Digital Gaps Influencing the Online Learning of Rural Students in Secondary Education: A Systematic Review

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Abstract—The digital gaps that were amplified due to the COVID-19 pandemic deepened more in vulnerable areas in different parts of the world. The present work aims to analyze the study of digital gaps that influence online learning of students from rural areas in secondary education, based on a systematic review of the literature. It was developed using the PRISMA methodology, the scientific information was retrieved from the Web of Science and ERIC databases in a period of three months. In the searches it was taken as inclusion criteria; open access, year of publication 2017 - 2021, English and Spanish language, rural secondary education level and exclusion; articles whose studies were carried out in higher education, in specific areas, related to research policies, evaluation, studies before 2017 and articles from systematic reviews. The results and findings emphasize that digital literacy levels are scarce and limited in terms of the skills developed by students and teachers to achieve digital competencies, in addition to restricted access due to technological, economic, and coverage gaps of families. The conclusions are aimed at strengthening urgent educational policies in addition to the integration of the school curriculum.

Index Terms—Digital gaps, digital skills, digital literacy, online learning, rural areas, secondary education, socio-economic aspect.

I. INTRODUCTION

Digital gaps were forged since the technology was evolving over the years; digital teaching and learning has created inequity in developed and underdeveloped countries, widening these inequalities according to their economy to respond to the availability of access and use of digital tools [1]-[3], in addition to considering human capital suitable for intervention through quality digital literacy [4]-[6]. Another aspect is the impact of the pandemic on the household economy to access computers and broadband internet [7], [8], in addition to taking into account the mobilization of their skills to be able to manipulate them, making visible that only dynamic economies could face the technological and digital world [1], [9], [10].

The systematic reviews reviewed tend to know the ICTs integrated into distance education models, barriers in the educational system and evaluate the quality of learning of students in rural areas [11], [12], as well as analyze the innovation processes developed within the framework of a new school model that leads to analyzing teacher preparation, content integration, and curricular transversality in the context of community and school [13]. Therefore, the study will deepen the analysis of digital gaps from four dimensions: digital inequality; inequality on the internet; hardware inequality, and quality of digital content [1], [4].

A. The Current Context of Digital Gaps

Digital gaps have gained more momentum with the health emergency caused by covid-19 that has forced all countries in the world to modify their face-to-face education for distance education [14], [15], conceived as the division between those who have the possibility of benefiting from ICT and the group that is still unable to do so [16], [17]. In addition to being the form of exclusion that widens the abyss that separates regions, countries, groups of citizens from society [18].

Online teaching and learning as a result of the confinement, was showing problems in the use of software, hardware, content quality, broadband internet connection, as well as the use of only one device per family; with students in rural areas being the most affected [1], [15], [19]. Overcoming these gaps can prevent school dropout, unequal learning between urban and rural, given by the incoherent educational policies that have not been sustainable over time, leading students to failure and frustration in distance education [4], [7], [10], [20]-[22].

The study agrees that digital gaps influence online learning from social and economic inequalities, lack of digital literacy, and online teaching methods [2], [7], [15]. In addition, it is amplified, because families have insufficient economic income, lack of technological tools, little knowledge of technology, poor internet connection, and even weakened emotional stability to accompany the educational process of their children [15], [19], [23]-[25].

Another aspect is digital literacy. It is verified that teachers and students had to improvise with the means they had at their disposal for the teaching-learning process, with insufficient mastery in digital skills, poor understanding of educational applications, learning networks, and online collaborative work [6], [15], [26]-[28]. In addition to considering the existence of emotional situations that prevent the promotion of digital skills and abilities such as motivation, stress levels, disconnection, integration, and trust with the digital world [29]-[32]; and the emphasis that institutional support plays an important role in forming competencies focused on the use of ICT, seeking the training, quality, and quantity of digital content [17], [33], [34].

Regarding teaching methods in the context of rural education, teachers did not make significant changes in online teaching strategies, activities did not involve creativity and collaboration, information was overstretched, and excessive use of virtual environments. The curriculum turned out not to be relevant [20], [23], [35]-[37].

The analysis carried out gives a look at the globalized world covering studies of countries of the African continent (Africa and Tanzania), America (United States, Canada, Mexico, Dominican Republic, Peru, Chile, Ecuador), Europe (Spain, Germany, Ireland, Russia, Turkey), Asia (Afghanistan, United Arab Emirates, Philippines, India, Hong Kong, Nepal, Pakistan, Vietnam) and Oceania (Australia), and the positive and negative responses that have been generated around the digital gaps since this lockdown [7]. In addition, it will allow the emergence of deeper studies of each of the gaps presented in this study from a scientific, critical, and social analysis.

II. METHODOLOGY

The purpose of this study considers the real online learning needs of high school students, especially in rural areas, further deepened by covid-19. To this end, a systematic review of the literature (RSL hereinafter) has been carried out by consulting the Web of Science (WoS hereinafter) and ERIC databases [38]. To carry out the RSL, a qualitative approach was structured, which uses the collection and analysis of data to refine the research questions [39]. The bibliographic review was used as a fundamental stage of any research project to obtain relevant information in the field of study [40].

A. Procedure

Stage 1: The topic to be investigated and its search in thesauri was established, the research questions are raised, the search protocol in the WoS and ERIC databases.

Stage 2: After the retrieval of documents with the search equations (Table I) the articles were searched and selected through readings of the title, abstract, and keywords of each research article, including quantitative and qualitative studies, related to digital gaps and online learning.

Stage 3: The analysis and organization of the information found were carried out in a structured manner to identify the key elements of scientific research according to the terms of inclusion and exclusion (Table II).

TABLE I: SEARCH EQUATION ACCORDING TO WOS AND ERIC

Basis	Search equation
Web of Science	TS= (("Digital divide*" OR "Digital Inequality*" OR "Digital barrier*") AND ("online education" OR "distance education" OR "non face-to-face education") AND "high school") AND publication years (2017 OR 2018 OR 2019 OR 2020 OR 2021)
ERIC	("Digital divide*" OR "Digital Inequality*" OR "Digital barrier*") AND ("online education" OR "distance education" OR "non-face-to-face education") AND "high school" REFINED BY: YEARS OF PUBLICATION: (since 2017) AND TYPE OF PUBLICATION:(Journal articles)

Date of extraction ERIC: 23/07/2021 15:52; WoS: 30/07/2021

TABLE II: INCLUSION AND EXCLUSION CRITERIA

Inclusion	Exclusion
Studies on digital gaps and e-learning in the WOS and ERIC databases	Studies address digital gaps in specific areas.
Original articles published in open-access education journals and papers	Systematic review articles, not published in journals and education papers
Articles published in English and Spanish	
Articles published during 2017 - 2021	
Studies carried out in secondary education institutions in rural areas	Studies in higher education

The sequence followed in the retrieval of the information was carried out using the PRISMA methodology. A flowchart is presented showing the process from the initial location of the documents to the final examination of the sample of articles that make up the systematic review study as shown in Fig. 1. In the end, we selected 18 WoS articles and 17 ERIC articles. After this phase, another phase was opened, in which the content of the articles that helped us answer the research questions posed was analyzed in-depth:
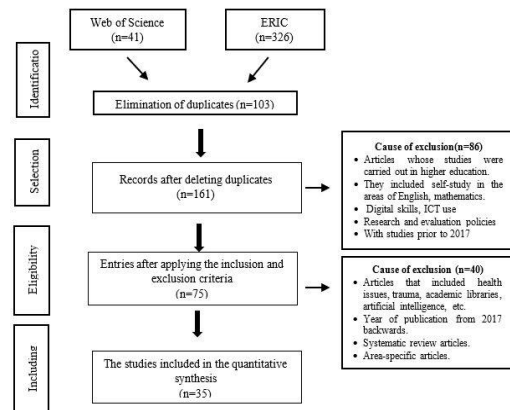

Fig. 1. Retrieval process of the analyzed information from the WoS and ERIC databases.

RQ1: What digital gaps influence the online learning of rural students in secondary education from papers published in journals indexed in WoS and ERIC?

RQ2: What are the socioeconomic aspects of the digital gaps in the access and use in online learning of students in rural areas of the analyzed documents of the journals indexed in WoS and ERIC?

RQ3: What are the levels of digital literacy that impact online learning of students from rural areas in secondary education with the highest incidence of documents published in journals indexed in WoS and ERIC?

RQ4: What are the strategies and tools used by teachers in the context of online teaching of rural education most considered in publications, based on the most cited authors and the most preferred keywords?

III. RESULTS

A. Digital Gaps Influencing Online Learning

Table III shows 6 documents that highlighted socio-economic aspects, 21 documents that emphasize the

aspect of digital literacy, and 8 documents highlight that the influence is given by the teaching methods and strategies used by teachers in online teaching.

TABLE III: DIGITAL GAPS THAT INFLUENCE ONLINE LEARNING

Articles	Quantity	Appearance
3,4,6,17,19,21,22,23,24,25,26,27, 28,29,30,31,32,33,34,41,42	21	Digital Literacy
2,7,8,10,15,20	6	Socioeconomic
1,5,9,14,35,36,37,43	8	Online teaching methods and strategies

B. Socio-Economic Aspects of the Digital Gaps

TABLE IV: SOCIO-ECONOMIC ASPECTS

Articles	Quantity	Appearance
15,20	Poverty situation	Rural areas, ethnicities, more vulnerable castes with dysfunctional families, parents with alcohol problems, students who tend to work.
2,10,15,20	Social exclusion	There is no look from the state, educational policies
2,7,10,20	Inequity	Unequal proportion in quality and quantity of equipment and resources.
20	Geography	Poverty due to inaccessible geography.
2,7,8,10,15, 20	Low income	Insufficient family income, scarce to afford the inputs for the learning of their children.
10,15	Internet Costs	Broadband, data plans, and digital devices with high costs and inefficiencies

The authors converge in 5 articles that carried out the analysis from the inequality and social exclusion of the state and authorities, 6 articles show that to access and make use of digital technologies, families must have economic income that can afford digital resources, 2 articles analyze the situation of poverty, being the ethnic groups the most vulnerable, 1 article of literary analysis that considers that geography plays an important role in the poverty of isolated families, as shown in Table IV.

C. Levels of Digital Literacy

Regarding the levels that determine digital literacy that have an impact on the online learning of students from rural areas in secondary education, 2 are considered: understanding of hardware/software and mastery in digital environments [23]; whose gap is reflected from two areas at the level of teachers and students.

At the level of teachers, studies have a positive description due to the contingency in digital training programs [3], [4], [6], [19], [34], [41]. But they also show a deficient level due to the unwillingness of teachers to be able to carry out training in electronic content, as well as the fear of using technologies for online teaching, [21], [23], [26], [33] according to Table V.

TABLE V. LEVELS OF DIGITAL LITERACY OF TEACHERS

Literacy Level	Articles	Description of positive aspects	Articles	Description of weakened/deficient aspects
Hardware/software understanding	4,33	• Participation in plans, programs, computers, hardware, and Internet	6,26	• Inadequate support of software and electronic content in regional languages, poor skills in technological tools.
Proficiency in digital skills	3,34,41	• Participation in e-learning communities and complex and dynamic educational environments, use of MOLEAP for learning assessment, and implementation of the rubric in digital curricula. • Use of technological pedagogical content knowledge (TPACK) and the DESIGNED model, use in complex and dynamic educational environments. • Participation in e-learning communities (eLC), collaboration, and problem-solving. • Development and implementation of an assessment rubric for digital curricula.	23,26,29, 31,33	• Does not frequently use collaborative methodologies mediated by ICT (interaction strategies with other elements e-learning platforms, blogs, wikis, WebQuest, social networking, educational robots, office automation, file sharing in the cloud, audiovisual presentation, video conferencing, video repositories, concept maps, and shared photo albums). • Deficiencies in the frequency and depth of technology use. • There is a lack of educational e-content management.

As for the students, the knowledge acquired is through self-instruction, their skills are used in social networks and network games, insufficient in the elaboration of their tasks, such as sophisticated presentations and complex searches, on the other hand, a positive advance of studies that show that the students have been duly trained by organizations of agreement and by the educational administration of their country [3], [17], [29], [42], according to Table VI.

TABLE VI: LEVELS OF DIGITAL LITERACY STUDENTS

Literacy Level	Articles	Description of positive aspects	Articles	Description of weakened/deficient aspects
Hardware/software understanding	4,28,30, 42	• Digital skills acquired through self-instruction.	22,23,25	• Difficulty in typing skills, technical and software problems
Proficiency in digital skills	3,17,32 27,29,42	• Use of EDMODO, writing skills, debates, and discussion. e-learning module. • Design, development, and implementation of culturally adaptive learning interfaces to empower student learning	19,25,28,31 ,32 21,24	• Difficulties in using a search engine. • Lack of confidence to share your posts online. • Obstacles and problems in online classes, including problems submitting assignments and attending online classes. • Use of time in the game and social networks

D. Strategies and Tools Used by Teachers in the Context of Online Teaching in Rural Education

Regarding the methods and strategies used by teachers in online learning interaction, they were synchronous methods complemented by asynchronous home-based extension activities [1], [14], [43]. However, the use of online strategies was deficient, observing limited professional development [35]-[37], according to Table VII

TABLE VII: STRATEGIES AND TOOLS USED BY TEACHERS

Articles	Indicator	Description
5,37	Flexible scheduling	Remote work time, without oversaturating students, interaction that involves creativity and collaboration.
5,9,35,36	Pedagogical skills	Implementation of e-schools, electronic diary; library mobile application, interactive panels.
5,14,37,43	Handling digital tools and resources	Devices, apps, iPad use, videos, webinars, IMA use such as WhatsApp, video conferencing (VC), Google Classroom, Zoom, Google Drive use, and social networking.
9,43	Pedagogical leadership	Effective tutoring
1,14,15,43	Asynchronous methods - synchronous and transmission channels	Inverted Classroom, Blended and combined methods. Internet, radio, and television
9,35,43	Evaluation	Of learning, search for student autonomy.
1	Digital content quality	Specific and interactive contents, design of digital material.
1,9,43	Teaching strategies	Meaningful activities, distribution of tasks

IV. DISCUSSION

The results obtained from the analysis of the articles on the impact of digital gaps have shown that schools in rural areas living in poverty and extreme poverty have been greatly harmed by the use of ICTs, [7], [15], [20], further increased by the circumstances of the state of emergency such as the covid-19 crisis. Parents cannot provide technological tools in quality and quantity, due to the low level of income and high costs of the internet, thus reducing the participation of students, causing dropout [1], [5], [10], [21].

Digital literacy levels in understanding and mastering digital environments differ greatly between students and teachers. At the level of teachers, there is evidence of countries that with adequate educational policies have achieved the understanding of hardware and software through the training of their teachers [3], [4], [6], [19], [34], [41], on the contrary, there is fear and little willingness to use digital tools in their teaching [20]. At the student level, online learning was evidenced through self-instruction, the use of social networks, and gambling [20], [23]. Conversely, positive aspects allow students to learn using gamified platforms and tools that consolidate their digital skills [3], [17], [29], [32], [42].

The activity of teachers in rural areas has evolved in the context of the pandemic, modifying teaching methods from face-to-face to virtual, making school schedules more flexible to interact synchronously and asynchronously from ubiquity [1], [5], [14], [37], [43], corroborating that to avoid unlearning, various teaching strategies and accessible methods must be applied to student-teacher interaction [14], [35]. The time spent in the preparation of the learning sessions has played an adverse role and teachers did not demonstrate skills in designing quality interactive content [1], [36].

In the findings, it has been found that the closure of educational institutions would have short- and medium-term consequences for students and families in rural areas, increasing abandonment and absenteeism due to limitations of access and use in digital environments, [7], [15], [42]. A second finding regarding the appreciations in the use of technologies that lead to spending a lot of time on the design of their instruction [1], in addition to considering the diverse range of technological devices that students have that makes it difficult to use a standardized methodology for online learning. A third finding revolves around the development of digital competencies of students and teachers, enhancing them through training projects that lead to the understanding and mastery of technological resources [23].

The limitations can be evidenced in the search of the literature in other databases such as Scopus. The investigations tend more to independent subjects, it is not related to the analysis of what is presented.

V. CONCLUSION

This systematic review of the literature reflects the shortcomings concerning socioeconomic factors, poverty of families, coupled with low broadband coverage, low digital literacy, and methodological strategies that are gradually being worked on by developed countries, unlike underdeveloped countries that are still latent. Undoubtedly, the present study is inclined to strengthen urgent educational policies; in terms of the relevant equipment, infrastructure, and digital literacy that motivates teachers and students to achieve digital skills, as well as their integration into the school curriculum in a creative way to avoid dropping out and abandonment.

The trend of the literature reports an in-depth analysis of the socio-emotional environment, as well as the adaptation of the teaching process of teachers and students about the transfer of digital skills, as an emerging line for future research.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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