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# Digital divide and accessibility in online education

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**Abstract:** The accelerated transition to online learning, driven by the COVID-19 pandemic, has exposed deep educational inequalities and barriers to access in digital contexts. The purpose of this article is to identify four main types of barriers: digital divide, difficulties in executive and psycho-emotional functions, poor pedagogical design, and limitations in socio-communicative communication, through a systematic review of literature based on the PICO strategy. Findings reveal that limited access to technology, lack of digital literacy, and demotivation caused by inadequate resources hinder the learning experience for many students, especially in vulnerable contexts. The difficulties associated with the lack of social interaction and emotional support in digital environments are also highlighted. Based on the findings, measures such as teacher training, the creation of accessible and flexible content, and the implementation of pedagogical strategies that promote collaboration and inclusion are proposed. In conclusion, this study highlights that not only will tackling these barriers boost the effectiveness of online learning, but they also open up new opportunities to promote more equitable and accessible education.

***Keywords:*** *Digital divide, Educational accessibility, Educational barriers, E-learning, Online education.*

## 1. Introduction

Online learning or e-learning has become an essential tool and is shown to be an inevitable option for the education of the future. Actually, this type of learning has received considerable attention due to the global spread of the COVID-19 pandemic, as many educational institutions were forced to transform their students' education suddenly due to school closures. Multiple authors agree that it will continue because these new educational trends are more in line with the digital world of the twenty-first century [1, 2].

The digital divide, low acceptance of technology, low user satisfaction of e-learning, and lack of human and technical infrastructure have led to many challenges in the acceptance of technology in the education sector, particularly in developing countries [3]. Poor and emerging nations have a shortage of technological infrastructure and their access to low-cost network options is inadequate. According to Treve [4] statistics highlight that only 60% of the world's population is online, with large differences between regions, while Internet penetration is 95% in North America, in Africa it is only 39.3%.

There is no doubt that COVID-19 exposed inequalities in educational opportunities. While developed countries were able to easily plan for the shift to virtual learning, and appease the adverse effects of the pandemic, the situation was not so easy for developing countries. In Europe, the immediate switch to online mode after the closure of the centers was 85%, while in Africa it was 29% [4]. Despite this inequality, online learning allows for synergies and collaborative experiences and union between different universities and institutions without geographical and political distinction [5] which could reduce inequalities between nations.


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Distance learning also presents challenges when it comes to characterizing the students with special educational needs. According to Minhas and Freeman [6] the physical environment of the classroom can provide indications that suggest the presence of disorders, such as learning disabilities, attention deficit hyperactivity disorder, autism spectrum disorder, among others, but that these indications can go unnoticed in a virtual environment.

Nonetheless, the accessibility of online courses is critical to attracting those who would not be able to participate in traditional learning. For example, according to Bashir, et al. [7] the *Open University* reported that 26% of its undergraduate students in the UK lived in disadvantaged areas. In addition, relevant data provided by the Universia Foundation [8] shows the preference that students with disabilities have between the face-to-face modality (1% of the total number of students) and the distance modality (4.2% of the total number of students). These data show a significant difference in the ratios, which implies that the distance modality is especially attractive for students with disabilities and emphasize the importance of studies that contribute to their inclusion in digital environments.

Despite the potential challenges, which were discussed in this review, online learning shows many opportunities. Online learning opportunities include flexibility, such as being able to structure learning around lifestyle requirements (e.g., treatment or care for disabilities) and participating in academic circles regardless of difficulties with vision, speech, or mobility [9]. According to Forde and OBrien [10] it facilitates higher-order learning, allows the practice of skills in a safe environment, effective use of class time, allows access to education for all, learning comes to life, enables a wide range of learning materials, and promotes autonomous learning.

Thus, online courses allow educational institutions to attract and educate a more diverse student population. Further progress on accessibility and diversity in education is crucial to ensure that everyone has equal learning opportunities. The first step in providing equitable and accessible education is to identify existing barriers so that they can be removed.

Therefore, this article aims to know the accessibility barriers faced by students in digital learning through a systematic review of the literature using the PICO search strategy.

### *1.1. Inequality and the Digital Divide*

The digital divide cannot be measured in dichotomous terms as has sometimes been done (access/non-access to the Internet or ownership/non-ownership of devices). According to Katz, et al. [11] the digital divide is the lack of connection during a continuum, people may be insufficiently connected due to interruptions in Internet access, slow or insufficient devices or connection for needs, family sharing of devices, depending only on mobile phones or difficulty in technological maintenance.

Several authors point out three levels of digital inequality [1, 11] the first level refers to unequal access to the Internet and digital devices; the second level to discrepancies in digital matters, skills and commitment; and third-level, to the differential results of one's efforts to use access and digital skills to achieve a goal. An accessible instructional design can have an impact on the second and third levels.

Connection problems and access to technologies is the key to achieving equitable digital learning, even so, the study by Katz, et al. [11] shows that the variation in competence for digital learning is more significant than communication challenges. To be digitally competent need to develop skills to successfully locate information online and assess its quality, as well as to participate in the production of digital content.

Universities could support vulnerable students by reducing their levels of digital poverty and consider providing them with access to the internet and equipment. When the environment is not suitable or due to digital poverty, they will need a place on campus to work where they are provided with laptops and internet access, either in the library or other student-centered spaces [7]. In this way, equitable learning experiences could be guaranteed throughout the student cohort

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## 2. Methodology

*2.1. Systematic Review*

In the systematic review about barriers, the published literature on the topic has been exhaustively scanned to find answers to the research question clearly defined with the PICO strategy [12] and relying on the PRESS strategy [13]. Finally, the following search stages have been followed, listed in Table 1.

**Table 1.**
Stages of the systematic review.

| Stage | Description | Result/Product |
|---|---|---|
| 1. Identifying the problem | Since the pandemic, relevant barriers have been identified in online learning for research. | Approach to revision. |
| 2. First research question | Initial formulation of the research question based on initial observations and initial keywords. | Initial question and preliminary keywords. |
| 3. Initial Exploration | Preliminary literature review to adjust the research question and refine key terms. | A fine-tuned question and an adjusted approach. |
| 4. Evaluation of initial evidence | Critical selection of studies to approach the topic and be able to ask a good question. | Cleaned keywords. Studies identified. |
| 5. Identifying the Ultimate Question | Final refinement of the research question based on the initial assessment. | Definitive question for the systematic review. |
| 6. Search for evidence | Conducting systematic searches in relevant databases. | Initial set of studies found. |
| 7. Debugging the results | Elimination of duplicates and selection of studies according to inclusion and exclusion criteria. | A curated list of included studies. |
| 8. Evaluation of the results | Critical and systematic analysis of the selected studies. | Final set of studies evaluated. |
| 9. Extraction of results | Extraction of key data to synthesize evidence and draw conclusions. | Summary of results and conclusions. |

Table 2 shows the four components of the PICO strategy adapted to education in order to construct the research question using this strategy.

**Table 2.**
PICO strategy.

| Acronym | Definition | Description |
|---|---|---|
| P | Population | Students in digital learning environments |
| I | Intervention | Identification of educational barriers in digital contexts |
| C | Comparison | Educational situation before and after the COVID-19 pandemic |
| Or | "Outcome" (Results) | Educational accessibility |

Through these descriptors in Table 2, the following research question was constructed: What are the barriers that prevent educational accessibility to students in digital learning environments today, taking into account the rapid change towards these environments accelerated by the pandemic?

The search was carried out during the months of February, March and April 2024, the first exploratory search was carried out in the university library's search engine with access to multiple databases, Google Scholar, grey literature (UNESCO, UN reports), and by the "snowball" method selecting relevant articles that the authors consulted cited. The definitive and systematic search with the question based on the PICO strategy was carried out in impact databases such as ERIC and Web of Science (WoS). The search terms have been extracted from the PICO question and the keywords have been selected using the European Thesaurus of Education. The definitive search strategy that uses Boolean operators (Y, O) and truncations is shown in Table 3.

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**Table 3**.
Search strategy.

| Element | Description |
|---|---|
| Keywords | "Educational accessibility", "Students", "Educational barriers", "Digital learning", "Pandemic" |
| Synonyms and related | "Access to education", "Students", "Obstacles", "E-learning", "Distance learning", "COVID-19", "Coronavirus" |
| Boolean Operators | (Educational accessibility OR Access to education OR Equal opportunity) AND (Student* Barriers OR Student* Obstacles OR Student* Difficulties) AND (Online education OR Distance education OR e-learning OR Digital education) AND (Pandemic OR COVID-19 OR Coronavirus) |

Once the search strategy was defined with Boolean keywords and operators, it was critical to establish rigorous inclusion and exclusion criteria to ensure that the selected studies were relevant and aligned with the research objectives. Table 4 describes these criteria, which allowed the results obtained to be filtered according to the type of literature, language, chronology and thematic content.

**Table 4.**
Inclusion criteria.

| Criterion | Inclusion | Exclusion |
|---|---|---|
| Type of literature | Peer-reviewed articles | Conference proceedings, doctoral theses, posters, book chapters |
| Language | English and Spanish | Other languages |
| Chronology | 2020-2024 | Pre-2020 |
| Thematic area | Education | Other non-specific areas of education such as technology, psychology... |
| Content | Analyze student barriers to digital education | - Studies focused solely on technological barriers with no pedagogical implications<br>- Research not related to the digital educational context |

As the Table 4 shows, only peer-reviewed articles have been selected from 2020 onwards, as COVID significantly increased online education and thus boosted research in this field. Only articles in English and Spanish with full access to the text and that were collected in medium and high impact journals were selected.

In the stage of filtering the results of the final search with this search strategy, the scheme shown in Figure 1 was followed to obtain the most relevant results.

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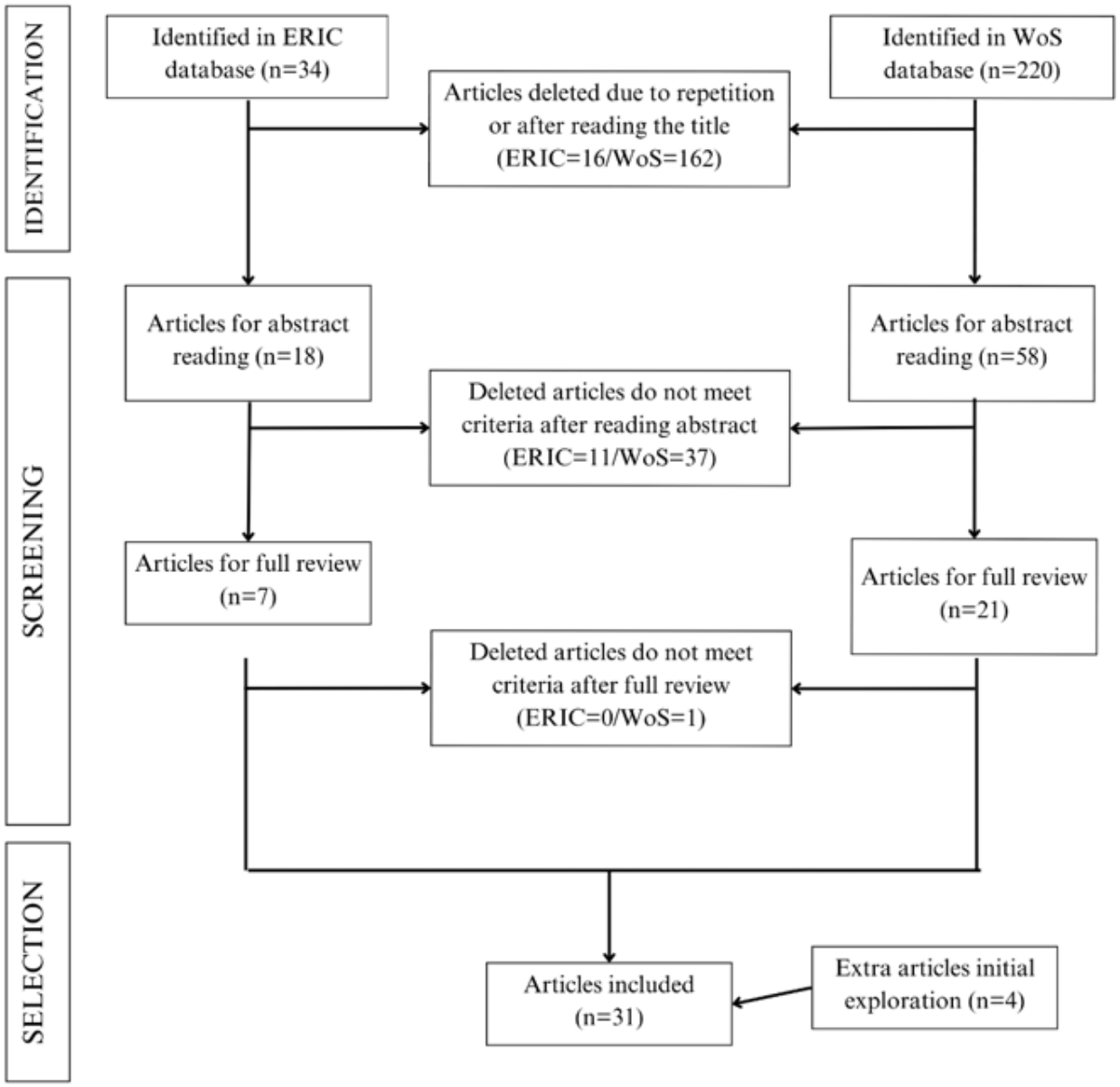


**Figure 1.**
Study search and selection diagram. Own elaboration, inspired by the PRISMA style.

## 3. Results

All research agreed that the pandemic has accelerated digitalization by providing analysis on the effects of such changes. In general, most of these articles were found focusing in the analysis on the higher education sector.

Four large groups of barriers to digital learning have been found, as shows the Figure 1: Digital divide, executive or psycho-emotional functions, instructional design and socio-communicative barriers.

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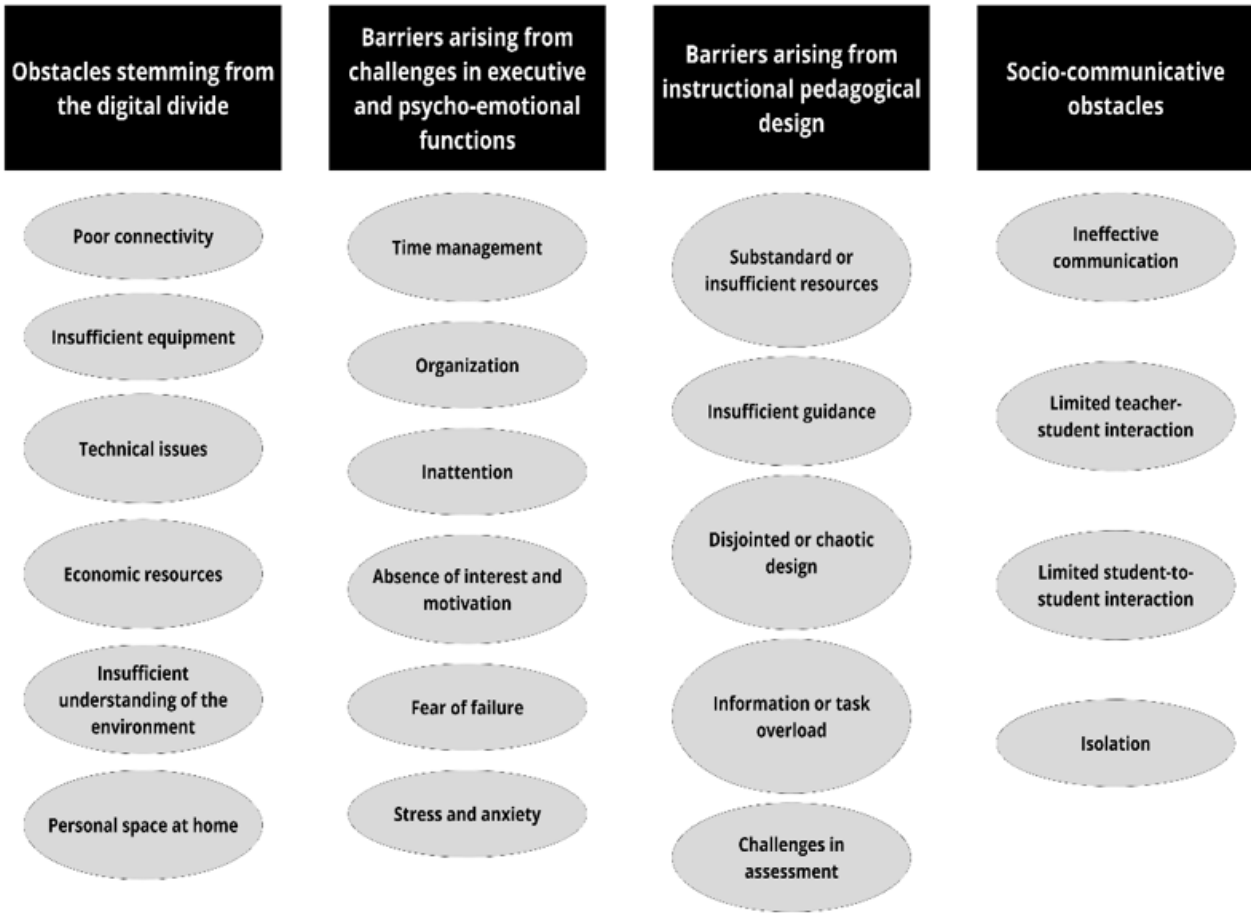


**Figure 2.**
Digital learning barriers. Own elaboration.

*3.1. Digital Divide*

The digital divide manifests itself in inequalities of access, both physical for access to technological resources, and in terms of digital literacy, which represents a significant challenge for the mobilization of digital resources. In this context, digital sustainability must prioritize the promotion of digital literacy to ensure that all people possess the knowledge and skills necessary to effectively navigate the digital world Sing Yun [2]. Bridging the digital divide is not only a matter of technological equity, but a fundamental condition for achieving inclusive and effective digital sustainability.

According to Sing Yun [2] digital sustainability implies the responsible use of digital technologies and resources to promote environmental, economic, and social sustainability. In this framework, educational processes are considered crucial to promote digital sustainability in a digital society with active learning. With the use of digital technology in education for sustainable development, school provides a crucial contribution to social cohesion and justice in an increasingly digitalized society.

One of the main challenges to achieving accessible digital education lies in the problems arising from the technological divide: the lack of devices, the challenges of network coverage that does not reach rural environments, and the costs of data services [1]. An unstable internet connection is a constant source of concern, as it makes it difficult to participate in live classes and download educational materials, interrupting the learning process recurrently [1, 14]. In addition, in multi-member households, students lacked an adequate environment to study. Many students reported constant distractions and a lack of a quiet place, which hindered their concentration and productivity [15].

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While these aspects cannot be ignored, and are critical factors, digital literacy must also be considered. During the pandemic, for example, it was found that in certain socioeconomically deficient environments, both students and teachers lacked training in the use of educational platforms, which generated frustration and adaptation problems [16, 17].

*3.1.1. Difficulties in Executive and Psychoemotional Functions*

Online learning requires autonomous time and task management, which is difficult for many students. The absence of a clear structure in classes makes it difficult for them to organize their schedules and prioritize activities, which leads to delays and accumulation of work [14].

Most studies Al-Kumaim, et al. [18]; Aroonsrimarakot, et al. [14]; Azizan and Abu-Shamsi [19]; Forde and OBrien [10]; Nazir and Khan [17]; Treve [4] and Sing Yun [2] point out the demotivation of students in digital environments as one of the main challenges in online education. Some reasons identified by students are distractions when at home, difficulty in understanding materials, boredom derived from static online learning and with little interaction, which as a whole causes a loss of interest and motivation [17].

In relation to attention, Aroonsrimarakot, et al. [14] observed that most students were distracted and tempted to view other sites while taking online classes. Lozoya, et al. [20] suggest that student engagement and information retention decrease with the duration of the activity, so material delivered in shorter chunks maximizes attention and retention [7].

Anxiety and stress are common emotions in this context. Adapting to a digital format, coupled with academic demands and technological limitations, greatly increases students' anxiety levels. In addition to this, difficulties in balancing academic and family responsibilities were further aggravated during the pandemic in some occasions [16].

An attractive design for e-learning content could have an impact on these barriers to attention and motivation. According to Al-Kumaim, et al. [18] positive emotional designs for online learning content significantly increase students' motivation levels and facilitate learning. Although they suggest that the results should be re-examined in the contexts of undergraduate and graduate students, because an emotional design may not benefit more advanced students.

On the other hand, Aroonsrimarakot, et al. [14] point out that low student motivation can be improved by developing social presence, i.e., by building interaction, collaboration, and relationships between teachers and students through various social networks, such as blogs, chat, forums, videoconferences, etc. The integration of these dynamics promotes more active and participatory learning, helping to overcome psycho-emotional barriers in online education.

*3.1.2. Inadequate Instructional Pedagogical Design*

Effective pedagogical design is essential to ensure that online courses are accessible and functional. The first step to achieve this is to implement a multimodal approach, which allows the visualization of content on multiple devices. Today's college students rely on quick and easy ways to communicate with their professors and perform tasks interactively. Mobile interactive learning applications could play a crucial role in this context [18]. According to Salakhova, et al. [21] 75.6% of the students in their study preferred to use tablets or mobiles to connect. Similarly, in the study by Aroonsrimarakot, et al. [14] 74.2% of students used smartphones, followed by laptops or desktop computers (15%). These data underscore the need for a multimodal approach that offers flexible and accessible content in multiple formats, allowing students to choose what best suits their learning context [1].

Delivering effective educational content goes beyond publishing lesson videos. Incoherent, disorganized, or difficult designs to identify key information hinder learning (Forde & O'Brien, 2022). Developing high-quality resources is a priority. In the study by Al-Kumaim, et al. [18] 37.3% of students reported stress due to inadequate resources. Likewise, Lozoya, et al. [20] found that some activities lacked meaning, a problem especially notable in quantitative disciplines, where students face greater challenges compared to qualitative subjects, which are better adapted to the virtual format [17].

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The coherent structure of the courses is another critical aspect. Content presented in a disorderly manner or without clear guidelines generates confusion and makes it difficult to follow the rhythm of classes [17]. Distance education frequently lacks adequate organization, which affects student satisfaction and content follow-up [14, 21]. Communicating deadlines accurately is also essential, as their omission generates confusion that negatively impacts academic performance [20]. On the other hand, information and homework overload can overwhelm students, affecting their performance [7].

Online assessments present additional challenges, such as technical glitches and inappropriate formats. These problems affect students' confidence in the assessment process and generate frustration [7]. It is recommended to combine short questions and essays that promote critical thinking, adapting the tests to the technical realities of students, such as connectivity issues, and offering flexible schedules or 24-hour availability [1]. In addition, instructions should be personalized and supplemented with appropriate feedback [4].

Accessibility is another key aspect of online design. For students with hearing impairments, script provision is required. For those with visual difficulties, it is necessary to optimize font size, color contrast, and ensure compatibility with screen readers, complying with the Web Content Accessibility Guidelines [22]. However, accessibility also implies clarity in activities. Lozoya, et al. [20] identified that unclear descriptions made it difficult to understand the tasks.

The pedagogical approach should be student-centred and encourage active, self-directed participation. While this approach can be positive, it also comes with risks, such as distractions and difficulties related to self-discipline [4, 23]. The visual and technical design of content is equally important, as low-quality resources can demotivate students [10, 18].

To improve the learning experience, it is recommended to offer materials in various formats (MP4, PDF, PowerPoint), compressed for easy download and accessible on platforms such as Blackboard, WhatsApp or Google Drive. Dividing content into short episodes of 15 to 20 minutes promotes progressive assimilation and keeps students' attention [1]. Tasks should also be fragmented into smaller, more understandable components [4].

Synchronous sessions are valuable for clarification and questions. Tools such as email, Blackboard Collaborate, Zoom, and WhatsApp groups can facilitate these interactions [1]. In addition, recording these sessions and making them accessible allows for more flexible and self-directed learning [14, 20].

Finally, the work of Fitzpatrick and Trninic [24] highlights how the principles of Universal Design for Learning (UDL) can improve accessibility in online courses for students with intellectual disabilities. Among the strategies implemented are adapted assessments (oral, visual or written responses), questions with images and voice-overs, and progressive accompaniment towards the student's independence. These measures not only promote active participation, but also facilitate the transfer of learning to everyday contexts, underlining the importance of inclusive and personalized pedagogical design.

*3.1.3. Socio-Communicative Barriers*

Social-communicative barriers represent a significant challenge in the context of online learning, where student-teacher interactions are critical to academic success. According to Lozoya, et al. [20] students reported a lack of communication and support from teachers, who in some cases did not clarify doubts about content or activities. Although there is a general interest in more interactive lectures, only half of students are comfortable using video cameras to actively participate, which limits visual interaction and interpersonal connection [7].

Effective communication has been identified as a key pillar in the virtual environment. Tools such as emails, announcements, videos, and phone calls are used to maintain minimal interaction [22] but students insist on the need for constant communication, empathy in the face of technical problems and unexpected situations, and a variety of communication strategies [20]. In addition, learners demand constructive, detailed, and timely feedback, which not only improves content comprehension, but also reinforces their confidence in the learning process [14].

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Teamwork, while having the potential to reinforce complementary skills among students, also presents challenges. While teamwork fosters the responsibilities and learning with complementary skills that each individual on the team possesses, it is not easy for some of the team members because some of them might not have the same commitment and others might fall behind, for example, due to connectivity issues [19].

Likewise, online learning, while accessible, can be a lonely experience. These feelings of loneliness are even greater in students with disabilities since their perceptions are intertwined with their experiences of living with disabilities [9]. In addition, concerns about whether others will understand your disability can intensify, as contacts with other students are often limited to their coursework or other academic activities and do not come up as a topic of conversation. They fear that their behaviors may be misinterpreted. To address this issue, it is essential to encourage authentic interactions and create non-academic spaces for socialization, such as informal discussions, recreational activities, and virtual events, that promote a sense of community [9, 16].

In some of the studies consulted, students point out the need to collaborate with others to establish authentic social interactions rather than formal interactions [9]. Their comments referred to introducing some activities, places and personnel that facilitate informal (non-academic) socialization. Students suggest that activities and events be generated for informal socialization such as discussions unrelated to the course content to combat loneliness in online learning,

According to Treve [4] The power differences between teachers and students are blurring and educators must intentionally create opportunities for students to share their experiences and participate in activities to make it a student-centered pedagogy, based on constructivism. According to Downie, et al. [25] students see online learning as a collaborative enterprise, and highlight their desire to participate as co-producers of learning content. This entails a resulting shift in the conceptualization of the teacher-student relationship towards a more reciprocal model [25] and the potential role of students as co-creators of content.

## 4. Discussion of Results

The findings of this systematic review highlight several multidimensional barriers affect the accessibility and effectiveness of online learning. Knowing them will allow teachers to make an instructional design aligned with the principles of UDL, creating courses that are accessible and equitable for all. These barriers, grouped into four broad categories (digital divide, psycho-emotional difficulties, pedagogical design and socio-communicative barriers). These categories do not act in isolation, but are interrelated and reinforce existing inequalities in educational contexts

The digital divide is a persistent structural obstacle that emerges as an architectural challenge that transcends access to devices and connectivity. As Katz, et al. [11] point out, technological inequalities not only limit participation in virtual environments, but also directly affect the digital skills of students and teachers. In addition, unequal effects are observed according to the socioeconomic context, with students in rural and disadvantaged environments facing greater difficulties in accessing a stable connection and adequate equipment [14, 19]. Without equitable access to technological resources, online education cannot be considered a fully inclusive solution.

Psycho-emotional and executive function barriers and their impact on motivation are key elements to take into account in online learning because it requires high levels of self-management and discipline, characteristics that are not always developed in students, especially in contexts of uncertainty such as the one generated by the pandemic. Demotivation, stress, and lack of social interaction were identified as key barriers in multiple studies [14, 17]. The abrupt transition to the digital format exacerbated these problems, since virtual environments lack the emotional supports inherent to the physical classroom. According to Lozoya, et al. [20] the emotional design of resources, which integrate interactivity and dynamism, could mitigate demotivation and facilitate more effective learning.

Online learning focuses on self-directed study, and students are required to take responsibility for their own learning, taking the time to get comfortable with a skill by rewinding and reviewing skill

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demonstration videos at their convenience [10]. In the study by Lozoya, et al. [20] despite the drawbacks and problems detected, the students also showed positive attitudes, since thanks to the challenges presented they had been able to develop skills such as patience, organization, resilience, autonomy, responsibility, stress management, adaptation, and discipline.

Inadequate pedagogical design was highlighted as a limitation that amplifies students' difficulties, especially when resources lack clarity, accessibility, or accommodations. Excessively extensive activities, disorganized content, and assessments poorly adapted to digital environments increase cognitive load and academic stress [7, 20]. As proposed by Treve [4] and Fitzpatrick and Trninic [24] a pedagogical design based on the principles of Universal Design for Learning (UDL) could ensure that courses are accessible to a diverse student population, including those with disabilities.

The design, development, and delivery of high-quality learning resources play an important role in helping students achieve their desired learning outcomes [10]. Therefore, good digital design skills allow educators to develop course content that students can interact with in a meaningful way.

Another fundamental aspect of online learning is teacher training in digital skills, which is essential to design interactive and meaningful materials that respond to students' needs and promote deeper learning [10]. One solution for the structure of the course content is to be short, concise, simple, up-to-date, applicable in everyday life, and not to put unnecessary pressure on students [14].

University faculty should design and implement meaningful online learning activities with guidance and feedback to facilitate knowledge building and student learning management. As Videla, et al. [5] state, the transformation of learning requires a new curricular design that contemplates both changes in the forms of assessment and in the programs implemented, which is built on cooperative foundations.

In digital learning, the concept of "loneliness" is relevant due to the lack of interaction and feedback between students and teachers, being one of the fundamental characteristics in the design of a virtual environment. For this reason, it is presented as one of the greatest weaknesses in e-learning. Students demand constant and empathetic communication from teachers, as well as spaces for social interaction to mitigate the feeling of isolation [9, 20]. However, teachers' lack of training in virtual communication strategies and low student participation in interactive activities (e.g., videoconferencing) make it difficult to establish effective interpersonal relationships [1]. Creating collaborative environments and promoting non-academic activities could strengthen the sense of community and reduce perceived loneliness.

Faculty-student interactions and peer mentoring support could be scaled up in universities to create a sense of community and have a positive impact on student engagement in online learning. [16]. To support relationship needs for inclusive online learning, communities can be established at different levels, from courses and programs to university, so that higher education students can count on the support of their peers to build their confidence and improve their connection [16].

The four categories of barriers do not operate in isolation. For example, the digital divide can increase anxiety (psycho-emotional barrier) in students who cannot connect in a stable way; This, in turn, has an impact on motivation and can lead to abandonment of training activities or a low commitment to learning. On the other hand, a limited pedagogical design (poorly interactive or disorganised resources) can aggravate the digital divide by demanding high technical requirements or cognitively overloading students. These design shortcomings also undermine communication with the teacher, causing isolation.

## 5. Conclusions

In general, the review confirms that the success of digital learning depends both on the quality of the technological infrastructure and on the relevance of the pedagogical design and adequate socio-emotional support. It is essential that institutions guarantee devices and internet access for students who require it, while implementing teacher training programs for the mastery of digital tools and participatory teaching methodologies.

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Transforming face-to-face course to a blended or online format is not a simple matter of translating ideas and content into an online learning management system. The design and implementation of online courses must consider a wide range of factors to ensure equity, accessibility, and effectiveness in learning. The research has identified significant barriers in four main areas: digital divide, psycho-emotional difficulties, pedagogical design and socio-communicative barriers. These findings underscore the need for a comprehensive, student-centered approach that addresses these limitations in a coordinated manner.

To tackle the limitations encountered in a coordinated way, it is essential to design accessible and flexible courses, it is necessary to ensure that the resources and activities are clear, brief and adapted to different devices and platforms. This includes compliance with the Web Content Accessibility Guidelines to serve students with disabilities. The structure of the courses should facilitate self-discipline and organization, promoting autonomous learning by segmenting materials into manageable and dynamic blocks.

Likewise, institutions should implement infrastructure plans that guarantee a good internet connection and the availability of devices, while developing training programs in digital skills for teachers and students. Teacher training in digital skills and pedagogical design is crucial to ensure that activities are meaningful and tailored to students' needs.

Teachers must promote constant and empathetic communication, using synchronous and asynchronous channels. Feedback should be clear, timely, and constructive to reinforce students' motivation and confidence. To mitigate the feeling of loneliness and encourage more collaborative learning, it is key to integrate social activities, both formal and informal, that reinforce the sense of community.

While the challenges are significant, online learning also offers unique opportunities, such as flexibility and the ability to reach a diverse student population. However, its success depends on a concerted effort between institutions, teachers and students to overcome the barriers identified. Students need support in understanding how to manage and monitor their learning in order to strategically manage their time and learning environment. Therefore, teachers are required to be flexible in choosing content and tools that seem most appropriate for different interests, needs, and skill levels. Together, the combination of resources, digital literacy, emotional support, and pedagogical strategies focused on inclusion suggests a path to transform online learning into a more equitable and effective experience for the entire educational community.

In conclusion, the findings confirm that many of these barriers are interrelated and require comprehensive interventions. Not only do the digital divide affects the access to education, but they also influences on students' ability to get the most out of online courses, due to limitations in digital literacy. In turn, psycho-emotional barriers, such as demotivation, are aggravated by the lack of an inclusive and dynamic pedagogical design. As Bashir, et al. [7] and Yang, et al. [16] suggest, addressing these barriers holistically can transform digital learning into a powerful tool to reduce educational inequalities and foster inclusion.

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## Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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