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ORIGINAL

Transformation and digital challenges in Peru during the COVID-19 pandemic, in the educational sector between 2020 and 2023: Systematic Review

Transformación y retos digitales en el Perú durante la pandemia del COVID-19, en el sector educativo entre los años 2020 y 2023: Revisión Sistemática

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ABSTRACT

Introduction: digital transformation in the Peruvian educational sector has experienced a significant boost after facing the COVID-19 pandemic. During the period between 2020 and 2023, various innovative methods have been implemented to ensure the continuity of the academic year.
Objective: explain how the digital transformation was carried out in the Peruvian educational sector after facing the COVID-19 pandemic to the present (2020 – 2023).
Method: examples from many institutions, statistical studies and scientific and technological references were taken into account to achieve the objective. Throughout this work we are analyzing the different and innovative methods used by teachers to provide continuity to the academic year and how digital challenges were overcome.
Results: 78 documents from Scopus and Scielo were reviewed, leaving 62 after filtering. These cover 8 categories on the impact of the pandemic on education, the transition to online teaching, job skills, challenges and advantages of virtual education, innovation in higher education, educational evaluation in virtual environments, educational internationalization and challenges for teachers during the COVID-19 pandemic.
Conclusions: in conclusion, the digital transformation in the Peruvian educational sector after the COVID-19 pandemic has been fundamental to guarantee the continuity of the teaching-learning process.

Keywords: Technological Transformation; Pandemic; COVID-19; Digital Challenges; Educational Sector.

RESUMEN

Introducción: la transformación digital en el sector educativo peruano ha experimentado un importante impulso después de enfrentar la pandemia de COVID-19. Durante el período comprendido entre 2020 y 2023, se han implementado diversos métodos innovadores para garantizar la continuidad del año académico.
Objetivo: explicar cómo fue que se llevó a cabo la transformación digital en el sector educativo peruano después de afrontar la pandemia de COVID-19 hasta la actualidad (2020 – 2023).
Método: se tomó en cuenta ejemplos de muchas instituciones, estudios estadísticos y referencias científicas y tecnológicas para lograr el objetivo. A lo largo del presente trabajo estamos analizando los distintos e innovadores métodos empleados por los docentes para dar continuidad al año académico y como fueron superados los retos digitales.
Resultados: se revisaron 78 documentos de Scopus y Scielo, quedando 62 tras filtrar. Estos abarcan 8 categorías sobre el impacto de la pandemia en la educación, la transición a la enseñanza en línea, habilidades laborales, desafíos y ventajas de la educación virtual, innovación en la educación superior, evaluación educativa en

entornos virtuales, internacionalización educativa y desafíos para docentes durante la pandemia de COVID-19. **Conclusiones:** en conclusión, la transformación digital en el sector educativo peruano después de la pandemia de COVID-19 ha sido fundamental para garantizar la continuidad del proceso de enseñanza-aprendizaje.

Palabras clave: Transformación Tecnológica; Pandemia; COVID-19; Retos Digitales; Sector Educativo.

INTRODUCTION

The COVID-19 pandemic that occurred between 2020 and 2023 arrived in Peru at a time of technological vulnerability and has had negative effects on many sectors. The Peruvian education sector was one of the hardest hit as a result of this, causing a radical change in the lives of many teachers and students. Technological advancement today is a topic that has been reinforced and used much more in recent years. For this reason, in this work the topic of digital transformation in Peru during the COVID-19 pandemic is developed, in the educational sector between the years 2020 and 2023.

In this way, this research article focuses its attention on verifying how the digital transformation developed in the Peruvian education sector during the times of the COVID-19 pandemic between 2020 and 2023. Considering this question, it can be shown that between 2020 and 2023, as a result of the COVID 19 pandemic, the Peruvian educational sector had an incredible digital transformation, it had to innovate and start using hardware and software technological tools to be able to face the drastic changes that were generated in the type of teaching previously implemented.

We must clarify that in the COVID-19 pandemic, each teacher assumed changes in teaching, going from in-person to remote teaching. With the objective of transforming the teaching methodology and enabling students to develop, surveys were created using a certain number of students as a sample. These results were appropriate to create a bridge so that all the information from the classes reaches the students and thus they can improve their quality of knowledge, and that their economic or social condition is not an obstacle, negatively affecting their learning.

As a result of the COVID-19 pandemic and in order to avoid the loss of school learning, the use of technology was chosen as the first solution to provide continuity to teaching, changing the form from in-person to virtual, thanks to This wild change made it possible to notice the technological deficiencies that existed, not only in infrastructure but also in the inability of teachers to face the challenge.

Given the situation experienced, several educational establishments chose to close completely or partially, which temporarily or permanently prevented the continuation of in-person education. This measure will be maintained until the educational system is stabilized and the necessary measures are implemented to control the latent threat. In relation to this topic, Canaza shares his opinion about the interruptions and changes we have experienced:

Until this happens and while the crisis resulting from the coronavirus pandemic lasts, an educational approach has been promoted that seeks to overcome space restrictions and provide students with real-time access through the significant use of information technologies and communications (ICTs).

According to Rodríguez et al.[1], digital transformation involves the incorporation of new technologies in all aspects of a company or institution with the purpose of enhancing its strategic opportunities. According to his vision, it is crucial for institutions to stay up to date in terms of technology, optimizing their processes and strategies to achieve a competitive position in the market of their sector.

According to Peniche Cetzal[2] in 2020, Cetzal and his colleagues carried out a study with the purpose of analyzing the factors that affect the work of secondary education teachers. To do this, they used a mixed research approach, combining quantitative and qualitative methods. The research findings demonstrated that, indeed, there are both internal and external elements that exert a significant influence on teacher participation and commitment.

By Chanto Espinoza et al.[3] during the COVID-19 pandemic, we had an enormous challenge due to the technological inability of many teachers. To face this, there was a rapid reinvention of a different job, each teacher assumed changes in teaching, going from teaching in-person to remote. All this with the aim of transforming the teaching methodology previously implemented and allowing students to develop, in this regard he tells us: Faced with the challenge, each teacher quickly adapted and adopted a different work approach, creating new learning activities and assessments appropriate for teaching in a distance education environment.

Surveys were carried out with the purpose of evaluating and facilitating connectivity for both students and teachers. Likewise, many institutions decided to provide notebooks and tablets to those students who lacked devices to be able to carry out their classes effectively. One of the main challenges was the adaptation of the subject contents to a completely virtual format.

During this process, resources and materials were provided for both teachers and students, in addition to

offering recommendations on holding videoconferences, suggestions for remote midterm and final exams, as well as instructions for using programs for online meetings and classes.

METHODOLOGY

The systematic analysis of the documentation carried out involved the following stages:

A. Define information sources: In this phase, the relevant information sources for the review were determined, such as academic databases, scientific journals, conferences, books, among others.
B. Define controlled vocabularies and search equations: A set of key terms and concepts, including controlled vocabularies, were established to construct effective search equations. These search equations were used to retrieve relevant studies in the databases.
C. Define criteria for inclusion/exclusion of documents: Clear, predefined criteria were established to determine which documents would be included in the review and which would be excluded. These criteria could be related to the type of study, language, year of publication, thematic focus, among other relevant aspects.
D. Analysis of information obtained: Once the relevant documents were obtained, a detailed analysis of the information extracted from each study was carried out. This involved extracting and synthesizing relevant data, identifying common patterns, trends or findings, and presenting the results in an organized and coherent manner.

DEVELOPMENT

Sources of Information

In the systematic analysis of the literature, the information sources Scielo and Scopus were selected. These academic databases are widely used in scientific research and contain a wide range of academic publications, scientific journals and other relevant documents in various disciplines. By including these sources of information, we sought to obtain broad and exhaustive coverage of studies relevant to the review. It is important to note that the selection of information sources may vary depending on the research topic and the specific objectives of the review.

Search equations

In order to define the strategy and equation for searching for information sources, we have used the PICO strategy: Population, Intervention, Comparison, Results.

P: Population: Secondary and higher education sector.
I: Intervention: Transformation and digital challenges that teachers faced in order to get ahead during the COVID-19 pandemic
C: Comparison: Virtual Teaching VS Traditional Teaching
O: Outcome: Results obtained by teachers, adaptability to the remote environment, development, new teaching methods and strategies.

Peak question

How was the technological transformation in the Peruvian educational sector with the use of technology for traditional teaching?

Alternative questions

How did the COVID-19 pandemic impact higher education?
How does technology and digital transformation occur in education?
How was employability and skills for the labor market managed during the pandemic?
How did it improve teaching and learning in virtual environments?
What changes have innovated in higher education in recent years?
How to define quality education?
What is international education like?
What challenges and problems did teachers face in COVID-19?

Table 1. PICO strategy

Parameters	Term	Vocabulary
P	Education sector	High school level Higher education level
I	Digital Transformation	Technological transformation Technological Changes Digital Challenge

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C	Traditional Teaching	Traditional teaching Traditional school Pandemic COVID 19
O	Adaptability to change	Research Development Selection Use

As the results may be different and there is no accuracy, we decided to carry out the search equation based on the population, comparison and intervention.

Finally, the search equation was:

title-abs-key= ("High school" OR "Higher education" OR "Traditional teaching" OR "Traditional school") AND ("Pandemic" OR "COVID-19") AND ("Technological transformation" OR "Technological Changes" OR "Digital Challenge") AND (LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023)) AND (LIMIT-TO (LANGUAGE , "Spanish") OR LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))

Document Inclusion/Exclusion Criteria

Document inclusion/exclusion criteria are used to establish the selection parameters of documents that will be considered in an analysis or review. These criteria help ensure the relevance and quality of the documents included in the study.

1) In the present study, the following inclusion criteria were established:
   a) Documents published in the last three years, with this we ensure the timeliness of the information.
   b) Documents written in Spanish or English, this makes it easier for us to understand and analyze.
   c) Documents that directly address the research topic, with this we can focus only on key and relevant aspects.
   d) Documents that present real or theoretical results that help us with the existing body of knowledge.
2) On the other hand, the following exclusion criteria were applied:
   a) Duplicate documents.
   b) Documents not accessible in their entirety.
   c) Documents that do not meet the methodological quality criteria.

These criteria will be used as a guide for the selection and evaluation of documents relevant to the study, ensuring the integrity and reliability of the results obtained.

Description of the considered selection logic (PRISMA)

The description of the considered selection logic is based on the guidelines established by PRISMA. For the present study, a rigorous approach was followed in the selection of documents included in the systematic review.

Initially, an exhaustive search was conducted in academic databases and other relevant sources using specific search terms and keyword combinations, such as “High school level”, “Higher education level”, “Technological transformation”, “Technological Changes”, “Digital Challenge”, “Traditional teaching”, “Traditional school”, “Pandemic”, “COVID 19”.

Predefined inclusion and exclusion criteria were then used to filter the identified documents. These criteria considered aspects such as the relevance of the content, language, publication period and methodological quality.

Finally, the diagram corresponding to this review is shown, following the guidelines established in the PRISMA declaration (figure 1).

RESULTS

Now, the result of the review is presented:

A. After applying the search formula, a total of 78 documents were found from two databases: Scopus and Scielo. Of this total of documents, 6 documents were discarded because they were research projects that were currently in development. Following our initially defined inclusion and exclusion criteria, it was validated that these 16 articles would not add to our research for the reason that they are currently in development and we would only rely on completed research documents.
B. After the first filter we were left with a total of 62 documents, which are being grouped as follows table 2.

Results of the documents reviewed in general

A total of 8 categories were group defined, subsequently each of the research documents was grouped into one of them, these categories with the corresponding total number of documents are as follows table 3.

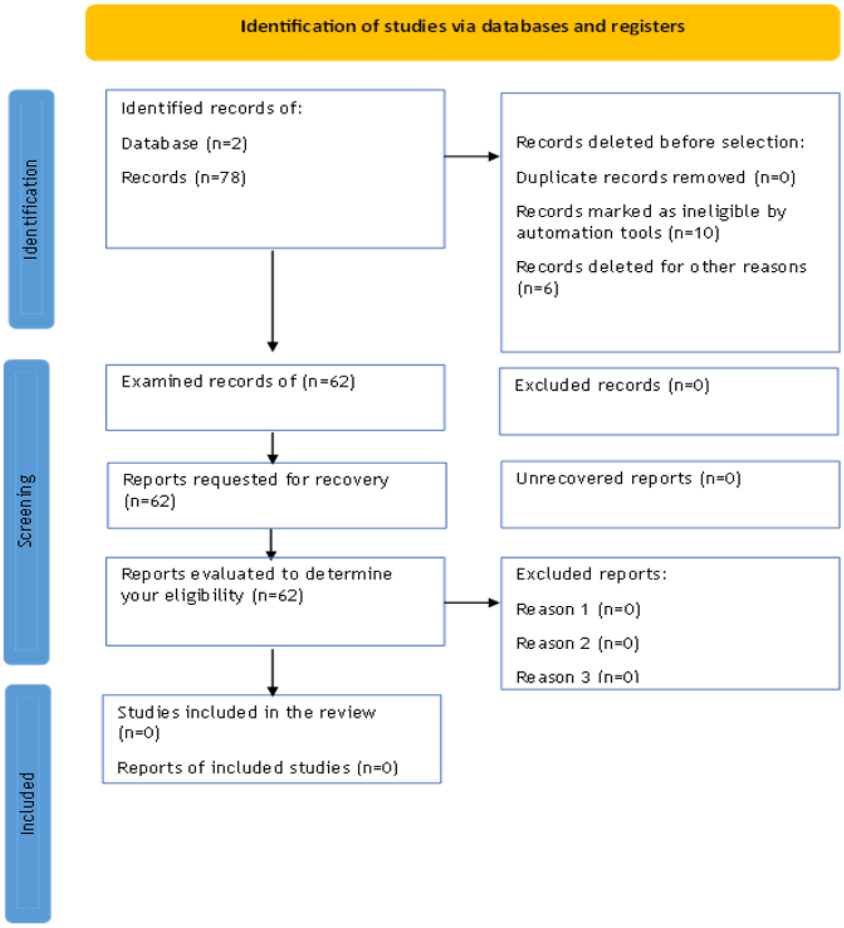

Figure 1. Prism diagram

Table 2. Number of documents per year and database

Year	Number of documents	Database
2020	7	Scopus
2021	21	Scopus
2021	3	Scielo
2022	17	Scopus
2023	14	Scopus

Table 3. Number of documents per category

#	Category	Number of documents
1	Impact of the pandemic COVID-19 in higher education	11
2	Technology and transformation digital in education	11
3	Employability and skills for the labor market	5
4	Teaching and learning in virtual environments	10
5	Innovation and changes in higher education	6
6	Evaluation and educational quality	4
7	Internationalization of the education	3
8	Challenges and problems	12

Additionally, each of the titles were divided between the 8 aforementioned categories, being part of only one category per title according to the chosen criteria. This division is the following:

Table 4. Documents divided according to category

Documents	Category
Alshamsi et al.[4]	1
Mory Chiparra et al.[5]	1
Hidayati & Saputra[6]	1
Nuere & De Miguel[7]	1
Rapanta et al.[8]	1
Al Freih[9]	1
Garcez et al.[10]	1
Ma et al.[11]	1
Pursell & Iiyoshi[12]	1
Ruiz Ortiz et al.[13]	1
Sergejeva et al.[14]	1
Amalia et al.[15]	2
Kelly et al.[16]	2
Merkus & Schafmeister[17]	2
Nesenbergs et al.[18]	2
Nuere & De Miguel[7]	2
Al Freih[9]	2
Wargo & Simmons[19]	2
Garcez et al.[10]	2
Ward et al.[20]	2
Apostolidis et al.[21]	2
García Vera et al.[22]	2
Habets et al.[23]	3
Groshen & Holzer[24]	3
González Bravo et al.[25]	3
Nita & Gut[26]	3
Nissim & Simon[27]	3
Kelly et al.[16]	4
Hidayati & Saputra[6]	4
Al Freih[9]	4
Antonopoulou et al.[28]	4
Magunje & Chigona[29]	4
Merkus & Schafmeister[17]	4
Suing et al.[30]	4
Zizka & Probst[31]	4
Patiño et al.[32]	4
Van Wyk[33]	5
Salas et al.[34]	5
Scavarda et al.[35]	5
Núñez Valdés et al.[36]	5
Barrera Verdugo[37]	5
González Bravo et al.[25]	5
Karataş et al.[38]	6
Kassem et al.[39]	6
Ortiz Martínez et al.[40]	6
Okoye et al.[41]	6
Ma et al.[11]	7

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Oleksiyenko & Liu[42]	7
Qi et al.[43]	7
Mory Chiparra et al.[5]	8
Pantoja Burbano et al.[44]	8
Flavin[45]	8
Sergejeva et al.[14]	8
Sacală et al.[46]	8
Sergejeva et al.[14]	8
González Bravo et al.[25]	8
Davidescu et al.[47]	8
Garcez et al.[10]	8
Ma et al.[11]	8
Antonopoulou et al.[28]	8
De Vries[48]	8

Disaggregation of the documents along with the categories to which they were grouped:

a) Impact of the COVID-19 pandemic on higher education: The documents found in this category provide an overview of how the COVID-19 pandemic affected education at the secondary and higher levels, both nationally and internationally. Within these articles, the processes that were carried out in countries such as Australia, Indonesia, Peru, China, etc. are detailed. Where in many of them they tried, at all costs, not to lose the academic semester, nor the teaching that they had already been giving in a traditional way. According to Alshamsi et al.[4] in some countries, extreme teaching methods were implemented, for example, in the country of the United Arab Emirates, a total of 234 000 hours of teaching divided into 61 000 online classes were published for free, within which a total of 21 000 hours of professional development, providing remote employment to more than 1 900 people in the country. By De Vries[48] here are also studies where the level of employability during the pandemic of 12 576 students in the areas of Science, Mathematics, Technology and Engineering is compared to professionals from different areas in the country of Australia, the opportunities and benefits are discussed. challenges to incorporate teaching for employability in all the faculties of the country.
b) Technology and digital transformation in education: During the COVID-19 crisis, a rapid transition to online teaching was experienced at all educational levels. Research was carried out to evaluate the impact of online teaching in various contexts, including higher education, basic and secondary education, and education in rural areas. The results were diverse, but in general it was concluded that online teaching can have positive effects on learning outcomes, student participation, as well as the development of mathematical skills and creative thinking. However, challenges were also identified, such as the need to quickly adapt to new technologies, ensure equal access to online education, and address institutional conditions to support online teaching. These studies highlight the importance of using technological tools effectively and considering students and teachers as fundamental parts of the educational process.
c) Employability and skills for the labor market: The research studies presented in this category address different topics related to higher education and leadership in times of crisis, such as digital transformation, educational quality, adaptation to the Covid-19 pandemic and the role of systems of information in educational management. These studies highlight the importance of developing agile leadership skills and competencies, as well as encouraging the participation and active participation of students in knowledge acquisition processes. Additionally, the need for effective communication and adapting to rapid changes in changing educational environments is emphasized. In general, these studies highlight the quality of continuous improvement and creation in the educational stage to face current and future challenges.
d) Teaching and learning in virtual environments: According to Zizka & Probst(31) during the COVID-19 pandemic, teaching and learning in virtual environments became a necessity to ensure educational continuity. Some of the facts detailed in these research documents are: Massive increase in online education: The pandemic led educational institutions in all parts of the world to take significant measures and adjustments, adopting online education as a social distancing measure. A significant increase was observed in the use of virtual educational platforms, video conferencing applications and online resources. Challenges for students and teachers: The abrupt transition to online education posed challenges for both students and teachers. The lack of equitable access to technology and

the Internet became a barrier for many students, especially those in disadvantaged communities. Teachers had to quickly adapt their teaching methods and learn to use new technological tools and platforms. Adaptation of teaching methods: Teachers had to rethink their pedagogical approaches for the virtual environment. Strategies were developed to encourage active student collaboration, such as the use of interactive activities, online discussion forums, and individualized feedback. The creation of multimedia content and the use of digital resources also became common. Advantages of online education: Despite the challenges, online education presented some advantages. Students had the opportunity to develop relevant digital skills and technological competencies in an increasingly digitalized environment. In addition, the pandemic has promoted the adaptability of schedules and improved access to online educational resources allowing for more autonomous learning. Importance of interaction and emotional support: During online education, the importance of maintaining interaction and emotional support between students and teachers was recognized. Strategies were implemented to encourage regular communication, such as live video conferencing sessions, virtual tutoring, and online study groups. It is important to note that online education during the pandemic has been a constantly evolving scenario. Experiences and approaches may vary depending on local circumstances and educational policies.

e) Innovation and changes in higher education: During the COVID-19 pandemic, secondary and higher education underwent significant changes, driving innovation in response to the restrictions imposed by social distancing. Higher education institutions transitioned to online education, using virtual platforms and video conferencing tools. Blended learning was chosen, combining in-person and virtual elements when possible. In addition, there was greater use of educational technology, in order to facilitate teaching and learning in virtual environments. There was a lot of emphasis on accessibility, ensuring that resources and supports are accessible to all students. There was also innovation in assessment and formative feedback, adapting assessment methods to the online environment. The development of digital skills in students was promoted, recognizing the importance of digital competence in the digital age. Likewise, it explored opportunities for virtual international collaboration, expanding intercultural learning opportunities.
f) Evaluation and educational quality: During the COVID-19 pandemic, the need to adapt assessment methods in virtual environments was highlighted, emphasizing the importance of using flexible strategies, such as project-based assessment, online presentations and virtual discussions. Additionally, the importance of addressing equity in assessment was highlighted, ensuring that all students had equitable access to the necessary tools and resources. Formative assessment and effective feedback also played a crucial role during that period. Providing constructive and timely feedback to students was an important practice to improve learning. Likewise, attention was paid to educational quality in virtual environments, and specific frameworks and standards were developed to evaluate and improve it.
g) Internationalization of education: The COVID-19 pandemic had a great and very significant impact on the internationalization of education worldwide. The scientific studies grouped in this category aim to analyze the changes and challenges experienced during this period. In response to travel restrictions and social distancing measures, educational institutions were forced to quickly adopt online education as an alternative. This transition to virtual education allowed international students to continue their studies from their home countries, reducing geographic barriers and fostering global collaboration. Cooperation and collaboration between educational institutions from different countries played a fundamental role during the pandemic. The creation of alliances and collaborative agreements facilitated the exchange of educational resources, knowledge and best practices in online teaching, helping to overcome emerging challenges. However, the cancellation of student exchange programs and limitations on international mobility negatively impacted students' cultural experience and practical learning. The suspension of in-person programs and the adoption of virtual formats generated inequalities in access to education, exacerbating the existing digital divide. All of these scientific analyzes highlight the need to address the identified challenges and develop effective strategies for inclusive and equitable educational internationalization in the post-pandemic context. It is essential to guarantee access to online education, strengthen international collaboration and promote the resilience of educational institutions in the face of future crises. The COVID-19 pandemic has transformed the internationalization of education, driving mass adoption of online education and fostering global collaboration. Although there were many challenges and inequalities, opportunities were also created to rethink educational models and strengthen international cooperation for the benefit of students.
h) Challenges and problems: During the pandemic, teachers faced various challenges and issues while adapting to online teaching. They had to learn new technological skills and use virtual learning

platforms. Additionally, challenges emerged related to equitable access to technology and Internet connectivity for all students. The lack of interaction and active participation of students, as well as the difficulty in evaluating and providing effective feedback, also represented significant obstacles. All of this resulted in additional workload for teachers. Despite these challenges, they sought creative solutions and adapted their teaching methods to ensure the continuity of their students' learning during the pandemic. According to Mory Chiparra et al.(5)The results obtained in this group revealed that the pandemic caused a sudden interruption in the paradigm of in-person university education in Peru. As a consequence, article 47 of University Law No. 30220 was modified to establish face-to-face, blended and distance teaching modalities. The need for universities to leave their comfort zone and adopt information and communication technologies (ICT) was highlighted, comprising a set of electronic tools and systems that facilitate access, storage, transmission and processing of information as an opportunity. for academic development.

DISCUSSION

During the period from 2020 to 2023, an important change occurred in the Peruvian educational field, with the rapid adoption of the distance education modality. According to the results obtained, educational institutions implemented various digital strategies, such as the use of online platforms, videoconferencing tools and digital educational resources, with the aim of ensuring the continuity of the learning process. This transition was essential to allow students to access education despite the restrictions imposed by the pandemic.

During this transformation, the presence of a digital divide in the country was identified as one of the main challenges. Data collected shows that many students, especially those residing in rural and low-income communities, faced significant barriers due to lack of internet access and limited availability of electronic devices. These results highlight the importance of addressing the digital divide through policies and programs that promote equitable access to digital education throughout the national territory, which made teacher training and their capacity to adapt revealed as critical factors for the success of distance education. Our results indicate that many teachers faced challenges in quickly adapting to new technologies and online teaching methodologies. Although training programs were implemented, the need for a continuous and broad approach to develop digital and pedagogical skills in teachers was identified. These findings highlight the importance of providing adequate support and resources to help teachers effectively adopt digital education, ensuring that the digital transformation had a significant impact on the teaching-learning process in Peru. The results obtained indicate that, although distance education allowed for continuity of learning, it also posed challenges in terms of interaction between students and teachers, active participation and effective feedback. Additionally, variability was observed in the quality and access to digital educational resources, which influenced the students' learning experience. These findings highlight the importance of addressing these challenges and ensuring an effective and high-quality online learning experience, and support the need to implement policies and programs aimed at addressing these challenges, with the aim of ensuring inclusive and quality education. in the digital environment.

CONCLUSIONS

As a result of the COVID-19 pandemic, a negative impact was generated within the Peruvian educational sector, creating the need for a digital transformation for better teaching, with the use of technological tools: both hardware and software, thus resolving the changes. In the form of teaching, teachers had to assume the new changes in teaching, going from the face-to-face modality to the remote modality, with the aim of guaranteeing the development of the students. On some occasions, conducting surveys and distributing technological devices such as tablets and notebooks to ensure the connectivity of students and teachers.

The COVID-19 pandemic caused a digital transformation in the Peruvian education sector between 2020 and 2023, with significant changes in the way education is carried out, it has also highlighted challenges related to the digital divide, teacher training and the impact on the teaching-learning process.

The use of digital transformation in education during the pandemic made it possible to overcome time limitations and immediately reach students through information and communication technologies (ICTs), thus seeking the implementation of new technologies in our educational sector can improve and help institutions create new strategic opportunities to adapt to changes and guarantee the continuity of teaching, thus achieving an effective position within the market.

In the research carried out, select documents that address the topic of digital transformation in education during the pandemic were identified, the documents were reviewed and grouped into categories for better understanding.

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CONFLICT OF INTEREST

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