPUS Scientific articles	Educational level other than higher Does not appear in these databases Book chapters, conference proceedings, etc.

Table 2. Inclusion and exclusion criteria of the studies analysed
(Zawacki-Richter, Marín, Bond & Gouverneur, 2019)

2.3. Coding System and Synthesis Method

Once the studies on which the analysis was to be performed were obtained, we proceeded by consensus and in parallel to implement a coding system that would allow for the synthesis of the results. In this way, three research questions were established based on the objectives set by the review. Table 3 shows the research questions of this systematic review.

Question number	Research question
RQ1	How did the digital divide affect virtual learning and ICTs implementation during the pandemic?
RQ2	What methods were used for its evaluation?
RQ3	What proposals are made to counteract the presence of the digital divide?

Table 3. Research questions of the systematic review

For the coding process, the software QDA Miner v. 2.0.9 was used since it offers more possibilities for text encoding than Rayyan. Based on the research questions, three main codes were established: “impact”, “evaluation” and “proposals”, which were used to analyse the three research questions in QDA Miner. The content of the articles was coded in the above-mentioned qualitative analysis software, in which the results linked to the research questions were recorded. Thus, different variables associated with each of the three codes were obtained to enable us to answer the questions posed. In this way, firstly, the coding made it possible to analyse the impact caused by the digital divide in higher education during the pandemic (structural and institutional deficiencies, deficiencies in digital literacy, as well as the access to digital learning media). Secondly, the methods used to assess the impact of the digital divide were addressed, thus considering the papers’ research methodologies; and finally, the approaches proposed in the articles in order to minimize or advance towards the reduction of the digital divide were considered. Although it has not been part of the research questions, the impact of the gender digital divide was also considered in the analysis. In that respect, the four authors worked independently on data retrieval from each of the studies.

2.4. Assessment of Selection Bias

As noted above, two tools (Rayyan and QDA Miner), were used to assess the risk of bias, through which the four review authors proceeded to select and later analyse the studies. Parallel work using this software allowed sharing the results obtained at each stage of the review.

3. Analysis and Results

Once the contents of the seventeen scientific articles that made up the studies included in the review were analysed, the results obtained are presented, depending on each of the three variables that respond to the research questions raised in this work. First, a brief description of the selected studies is offered to measure the impact that the digital divide has revealed in the educational field. Then the evaluation methods to assess its impact are specified and, finally, the different proposals to mitigate the consequences of the digital divide are presented.

3.1. Selection and Characteristics of the Studies

The search strategies and inclusion criteria approached in this review have made it possible to obtain a sample that, first, has the characteristic of including many world regions. In this respect, considering the research included in our systematic review, the countries whose educational programmes are analysed are Spain (23%), Mexico (18%), Nigeria (12%), the United States (12%), Israel (6%), South Africa (6%), Zimbabwe (6%), Bangladesh (6%), Uganda (6%), Argentina (6%), and Pakistan (6%).

Table 4 shows a list of the selected articles, along with their title, the country where the research was carried out and the number of authors.

Article	Title	Country
Anyika, Anikelechi & Thobejane (2021)	The Impact of Covid-19 on Nigerian Education System	Nigeria
Astudillo (2021)	TIC en la Educación Superior para solventar una crisis sanitaria	Mexico
Barrientos-Báez, García, Á.P., & Caldevilla-Domínguez (2021)	Technological digital literacy: volunteer training	Spain
Frei-Landau & Avidov-Ungar (2022)	Educational equity amidst COVID-19: Exploring the online learning challenges of Bedouin and Jewish Female Preservice Teachers in Israel	Israel
Gan & Sun (2022)	Digital Barriers and Individual Coping Behaviours in Distance Education During COVID-19	United States
Gómez & Martínez (2022)	Usos del internet por jóvenes estudiantes durante la pandemia de la covid-19 en México	Mexico
Jiménez, Garay & Santos (2021)	Vivencias y experiencias de estudiantes universitarios en ambientes virtuales de aprendizaje en tiempos de confinamiento educativo	Mexico
Katz, Jordan & Ognyanova (2021)	Digital inequality, faculty communication, and remote learning experiences during the COVID-19 pandemic: A survey of U.S. undergraduates	United States
Majola & Mudau (2022)	Lecturers' Experiences of Administering Online Examinations at a South African Open Distance e-Learning University During the COVID-19 Pandemic	South Africa
Muchabaiwa & Gondo (2022)	Covid-19 and the virtual classroom conundrum in Zimbabwean universities	Zimbabwe
Rangel-Pérez, Gato-Bermúdez, Musicco-Nombela & Ruiz-Alberdi (2021)	The Massive Implementation of ICT in Universities and Its Implications for Ensuring SDG 4: Challenges and Difficulties for Professors	Spain
Rodicio-García et al. (2020)	La Brecha Digital en Estudiantes Españoles ante la Crisis de la Covid-19	Spain
Saha, Dutta & Sifat (2021)	The mental impact of digital divide due to COVID-19 pandemic induced emergency online learning at undergraduate level: Evidence from undergraduate students from Dhaka City	Bangladesh
Sebbowa (2022)	History Education during COVID-19: Reflections from Makerere University, Uganda	Uganda
Suárez, García-Perales & Elisondo (2021)	La vivencia del alumnado en tiempos COVID-19: estudio comparado entre las universidades de Extremadura (España) y Nacional de Río Cuarto (Argentina)	Spain, Argentina
Sumra, Mumtaz Mohamed, Haseeb & Ansari (2022)	Online Education amid COVID-19 Crisis: Issues and Challenges at Higher Education Level in Pakistan	Pakistan
Ukaogo, Orabueze & Ojukwu (2021)	Tertiary Teachers Strike (TTS) and e-Learning Deficit amidst Covid-19 Crisis in Nigeria	Nigeria

Table 4. List of selected articles

3.2. Impact of the Digital Divide on E-learning

Regarding the impact of the digital divide in higher education, a total of eight variables were coded, which were indicative of the difficulties revealed in the selected studies. In this way, three of the variables proposed are directly related to their digital divide levels: access problems (present in 65% of the studies), usability problems (71%) and appropriation problems (29%). The rest of the variables respond to inadequate infrastructure (65%), deficient training of academic staff (29%), inequalities between sociocultural environments (59%), increased anxiety and frustration (18%), and limitations attributed to the gender gap (12%).

As can be seen, there are four items that prevail in this analysis. Two of them, the problems of infrastructure and access to technology, appear closely linked and both are present in all the studies carried out in developing countries. The difficulty that occurred most frequently, however, was related to usability problems (71%) in the second level of the digital divide. This type of problem appeared in all the studies carried out in developed countries. In addition, the consequences derived from contextual inequalities (59%) were manifested with a high frequency in rural areas, less favourable socioeconomic environments or cultural beliefs that become sometimes an obstacle to adopting virtual learning.

3.3. ICT Impact Assessment

The methodology used in the analysed studies corresponded mainly to qualitative research (59%), specifically in 10 of the works, with the designs of case studies, the analysis of surveys and questionnaires, being content the most used. Furthermore, a quantitative analysis was used as a tool in five of the studies (29%), using evaluative research designs, questionnaire analysis and surveys. Two studies present a mixed methodology with descriptive analyses (12%). In most cases, digital media was used to carry out surveys, questionnaires and interviews in order to make the population studied more extensive.

3.4. Measures to Respond to the Effects of the Digital Divide

Regarding the proposals made in the analysed studies and in order to minimize the consequences of the digital divide, a total of eight variables were addressed. In this case, four types of responses that were proposed as a society to respond to the effects of the digital divide stood out. First, the ones related to teacher training improvement with respect to the management of technological tools (present in 53% of the studies); secondly, a functional political and institutional response to the observed obstacles (47%); thirdly the improvement and implementation of programs leading to the development of digital literacy in students (47%) and linked to the political response, an advance in the technological infrastructures put at the service of teaching (35%). In this respect, we also considered it necessary to attend to the role played by the emotional aspects of virtual learning (18%), in order to address the different sociocultural factors that can influence the deepening of the digital divide (12%), the implementation of an equity mentality (6%), and, finally, discuss an infrequent aspect within the improvement measures although reiterated in the analyses, which is the development of programs that allow self-regulation by the student body (6%). Table 5 shows a list of the codes used for the analysis together with the variables identified in each of the studies.

With regard to the results obtained in our study, we can point out that in relation to the first question of this research, concerning the repercussions of the digital divide on e-learning, three main variables were associated with it: (i) problems of access, (ii) problems of use, and (iii) inequalities linked to socio-economic factors. Regarding the studies' evaluation methodology, a large majority of them employed qualitative analysis through case studies, survey analysis and questionnaires. The proposed improvement measures emphasised teacher training, policy and institutional action as well as infrastructure developments, and digital literacy programmes to mitigate the impacts of the digital divide.

Study code	Impact	Evaluation	Proposal
Anyika et al. (2021)	Inadequate infrastructure; Poor academic staff training	Qualitative; content analysis	Functional policy response
Astudillo (2021)	Appropriation issues; Inequalities between environments; Poor academic staff training; inadequate infrastructure	Qualitative; Study of cases; content analysis	Teacher training
Barrientos-Báez et al. (2021)	Access problems; Usability problems	Quantitative; evaluative research	Importance of emotions; Digital literacy improvement
Frei-Landau & Avidov-Ungar (2022)	Usability problems; Inequalities between environments; Inadequate infrastructure; Limitations by gender	Qualitative; Study of cases	Address sociocultural factors; Improve infrastructures; Digital literacy improvement
Gan & Sun (2022)	Usability problems; Inequalities between environments; Inadequate infrastructure;	Qualitative; Survey Analysis	Improve infrastructures; Implement Equity Mindset
Gómez & Martínez (2022)	Inequalities between environments; Usability problems; access problems	Quantitative; Survey Analysis	Improvement of digital literacy; Address sociocultural factors
Jiménez et al. (2021)	Usability problems; Appropriation issues	Qualitative; Study of cases	Develop self-regulation programs; teacher training
Katz et al. (2021)	Access problems; Usability problems; Appropriation issues	Quantitative; Questionnaire analysis	Improve infrastructures; Digital literacy improvement
Majola & Mudau (2022)	Access problems; Inadequate infrastructure; Appropriation issues	Qualitative; Study of cases	Improvement of digital literacy; teacher training
Muchabaiwa & Gondo (2022)	Inadequate infrastructure; Access problems; Inequalities between environments; Usability problems; Limitations by gender; Poor academic staff training	Qualitative; exploratory study	Improve infrastructures; Improvement of digital literacy; Teacher training; Functional policy response
Rangel-Pérez et al. (2021)	Increased anxiety, frustration; Usage problems; Inequalities between environments	Mixed; Descriptive analysis; Questionnaire analysis	Teacher training; Ethical and humanistic perspective
Rodicio-García et al. (2020)	Access problems; Usability problems; Appropriation issues; Inequalities between environments	Quantitative; Questionnaire analysis	Functional policy response; Digital literacy improvement
Saha et al. (2021)	Access problems; Inadequate infrastructure; Usability problems	Mixed; descriptive analysis	Improve infrastructures; Functional policy response; Teacher training; Importance of emotions
Sebbowa (2022)	Usability problems; Access problems; Inadequate infrastructure; Inequalities between environments; Increased anxiety, frustration	Qualitative; Study of cases	Teacher training; Importance of emotions; functional policy response
Suárez et al. (2021)	Poor academic staff training; Increased anxiety, frustration; Usability problems; Adequate infrastructure; access problems	Qualitative; Survey analysis; Study of cases	Functional policy response; Improvement of digital literacy; Teacher training
Sumra et al. (2022)	Access problems, inadequate infrastructure; Inequalities between environments; Poor academic staff training	Quantitative; Questionnaire analysis	Teacher training; institutional organization; Improve infrastructures; Functional policy response
Ukaogo et al. (2021)	Inadequate infrastructure; Inequalities between environments; access problems	Qualitative; Study of cases	Functional policy response

Table 5. Coding and results of the variables identified in the studies

4. Discussion and Conclusions

The systematic review proposed in this work made it possible to trace a path that can give an answer to the questions formulated at the beginning: (i) what are the parameters the greatest impact of the digital divide showed during the years of the recent pandemic, (ii) what were the methods used to assess that impact, and, finally, (iii) what proposals can be made in order to minimize those consequences. In this section, an interpretation of the results obtained is made, emphasizing the evidence indicated in the studies.

4.1. Interpretation

From the data obtained in the analysis, it is evident that the first two levels of the digital divide continue to show their impact on e-learning. Although the number of computers and Internet connections continues to grow, especially in developed countries, the access gap is perpetuating, taking new forms. The devices used for digital learning do not always incorporate the necessary functionalities to meet the requirements of virtual learning. It can be stated then that the transition from information and communication instruments to meaningful tools (Sancho, 2008), is not achieved in many cases, or does not fulfil the functional character that is assumed for ICTs.

If the level of access to the digital divide was one of the great obstacles for virtual learning in the pandemic, the level of use has been revealed as another of the great problems exposed. The development of the essential skills for virtual learning is a still outstanding point in order to achieve digital inclusion, which also shows its impact on the essential communicative skills to achieve academic sufficiency. The workload, the location of materials and other aspects of virtual teaching require a fluid exchange between the actors in the teaching-learning process that is often paralyzed by the usability gap. In this sense, it is evident that the implementation of digital tools still requires training in digital competences for both teachers and students (Cabero-Almenara & Ruiz-Palmero, 2018; Rodicio-García et al., 2020).

The difficulties arising from the appropriation gap, that is, the results obtained through the use of digital tools, have been highlighted, although to a lesser extent. This specific gap, pointed out in studies of diverse geographical locations, represents an obstacle for which no specific measures have been proposed. Likewise, some studies report on the limitations derived from the digital gender gap: originating either from cultural restrictions, while the role of women in certain societies demands priorities that hinder the demands of virtual learning; or because training in certain technology-related skills has not traditionally been associated with women. There is a certain disagreement in some studies, however, about gender differences in terms of the usability gap (Frei-Landau & Avidov-Ungar, 2022; Muchabaiwa & Gondo, 2022).

On the other hand, providing teaching centres with the optimal technical means for virtuality, would allow the development of the necessary skills to ensure that their use do not imply a brake when it comes to perfecting self-regulatory habits for online teaching. They can also help to mitigate the feelings of anxiety that can frustrate the learning process. This measure not only includes educational facilities, but also the implementation of programs that serve to suitably equip the students themselves. This reflects the considerations that place the focus on the social divide (Cabero, 2015) as a determining factor when referring to the digital divide. Similarly, inequalities motivated by economic, cultural and generational circumstances (Castaño & Webster, 2016; Somolinos, 2018; Varela, 2015) have a crucial influence when weighing institutional policies that decide on available training programmes and infrastructures.

Finally, the results achieved have made it possible to respond to the specific objectives set out in our research. Our study has succeeded in assembling an orderly and coherent bank of up-to-date bibliographical references that make it possible to study the concepts of the digital divide and digital competence in depth. Similarly, we have produced a bibliographical corpus analysing the current issues surrounding the digital divide and e-learning in higher education. Finally, different studies that evaluate the incorporation of digital resources in higher education in the last three years have been analysed, as well as the proposals suggested to improve the scope of their inclusion.

4.2. Limitations of the Evidence

Finally, it is pertinent to point out the limitations of the study. The main limitation of this systematic review is linked to the selection of studies, as the breadth of the sample, was reduced to the WOS and SCOPUS databases in order to seek the highest possible quality. On the other hand, the search strategies and inclusion criteria used may have excluded some works of relevance to this review. Our initial question about the impact on higher education may have also limited the number of studies that could have been considered, amongst which it is possible to find numerous research studies dedicated to other educational stages. In this respect, the decision adopted for this review does not address the full impact of the digital divide in the educational field during the pandemic, consequently, we plan to expand this search strategy to the entire education system in future research. On the other hand, this research has not conditioned its analysis to the impact of the digital divide on social groups with certain characteristics. Economic, cultural and gender criteria, among others, are significant parameters of analysis in the study of the digital divide.

4.3. Future Research

With the above observations in mind, we believe it would be interesting to conduct a systematic review that focuses specifically on analysing the gender digital divide consequences during the pandemic years. It would also be necessary to carry out research to compare the results obtained in this study with studies focusing on the effects of the post-COVID digital divide. We believe that both the use of digital tools for teaching and communication among those who make up the educational context, maintain high levels of frequency of use although not with the same intensity.

It would also be valuable to include as a criterion for future research to describe certain variables that condition the characteristics of certain social groups. In this way, we could identify the presence or absence of certain consequences of the digital divide or the magnitude of proposed solutions taking into account such distinctions.

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References

- Álvarez, J.F. (2019). Nativos Digitales y brecha digital: una visión comparativa en el uso de las TIC. *Revista de la Asociación Española de Investigación de la Comunicación*, 6(11), 203-223.
<https://doi.org/10.24137/raic.6.11.12>
- Anyika, V.O., Anikelechi, I.G., & Thobejane, T.D. (2021). The Impact of Covid-19 on Nigerian Education System. *Journal of Intellectual Disability - Diagnosis and Treatment*, 9(2), 222-227.
<https://doi.org/10.6000/2292-2598.2021.09.02.9>
- Astudillo, M.P. (2021). ICT in higher education to solvent a health crisis. *Etic@net. Revista Científica Electrónica de Educación y Comunicación en la Sociedad del Conocimiento*, 21(2), 451-472.
<https://doi.org/10.30827/eticanet.v21i2.21780>
- Barrientos-Báez, A., García, Á.P., & Caldevilla-Domínguez, D. (2021). Technological digital literacy: volunteer training. *Investigaciones sobre lectura*, 15, 95-129. <https://doi.org/10.24310/isl.vi15.12560>

- Burgess, S., & Sievertsen, H. (2020). Schools, skills, and learning: The impact of COVID-19 on education. *VoxEu CEPR*. Available at: <https://tinyurl.com/suy8auxy>
- Cabero-Almenara, J., & Ruiz-Palmero, J. (2018). Las Tecnologías de la información y la comunicación para la inclusión: reformulando la brecha digital. *International Journal of Educational Research and Innovation (IJERI)*, 9, 16-30. Available at: <https://tinyurl.com/yvzmcp82>
- Cabero, J. (2015). Reflexiones educativas sobre las tecnologías de la información y la comunicación (TIC). *Tecnología, Ciencia y Educación*, 1, 19-27. <https://doi.org/10.51302/tce.2015.27>
- Cabero, J., & Barroso, J. (2015). *Nuevos retos en tecnología educativa*. Síntesis.
- Calderón, D.C. (2019). Una aproximación a la evolución de la brecha digital entre la población joven en España (2006-2015). *Revista Española de Sociología*, 28(1), 27-44. <https://doi.org/10.22325/fes/res.2018.16>
- Cañón, R., Grande, M., & Cantón, I. (2016). Brecha digital: Impacto en el desarrollo social y personal. Factores asociados. *Tendencias Pedagógicas*, 28, 115-132. <https://doi.org/10.15366/tp2016.28.009>
- Castañeda, L. (2019). Debates regarding Technology and Education: contemporary pathways and pending conversations. *Revista Iberoamericana de Educación a Distancia*, 22(1), 29-39. <https://doi.org/10.5944/ried.22.1.23020>
- Castañó, C., & Webster, J. (2016). *Género, ciencia y tecnologías de la información*. Editorial UOC.
- De Benito-Castanedo, J. (2017). Análisis bibliográfico sobre la brecha digital y la alfabetización en nuevas tecnologías. *Revista Electrónica Educare*, 21(2), 1-10. <https://doi.org/10.15359/rec.21-2.9>
- Domínguez, G., Jaén, A., & Ceballos, M.J. (2017). Educar la virtualidad. *Pixel-Bit. Revista de Medios y Educación*, 50, 187-199. <https://doi.org/10.12795/pixelbit.2017.i50.13>
- Dragulanescu, N.G. (2002). Review Social impact of the digital divide in a central-eastern European country. *Internacional Information & Library*, 34(2), 139-151. <https://doi.org/10.1080/10572317.2002.10762570>
- Fernández-Mellizo, M., & Manzano, D. (2018). Análisis de las diferencias en la competencia digital de los alumnos españoles. *Papers: Revista de Sociología*, 103(2), 175-198. <https://doi.org/10.5565/rev/papers.2369>
- Flórez, M., Aguilar, A.J., Peña, H., Yurley, K., Salazar, J.P., Pinillos, J.A. et al. (2017). Sociedad del conocimiento, las TIC y su influencia en la educación. *Revista Espacios*, 38, 39-46. Available at: <https://tinyurl.com/vfujnfbp>
- Frei-Landau, R., & Avidov-Ungar, O. (2022). Educational equity amidst COVID-19: Exploring the online learning challenges of Bedouin and Jewish Female Preservice Teachers in Israel. *Teaching and Teacher Education*, 111. <https://doi.org/10.1016/j.tate.2021.103523>
- Gan, I., & Sun, R. (2022). Digital Barriers and Individual Coping Behaviors in Distance Education During COVID-19. *International Journal of Knowledge Management (IJKM)*, 18(1), 1-15. <http://doi.org/10.4018/IJKM.290023>
- García, N., Rivero, M.L., & Ricis, J. (2020). Brecha digital en tiempo del COVID-19. *Revista Educativa Hekademos*, 28, 76-85. Available at: <https://tinyurl.com/8433kmc9>
- Gómez, D.A., & Martínez, M. (2022). Usos del internet por jóvenes estudiantes durante la pandemia de la covid-19 en México. *Paakat. Revista De Tecnología y Sociedad*, 12(22). <https://doi.org/10.32870/pk.a12n22.724>
- Gómez-Trigueros, I.M. (2023). *Desafíos de la inclusión digital. La brecha digital de género y las competencias digitales docentes en el contexto educativo*. Octaedro.
- González-Benito, A., Gutiérrez-de-Rozas, B., & Otero-Mayer, A. (2022). La brecha digital como factor de exclusión social: situación actual en España. *Cuestiones pedagógicas. Revista de Ciencias de la Educación*, 2(31), 105-130. <https://doi.org/10.12795/CP.2022.i31.v2.06>

- González, M., Ojeda, M., & Pinos, P. (2020). Desafío del siglo XXI en la educación: dando saltos del TIC-TAC al TEP. *Revista Científica*, 5(18), 323-344. <https://doi.org/10.29394/Scientific.issn.2542-2987.2020.5.18.17.323-344>
- Jiménez, V.G., Garay, J.R., & Santos, M.I. (2021). Vivencias y experiencias de estudiantes universitarios en ambientes virtuales de aprendizaje en tiempos de confinamiento educativo. *Dilemas Contemporáneos: Educación, Política y valores*, 9. <https://doi.org/10.46377/dilemas.v9i.2951>
- Katz, V.S., Jordan, A.B., & Ognyanova, K. (2021). Digital inequality, faculty communication, and remote learning experiences during the COVID-19 pandemic: A survey of U.S. undergraduates. *PLoS ONE*, 16(2). <https://doi.org/10.1371/journal.pone.0246641>
- Lloyd, M. (2020). Desigualdades educativas y la brecha digital en tiempos de COVID-19. In Casanova, H. (Coord.), *Educación y pandemia: una visión académica* (115-121). UNAM. Available at: <https://tinyurl.com/mryn7re2>
- Marín, V.I. (2022). La revisión sistemática en la investigación en Tecnología Educativa: observaciones y consejos. *RiTE Revista interuniversitaria de investigación en Tecnología Educativa*, 13, 62-79. <https://doi.org/10.6018/riite.533231>
- Majola, M.X., & Mudau, P.K. (2022). Lecturers' Experiences of Administering Online Examinations at a South African Open Distance E-Learning University during the COVID-19 Pandemic. *International Journal of Educational Methodology*, 8(2), 275-283. <https://doi.org/10.12973/ijem.8.2.275>
- Montiel, H., & Gómez-Zermeño, M.G. (2022). Rock the Boat! Shaken by the COVID-19 Crisis: A Review on Teachers' Competencies in ICT. *Frontiers in Education*, 6. <https://doi.org/10.3389/feduc.2021.770442>
- Moya-Otero, J., & Hernández-Ortega, J. (2020). Una metamorfosis educativa para alcanzar el desarrollo humano sostenible. Propuesta curricular desde la experiencia de innovación Atlántida. *Profesorado*, 24(3), 149-173. <https://doi.org/10.30827/profesorado.v24i3.15971>
- Morgan, K., Melendez-Torres, G., Bond, A., Hawkins, J., Hewitt, G., Murphy, S. et al. (2019). Socio-Economic Inequalities in Adolescent Summer Holiday Experiences, and Mental Wellbeing on Return to School: Analysis of the School Health Research Network/Health Behaviour in School-Aged Children Survey in Wales. *International Journal Of Environmental Research And Public Health*, 16(7), 1107. <https://doi.org/10.3390/ijerph16071107>
- Muchabaiwa, W., & Gondo, R. (2022). Covid-19 and the virtual classroom conundrum in Zimbabwean universities. *Journal of Education*, 86, 107-125. <https://doi.org/10.17159/2520-9868/i86a06>
- OECD (2022). *OECD Education at a Glance*. Available at: <https://tinyurl.com/bdf3x6nm>
- Olarte, S. (2017). Brecha digital, pobreza y exclusión social. *Temas Laborales*, 138, 285-313. Available at: <https://tinyurl.com/3pz4n47a>
- Osmond-Johnson, P., Campbell, C., & Pollock, K. (2020) *Moving forward in the Covid-19 Era: Reflections for Canadian Education*. EdCan Network. Available at: <https://tinyurl.com/yhn8f63n>
- Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D. et al. (2021). Declaración PRISMA 2020: Una guía actualizada para la publicación de revisiones sistemáticas. *Revista Española de Cardiología*, 74(9), 790-799. <https://doi.org/10.1016/j.recesp.2021.06.016>
- Prensky, M. (2011). *Enseñar a nativos digitales*. SM.
- Rangel-Pérez, C., Gato-Bermúdez, M.J., Musicco-Nombela, D., & Ruiz-Alberdi, C. (2021). The massive implementation of ict in universities and its implications for ensuring sdg 4: Challenges and difficulties for professors. *Sustainability*, 13(22). <https://doi.org/10.3390/su132212871>

- Redondo-Corcobado, P., & Fuentes, J.L. (2020). La investigación sobre el aprendizaje-servicio en la producción científica española: una revisión sistemática. *Revista Complutense de Educación*, 31(1), 69-83. <https://doi.org/10.5209/rced.61836>
- Robinson, L., Cotten, S., Ono, H., Quan-Haase, A., Mesch, G., Chen, W. et al. (2015). Digital inequalities and why they matter. *Information. Communication & Society*, 18(5), 569-582. <https://doi.org/10.1080/1369118X.2015.1012532>
- Rodicio-García, M.L., Ríos-de-Deus, M.P., Mosquera-González, M.J., & Penado-Abilleira, M. (2020). La brecha digital en estudiantes españoles ante la crisis de la Covid-19. *Revista Internacional de Educación para la Justicia Social*, 9(3), 103-125. <https://doi.org/10.15366/riejs2020.9.3.006>
- Rogers, E.M. (2001). The Digital Divide. *Convergence*, 7(4), 96-111. <https://doi.org/10.1177/135485650100700406>
- Roig-Vila, R., Mengual-Andrés, S., & Quinto-Medrano, P. (2015). Primary teachers' technological, pedagogical and content knowledge. [Conocimientos tecnológicos, pedagógicos y disciplinares del profesorado de Primaria]. *Comunicar*, 45, 151-159. <https://doi.org/10.3916/C45-2015-16>
- Saha, A., Dutta, A., & Sifat, R.I. (2021). The mental impact of digital divide due to COVID-19 pandemic induced emergency online learning at undergraduate level: Evidence from undergraduate students from Dhaka City. *Journal of Affective Disorders*, 294, 170-179. <https://doi.org/10.1016/j.jad.2021.07.045>
- Sánchez-Prieto, J.C. (2020). La revisión sistemática de la literatura en investigación educativa: posibilidades, riesgos y sostenibilidad. *Aula Magna 2.0*. Available at: <https://cuedespyd.hypotheses.org/8753>
- Sánchez-Serrano, S., Pedraza-Navarro, I., & Beltrán-Velasco, A.I. (2022). ¿De qué hablo cuando hablo de innovación educativa? Una revisión sistemática. In Carrascal-Domínguez, S., & Camuñas-Sánchez-Paulete, N. (Coords.), *Docencia y aprendizaje: Competencias, identidad y formación del profesorado* (587-606). Tirant lo Blanch. Available at: <https://tinyurl.com/2p9ba378>
- Sánchez-Serrano, S., Pedraza-Navarro, I., & Donoso-González, M. (2022). ¿Cómo hacer una revisión sistemática siguiendo el protocolo PRISMA?: Usos y estrategias fundamentales para su aplicación en el ámbito educativo a través de un caso práctico. *Bordón: Revista de pedagogía*, 74(3), 51-66. <https://doi.org/10.13042/Bordon.2022.95090>
- Sancho, J.M. (2008). De TIC a TAC, el difícil tránsito de una vocal. *Revista de Investigación en la Escuela*, 64, 19-30. <https://doi.org/10.12795/IE.2008.i64.02>
- Sebbowa, D.K. (2022). History Education during COVID-19: Reflections from Makerere University, Uganda. *Yesterday and Today*, 27, 117-142. <https://doi.org/10.17159/2223-0386/2022/n27a5>
- Somolinos, A. (2018). El reflejo del patriarcado en la administración electrónica. In Saiz, C. (Ed.). *Investigación joven con perspectiva de género III* (20-32). Instituto de Estudios de Género Universidad Carlos III.
- Suárez, B., García-Perales, N., & Elisondo, R.C. (2021). La vivencia del alumnado en tiempos de COVID-19: estudio comparado entre las universidades de Extremadura (España) y Nacional de Río Cuarto (Argentina). *Revista Española de Educación Comparada*, 38, 44-68. <https://doi.org/10.5944/reec.38.2021.28936>
- Sumra, K.B., Mumtaz, M., Mohamed, N.D., Haseeb, A., & Ansari, S.H. (2022). Online Education amid COVID-19 Crisis: Issues and Challenges at Higher Education Level in Pakistan. *IJERI. International Journal of Educational Research and Innovation*, 18, 240-259. <https://doi.org/10.46661/ijeri.6429>
- Tejedor, S., Cervi, L., Tusa, F., & Parola, A. (2020). Educación en tiempos de pandemia: reflexiones de alumnos y profesores sobre la enseñanza virtual universitaria en España, Italia y Ecuador. *Revista Latina de Comunicación Social*, 78, 1-21. <https://doi.org/10.4185/RLCS2020-1466>

- Teräs, M., Suoranta, J., Teräs, H., & Curcher, M. (2020). Post-Covid-19 Education and Education Technology ‘Solutionism’: a Seller’s Market. *Postdigit Sci Educ*, 2, 863-878. <https://doi.org/10.1007/s42438-020-00164-x>
- Trujillo, F., Fernández, M., Montes, M., Segura, A., Alaminos, F.J., & Postigo, A.Y. (2020). *Panorama de la educación en España tras la pandemia de COVID-19: la opinión de la comunidad educativa*.
- Ukaogo, V.O., Orabueze, F.O., & Ojukwu, C.K. (2021). Tertiary Teachers Strike (TTS) and e-Learning Deficit amidst Covid-19 Crisis in Nigeria. *Rupkatha Journal on Interdisciplinary Studies in Humanities*, 13(3). <https://doi.org/10.21659/rupkatha.v13n3.21>
- Van Dijk, J. (2017). Digital divide: Impact of access. In Rössler, P., Hoffner, C.A., & Van Zoonen, L. (Eds.), *The International Encyclopedia of Media Effects* (1-11). John Wiley y Sons. <https://doi.org/10.1002/9781118783764.wbieme0043>
- Varela, J. (2015). *La brecha digital en España. Estudio sobre la desigualdad postergada*. Comisión Ejecutiva Confederal de UGT.
- Vivanco-Saraguro, A. (2020). Teleducación en tiempos de COVID-19: brechas de desigualdad. *CienciAmérica*, 9(2), 166-175. <https://doi.org/10.33210/ca.v9i2.307>
- Zhou, L., Wu, S., Zhou, M., & Li, F. (2020). ‘School’s Out, But Class’ On’, The Largest Online Education in the World Today: Taking China’s Practical Exploration During The COVID-19 Epidemic Prevention and Control as an Example. *SSRN Electronic Journal*, 4(2), 501-519. <https://doi.org/10.2139/ssrn.3555520>
- Zawacki-Richter, O., Marín, V.I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education-where are the educators? *International Journal of Educational Technology in Higher Education*, 16. <https://doi.org/10.1186/s41239-019-0171-0>

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