

# Digital Accessibility in Virtual Learning Environments: a Systematic Review

## Acessibilidade Digital em Ambientes Virtuais de Aprendizagem: uma Revisão Sistemática

ISSN 2177-8310  
DOI: 10.18264/eadf.v11i1.1143

**Carlos Eduardo Rocha dos Santos\***<sup>1</sup>  
**Ligia Petrolini de Oliveira\***<sup>2</sup>  
**Victoria Alejandra Salazar Herrera\***<sup>3</sup>  
**Siony da Silva\***<sup>4</sup>

<sup>1</sup> Universidade Anhanguera de São Paulo. Avenida Raimundo Pereira de Magalhães, 3305, Pirituba – São Paulo – SP – Brasil.

<sup>2</sup> Universidade Municipal de São Caetano do Sul. R. Santo Antonio, 50 - Centro, São Caetano do Sul – SP – Brasil.

<sup>3</sup> Centro Universitário Faculdades Metropolitanas Unidas. Escola de Tecnologia, Engenharia e Arquitetura, Av. Brigadeiro Luís Antônio, 1089 - Bela Vista – São Paulo – SP – Brasil.

<sup>4</sup> Instituto Federal de Educação Ciência e Tecnologia de São Paulo. R. Pedro Vicente, 625 – Canindé – São Paulo – SP – Brasil.

\*[carlos.e.santos@anhanguera.com](mailto:carlos.e.santos@anhanguera.com)

### Abstract

*Information and Communication Technologies are present in people's daily lives, causing changes in entertainment, professional personal contact, and learning. E-learning courses use these resources through Virtual Learning Environments. In this context, it is essential that this environment has accessibility resources so people with disabilities can also follow the course. This article aims to 1) To identify the studies that are carried out with the objective of providing digital accessibility in E-learning courses; 2) To compare the selected studies to verify possible common characteristics between the researches; 3) To present the results of the analysis done, showing the similarities and differences between the research analyzed. A systematic review was carried out with articles, using as descriptors: "Virtual learning environment", "Accessibility" and "Disability", in which 14 articles were selected. The review found that most of the studies analyzed include people with visual impairments, use Moodle as a Virtual Learning Environment, and W3C and WCAG accessibility guidelines were identified as common in almost all articles studied. Developing proposals for accessible courses requires a multidisciplinary team, with accessibility planning from its conception. This avoids rework, costs, and expands the accessibility culture. Despite the present studies, it is observed that accessibility in E-learning courses will still have a long way to go.*

**Keywords:** E-learning. Moodle. Inclusion.



Received 03/08/2020  
 Accepted 21/12/2020  
 Published 12/01/2021

### HOW TO CITE THIS ARTICLE

**ABNT:** DOS SANTOS, C. E. R. et al. Acessibilidade Digital em Ambientes Virtuais de Aprendizagem: uma Revisão Sistemática. **EaD em Foco**, v. 11, n. 1, e1143, 2021.  
 DOI: <https://doi.org/10.18264/eadf.v11i1.1143>.

## Acessibilidade Digital em Ambientes Virtuais de Aprendizagem: uma Revisão Sistemática

### Resumo

*As Tecnologias da Informação e Comunicação estão presentes na vida diária das pessoas, provocando transformações no entretenimento, contato pessoal profissional e aprendizado. Cursos a distância empregam esses recursos por meio de Ambientes Virtuais de Aprendizagem. Neste contexto, é essencial que esse ambiente possua recursos de acessibilidade para que pessoas com deficiência também possam acompanhá-lo. Este artigo tem por objetivos 1) identificar os estudos que estão sendo realizados com o objetivo de fornecer acessibilidade digital nos cursos a distância; 2) comparar os trabalhos selecionados para verificar possíveis características comuns às pesquisas; 3) apresentar os resultados da comparação feita, mostrando as semelhanças e diferenças entre as pesquisas analisadas. Foi realizada uma revisão sistemática com artigos, utilizando como descritores: “Ambiente virtual de aprendizagem”, “Acessibilidade” e “Deficiência”, tendo sido selecionados 14 trabalhos. O levantamento constatou que a maioria dos trabalhos analisados contempla pessoas com deficiência visual e utiliza o Moodle como Ambiente Virtual de Aprendizagem, além de ter sido identificado que as diretrizes para acessibilidade W3C e WCAG são contempladas em quase todas as pesquisas. Elaborar propostas de cursos acessíveis necessita de uma equipe multidisciplinar que planeje a acessibilidade desde a sua concepção. Isto evita retrabalho, custo e amplia a cultura da acessibilidade. Apesar dos estudos apresentados, verifica-se que a acessibilidade em cursos a distância ainda terá que percorrer um longo caminho.*

**Palavras-chave:** Educação a distância. Moodle. Inclusão.

## 1. Introduction

The advancement of technological resources has promoted changes in society and this has repercussions in the educational area. These resources have contributed to the implementation of Distance Education (DE) by several educational institutions.

DE breaks through the barriers of space and time, as students can access the course environment whenever and wherever they are, as long as they have the minimum resources needed for such access. In this way, it democratizes knowledge, making access to people who, for various reasons, become “[...] excluded from face-to-face education” (VIEIRA BARROS; WARRIOR, 2019, p. 414).

The DE is more than a set of students and tutors communicating with each other through technologies, it is a set of elements (Institution, Quality, Evaluation, Pedagogical Model, Infrastructures, Course/ Curriculum, Teacher, Tutor, Technologies and the Student), all interconnected and working together for collective success to be verified (VIEIRA BARROS; GUERREIRO, 2019, p. 413).

Several platforms have been used in the provision of distance learning courses, through Virtual Learning Environments (VLE). These environments have communication resources, collaborative work, preparation of individual and group activities, in addition to school management. Moodle (Modular Object-Oriented Dynamic Learning Environment), ITAID (Information Technology in Advanced Internet Development) and Blackboard are examples of some of these environments. Considering the importance of permanent learning, the potential reach of this teaching modality and the advantages provided by online environments, they must offer accessibility resources.

For Salton, Agnol, Turcati (2017, p. 11) “[...] accessibility is to offer possibilities to overcome the barriers that exist in society, ensuring that all people can participate in the various social spheres.” Considering the use of information and communication technologies, accessibility corresponds to the user’s access to the desired information, considering its limitations that may be “[...] physical, auditory, visual, financial, technological or cultural” (MOREIRA, 2011, p. 11).

Distance Education in the context of inclusive education has the potential to become a tool that helps in the realization of the right to education of the various subjects with or without special needs. The use of Information and Communication Technologies (ICTs) in education has then been recognized as a potential resource for access to and promotion of learning (SOUZA; NAZÁRIO; LIMA, 2018, p. 02).

Although DE is a proposal for the democratization of education, and people with disabilities are protected by the laws for access to education, in Brazil, the practice of accessibility is still reduced (OLIVEIRA; SILVA, 2019).

For Pereira, Silva (2019, p. 03), “[...] ensuring accessibility is outside the scope of thinking of it as an improvement or bonus to users of technological tools, be they apps, websites or complex systems, is a right...”. Universal Design and Assistive Technologies (AT) feature compatibility are part of the solution to make DE inclusive, and thus include students, tutors, and teachers (MELO, 2012).

The concepts of accessibility and universal design are closely linked and related to the inclusion process of people with disabilities, also favoring human diversity and contributing to improving the quality of life of all (SCHLÜNZEN JUNIOR; MALHEIRO; SCHLÜNZEN; VIGENTIN, 2016, p. 121).

The accessibility suggested recommendations by the W3C (World Wide Web Consortium) and WCAG 2.0 (Web Content Accessibility Guidelines), as well as the evaluation of ATs, should be present in the planning of inclusive courses (QUEIROZ, 2019).

ATs are hardware and software designed to serve as digital accessibility tools for people with disabilities... aim to serve a target audience consisting of people with functional limitations - physical or sensory (QUEIROZ, 2019, p. 349).

In view of the context presented, this article aims to: 1) identify the studies that are being conducted with the objective of providing digital accessibility in distance learning courses; 2) to compare the selected studies to verify possible characteristics common to the researches; 3) to present the results of the comparison made, showing the similarities and differences between the analyzed studies.

## 2. Method

Our descriptive-discursive study is characterized as a literature review. The review papers are defined by Noronha and Ferreira (2000, p. 191 apud MOREIRA, 2004, p. 22) as

[...] studies that analyze the bibliographic production in a given thematic area, within a time cut, providing an overview or a state-of-the-art report on a specific topic, evidencing new ideas, methods, subthemes that have received greater or lesser emphasis in the selected literature.

“It is, therefore, a type of text that gathers and discusses information produced in the area of study” (MOREIRA, 2004, p. 22). “It serves to position the reader of the work and the researcher himself about the advances, setbacks or areas covered in penumbra” (IBID., p. 23).

The main types of literature review are: Narrative, Systematic and Integrative, having its definition according to the method of elaboration. We understand that our literature review is of the systematic type, since “[...] is a form of research that uses as a data source the literature on a given theme” (SAMPAIO; MANCINI, 2007, p. 84). In addition, it should be used “[...] for the survey of available scientific production and for the (re)construction of networks of thoughts and concepts, which articulate knowledge from various sources in an attempt to walk paths in the direction of what one wishes to know” (GOMES; CAMINHA, 2014, p. 396).

In order to raise and analyze the national productions that discuss Accessibility in Virtual Learning Environments for people with disabilities, we chose, among the various database options, the Brazilian Digital Library of Theses and Dissertations (BDLTD), which is a Brazilian portal of scientific information that operates in the expansion and consolidation of *Stricto Sensu* Graduate Studies throughout the country, which integrates and disseminates the full texts of theses and dissertations defended in Brazilian institutions of teaching and research.

Seeking works that interconnect themes such as Accessibility, Virtual Environment for Learning and Disability was a motivating factor for this systematic review. We understand that studies that deal with these themes can contribute greatly to the understanding of how people with disabilities are being contemplated in courses offered in the distance modality, being possible to verify which virtual learning environments are most used and, mainly, how accessibility for these people is thought of in these environments. The papers found were identified, compiled, organized, analyzed, and presented below.

### 2.1. Methodological path

We started our searches by defining the descriptors to be used in the BDLTD database, based on the themes of our interest, and the following keywords were defined: Accessibility, Disability and Virtual Learning Environment.

From the definition of the research locus, we used the descriptors “Accessibility AND Disability AND Virtual Learning Environment” and obtained as results 16 studies, two doctoral theses and 14 master’s dissertations.

In the next step, in order to select the works that would actually be part of our review, we apply some criteria, both inclusion and exclusion. We start with an exclusion criterion by applying a time filter.

We defined an interval of 10 years, considering all the research conducted from 2010, because we understand that, in this last decade, studies involving Distance Education and, consequently, virtual

learning environments, have grown exponentially (UNIVERSIA, 2016 apud KENSKI, 2017). Our interest was to investigate how accessibility and people with disabilities are contemplated in this model of education.

After delimiting the time interval that interested us, we excluded only one survey, which was conducted in 2002. This confirms our impression that most of the research on the topics of our interest has focused on the last decade.

After applying the exclusion criterion, we started to apply the inclusion criterion. In this sense, we were very objective, because the research to be selected, mandatorily, should contemplate the descriptors defined by us: Accessibility, Disability and Virtual Learning Environment. After checking all 15 remaining searches, we ended up excluding only one, since it did not include the descriptor "Virtual Learning Environment". This was a research that dealt with Public Accessibility Policies in educational institutions.

We completed our survey, after applying the exclusion criterion and the inclusion criterion, with 14 papers, two doctoral theses and 12 master's dissertations. All the documents that have been analyzed are presented in Table 1.

**Table 1:** Bibliographic data

	Title	Author	Type	Year	Institution
1	Accessibility in Moodle virtual learning environment for the visually impaired.	CHILINGUE, M. B.	Dissertation	2018	FIOCRUZ
2	Accessibility in virtual learning environments: possibilities for visually impaired students.	SIQUEIRA, A. L. F. C.	Dissertation	2017	UNOESTE
3	From accessibility to autonomy of visually impaired users in virtual learning environments.	BATALIOTT, S. E.	Thesis	2017	UNESP
4	Systematic for the development of guidelines in the design of graphical interfaces on tablet PCs aimed at typical users	KULPA, C. C.	Thesis	2017	UFGRS
5	Extension of the INTERA methodology for the development of educational resources accessible to people with visual impairment.	VAZ, P. T.	Dissertation	2017	UFABC
6	Accessibility of visually impaired people in Distance Education: guidelines for creating teaching materials in virtual learning environments.	SILVA, C. J. F.	Dissertation	2016	UFRPE
7	AVAVOZ - mediating the navigability and interaction relationships of visually impaired people and Moodle.	ARAÚJO, J. F.	Dissertation	2015	SENAI CIMATEC
8	Accessibility for visually impaired people in Moodle courses: a guide for teachers.	LEMOS, E. S.	Dissertation	2015	UFSM
9	Educational inclusion and Higher Education: reality and perspectives in Distance Education.	LORENSI, V. M.	Dissertation	2014	UFSM

10	Assessment of virtual teaching and learning environments accessible through usability tests with emotions.	BERG, C. H.	Dissertation	2013	UFSC
11	Accessibility for the deaf, in cyberculture: everyday life in networks and online Higher Education.	COLACIQUE, R.	Dissertation	2013	UERJ
12	Analysis of isotropic pathways adopted by visually impaired people in distance education course from an inclusive perspective.	TRENTIN, D. G.	Dissertation	2013	UNESP
13	Continuing education and school inclusion of students with disabilities: conceptions, feelings and practices of educators of the municipal school system of Presidente Prudente - SP.	GAKIYA, S. M. C.	Dissertation	2012	UNESP
14	Evaluation of the accessibility and usability of a virtual learning environment model for the inclusion of the visually impaired.	MARI, C. M. M.	Dissertation	2011	UFSCAR

Source: Prepared by the authors

### 3. Results

We dedicate this section to present the results of the analyses made, as well as to describe the bibliographic review of each of the selected papers, ordered according to Chart 1.

Chilingue (2018) worked in the Moodle environment whose aim was to

[...] analyze how this VLE is interacting with the visually impaired user, what are their addictions, their imperfections, and how it can be recommended, suggest changes and/or adaptations with a view to the inclusion and access of the content made available, provided that accessibility standards and guidelines are respected (CHILINGUE, 2018, p. 15).

His qualitative research carried out a “[...] descriptive, analytical and propositional study on a documentary and bibliographic basis” (CHILINGUE, 2018, p.19) with data collection through description. The evaluation was performed through web page accessibility evaluator portals in the five courses in the Moodle environment that the author had access to.

The results showed that Moodle does not meet WCAG 1.0 and 2.0 standards. There are barriers that partially or totally prevent People with Visual Impairment (PVI) from having access, in particular, people who need Assistive Technologies (ATs). For Virtual Learning Environments (VLEs) to be accessible, you need technical knowledge, ATs, detailed research on accessibility standards, and user testing.

The overall objective of Siqueira’s work (2017) was “[...] to analyze the resources necessary for courses that use virtual learning environments to enable accessibility, autonomy and independence of PVI” (IBID., p. 29). The platform studied was Moodle.

This work was done through qualitative research in a public higher education institution in the state of São Paulo. Two members diagnosed with subnormal vision participated in the research, one of which used a screen reader. For data collection, semi-structured interviews and observation were used.

Eight two-hour meetings were held to conduct the semi-structured interview and to observe the use of the environment by the guests.

The results showed that what environment is inclusive and that has accessibility and usability resources for inclusion of PVI, but there is a need for some adjustments. Higher Education Institutions need to prepare their VLEs to receive people with disabilities, not only for legal concern, but also to strengthen social inclusion and fulfill the social mission.

Bataliotti (2017) aimed in his work “[...] understand how a specialization course in distance mode enables the autonomy of the PVI in relation to their participation and performance in the VLE implemented, based on the existing accessibility recommendations” (IBID., p. 22).

His qualitative research adopted as a procedure of data collection the participant observation in two specialization courses in the area of Special Education. Of the three registered people who had some type of visual impairment, only two agreed to participate in the research.

The results confirm the state of the art that it is possible “[...] with pedagogical, digital, attitudinal and communications accessibility to provide an inclusive environment” (BATALIOTTI, 2017, p. 148). It is necessary to build and monitor the entire evolution of a course and verify the accessibility resources necessary to allow autonomy. The author highlights the follow-up of the team in such a way that the materials and activities remained accessible.

Kulpa (2017) carried out a paper considering users with Low Vision (LV) and tablet use, in order to answer the following question: “How can Graphical User Interfaces in Virtual Learning Environments (VLEs) be developed in order to improve the user experience with specific characteristics through the use of the Tablet PC?” (KULPA, 2017, p.14). To answer this question, the author outlined the following objective: “[...] improve the usability conditions of VLEs, so that developers create a Graphical User Interface (GUI), through a systematic able to provide guidelines aimed at typical users” (IBID., p.14).

The type of research used in this work is of an applied nature, through the development and availability of GUI for people with LV, qualitative (analysis of interaction between people with LV and tablet) and exploratory (interviews, practical experiences, case study). The results of this work were “[...] creation and structuring of a system that allows grouping and designing recommendations capable of guiding developers, in the increment of interfaces aimed at typical users” (KULPA, 2017, p. 237), taking into account the identification of guidelines (W3C, WCAG and MWBP - Mobile Web Best Practices) for the construction of GUIs, focusing on accessibility in users with BV, interacting with the VLE through tablet, and the recommendation to cover the largest number of users with difficulties and limitations.

Vaz (2017) investigated the challenges related to PVI access to DE, aiming to answer three questions:

- 1) What are the existing guidelines for the development of educational content accessible to PVI?
- 2) What are the main problems faced by PVI when interacting with existing educational content?
- 3) How to solve the accessibility problems of PVI content based on existing guidelines and tools? (VAZ, 2017, p. 18).

In this context, the author outlined the objective of “[...] adapt the INTERA methodology (Intelligence, Educational Technologies and Accessible Resources), using accessibility guidelines for the development of educational resources accessible to PVI, based on software engineering and human-computer interaction (HCI) techniques” (VAZ, 2017, p. 18).

To answer the first question, a theoretical reference was made with the main concepts involved in the subject. The second question was answered through a systematic review and a mapping and discussion

of the main problems faced by the PVI in the DE contents, collecting some guidelines related to problems of images, tables and forms, text and hypertext, video and animation, diagram, slide show, graphics and digital book. Finally, the third question was answered by applying the INTERA methodology for the development of a video lesson and a virtual class, both considering the guidelines and recommendations raised for each type of digital content. The contents and platform were validated by users and teachers through online evaluators (AccessMonitor and Wave) and questionnaires, respectively.

The author concluded that, for the elaboration of digital resources for PVI, in addition to the WCAG guidelines, Instructional Management Systems, PDF/UA (PDF/Universal Accessibility), "Principles of Universal Design", and experiences with PVI, are necessary to contribute the INTERA methodology and adapt it to accessible content at each stage (except the Project Management stage), considering the guidelines mentioned.

Silva's interpretive research (2016) aimed to promote the accessibility of the DE system of the Federal Institute of Education, Science and Technology of Piauí (IFPI) in relation to the inclusion standards of people with disabilities, in particular the PVI.

To achieve this goal, four methodological steps were proposed. In Step 1, the training needs of IFPI professionals on accessibility were identified through questionnaires. The results revealed ignorance about accessibility and ATs and point to the need for resources and training that allow professionals to adapt the environments and teaching materials in order to promote and facilitate the access of people with disabilities to education.

In Step 2, a manual verification was made and through an automatic validator of accessibility promotion strategies in the IFPI AVA (Moodle instance), with the support of a reference checklist (Guidelines WCAG 2.0 and e-MAG 3.0 - Brazilian Accessibility Model). These verifications pointed to problems that constitute barriers to access and use of VLE by persons with disabilities.

Stage 3 consisted of the evaluation of accessibility of digital educational resources made available by DE teachers in the VLE, as teaching material of disciplines. Several resources that were not accessible in two disciplines analyzed were detected and the only didactic material accessible to the screen reader was the activities available in the Word format. The results of the accessibility assessments of the VLE and the didactic resources were used in Step 4, in which a simple, direct and direct language guide was produced and evaluated in the context of IFPI teachers and other teachers interested in the theme, with guidelines for the production of teaching materials accessible to people with visual impairment and for the appropriate use of the accessibility resources of the VLE.

In the tests performed, the evaluators considered accessible both the environment configured for the provision of the guide and the resources available for PVI and that use screen readers as AT. The conclusion of the article highlights its contribution to the training of education professionals with the daily practice of building accessible digital educational resources, eliminating barriers to the PVI and thus contributing to a more inclusive educational system.

Araújo (2015) conducted his study based on the following research problem: How to provide WEB accessibility for inclusion of PVI in THE MOODLE VLE? (ARAÚJO, 2015, p. 02). She determined as the main objective "[...] develop for Moodle a WEB accessibility plugin to provide agility (short paths) and efficiency in the interaction of blind people with the said environment" (IBID., p. 02).

The author's challenge was to provide the PVI with better access to ava Moodle and for this developed a AT feature that makes use of voice recognition technique. This AT consisted of the installation of a plugin called AVAVOZ in Moodle VLE, which facilitated the interaction of PVI and VLE. This plugin follows the principles of software engineering and has been validated through two discussion forums created in



Moodle itself. These data collection instruments contained questions about the usability of the plugin and its contribution to navigability in the VLE.

In addition, tests were performed with the Markup Validation Service software of W3C, from which we sought to verify that the VLE was in accordance with the recommendations and accessibility guidelines. The main results showed that AVAVOZ expanded the functional capabilities of the PVI and contributed to Moodle accessibility, thus considerably reducing the efforts and time spent to perform the tasks in this environment.

Lemos (2015) carried out his work permeating the problem that education should serve everyone, especially the PVI, especially when we consider the modality of Distance Education. In order to overcome this possible problem, the researcher proposed as a general objective to create “[...] a guide to accessibility guidelines to support teachers in the preparation of their disciplines or courses, when they need assistance to make materials available for PVI” (LEMOS, 2015, p. 51). The idea was that this guide could contribute to teachers in the development of their online subjects.

The research was organized into nine stages: 1) Survey of guidelines; 2) Contact and monitoring of PVI; 3) Selection of guidelines to guide the preparation of the book; 4) Construction of the book in two stages; 5) Review; 6) Making the book available for teachers to create courses; 7) Creation of a course by the author, for the PVI to test the accessibility of this; 8) Testing and reorganization of the book from the opinions and answers of the questionnaires by teachers and students; 9) Reconstruction of the book.

They participated in the research “[...] five subjects: three teachers, named Teacher A, Teacher B, Teacher C, and two students with total visual impairment, named Student A and Student B” (LEMOS, 2015, p. 54). Two questionnaires were used as data collection instruments, one applied to students, and the other one to teachers. The product of this research was a Set of Accessibility Guidelines for PVI in Moodle, as well as a Learning Object for its dissemination, being possible to conclude that the study can contribute to teachers who have PVI in their classes of distance courses, opportunistic conditions of participation in these courses.

Lorensi’s study (2014) aimed to analyze how the Undergraduate Course in Special Education in the DE modality of the Federal University of Santa Maria enables inclusive actions for its students with disabilities. Vygotsky’s works that underlie the conceptions of learning and development of the individual from historical and social interactions were chosen as theoretical threads, as well as a theoretical foundation on the issues of AT, accessible communication and information technologies, and accessibility to the VLE.

A qualitative case study was conducted through face-to-face or virtual interviews with course participants. Content analysis was the chosen technique for data interpretation and allowed the achievement of the following results: DE can be inclusive for any student, whether with disabilities or not; DE can be favored by the use of information and communication technologies, and for students with disabilities computer-accessible technologies; educational inclusion in higher education is still a challenge in both face-to-face and DE; the inclusion for students with disabilities in the studied course still requires specific accessibility resources and services; accessibility issues are being planned and organized according to the needs of the demands of the students who enter; the DE was considered by the subject with disabilities included a viable option for the realization of the dream of academic training at the higher education level, due to the flexibility of spaces and times.

Berg (2013) brought the following guide question in his work: “How to evaluate the interface of an inclusive VLE to deaf people and listeners using emotions?” (BERG, 2013, p. 25). Therefore, the objective of the work was “[...] identify and promote a Case Study on Usability Tests with Emotions in Virtual Learning Environments Inclusive Learning” (IBID., p. 25).

The author adopted a bibliographic research complemented with the case study method and the DECIDE tool in the research planning. The study focused on the Accessible WebGD environment, using

Emocard (illustrations of faces that express emotions) to evaluate the following indicators: navigation, design and content understanding.

The author concluded the importance of elaborating evaluations of human-computer interaction (HCI) with emotions, due to the fact that “[...] emotions are difficult to express, so the use of nonverbal methods and techniques becomes more appropriate for the approach with the use of emotions” (BERG, 2013, p.70), to avoid the subjectivity of results.

Colacique (2013) investigated a number of fundamental issues, which:

How do deaf people inhabit the internet? What media and devices do you use? How does communication with the non-deaf happen? How can we offer the deaf a free, quality public education that respects its linguistic uniqueness? How to make accessible, for the deaf, a distance undergraduate course? What are the adaptations that CEDERJ already guarantees to deaf students? What are the necessary adaptations to promote the effective inclusion of deaf people in virtual learning environments, surpassing the mere translation of teaching materials and promoting online education? (COLACIQUE, 2013, p. 87).

The aim of the research was “[...] to think and propose accessibility strategies for deaf people [...] thought and evaluated by deaf people” (COLACIQUE, 2013, p. 83).

The author performed a mapping of the main barriers of usability and communicability between deaf people and VLE, considering as data source the use of narratives, some of them oral and others mediated by communication interfaces (e-mail, Facebook and CEDERJ platform). The narratives presented allowed us to describe how the deaf experience is on the Internet.

The results of the research, that is, the answers to the questions “are not definitive”, because “deafness is not a characteristic that uniformizes to all who participate in it”; thus, some actions were highlighted, among them, “the legal requirement to provide accessible content in virtual learning environments, be they videos, texts, or any other material; the importance of offering instruction in Libras to deaf users of this language; the realization of rights and differentiated evaluation, considering the linguistic singularities of the deaf in the courses, in addition to the mere consumption of information; the permanent training of tutors and coordinators, aiming to equip them to promote accessibility; and, more importantly, a sensitive look at the daily life of educational spaces, in order to perceive and guarantee the participation of all students” (COLACIQUE, 2013, p. 152).

The study by Trentin (2013) aimed to analyze the isotropic pathways (internal adaptations to restructure their way of perceiving and learning) used by PVI in DE. To achieve this objective, an analytical-exploratory research was carried out. This analysis was related to accessibility conditions in VLE Teleduc, for the performance of the ATs course, offered by the Paulista State University “Júlio de Mesquita Filho”, by Presidente Prudente.

The procedures for data collection had observations scored by a mediator and the application of questionnaires to four PVI. The analysis of the use of isotropic pathways by the PVI was based on Vygotsky's theories about proximal development zone and socio-constructivism. This analysis showed how the PVI advanced in their learning using their isotropic pathways. It was observed the use of external isotropic path, in the performance of the monitor with the study to access the tools and perform the activities of the course.

The important contribution of the work consists in the proposal of the contribution of another person assisting in the learning and inclusion of PVI in the DE, and its designation as an external isotropic path.

Future recommendations have also been prepared to improve the accessibility and interaction conditions of The PVI in the VLE Teleduc, aiming at greater autonomy and independence of these people.

Gakiya (2012) brought the following guide question in his work: “Did the continuing education carried out from the perspective of inclusive education promote change in the conception, posture and practice of educators in the face of the process of inclusion in school?” (GAKIYA, 2012, p. 15). To answer this question, the author had as a general objective “[...] to analyze the manifestations of educators participating in the Continuing Education Course in AT about their understandings, attitudes and practices regarding the school inclusion of people with disabilities [...]” (IBID., p. 16).

Her qualitative study was also characterized as a bibliographic research, because it was necessary to revisit other works whose themes were close to those of the author’s research; and as a documentary research, being necessary to use official documents of the Municipal Department of Education of Presidente Prudente / SP, municipality where the research was carried out. Thus, the research was organized in six stages: 1) Bibliographic survey; 2) Contextualization of the course; 3) Collection of Documents; 4) Preparation and application of online questionnaire; 5) Interview; and 6) Analysis of the collected data, and steps 3, 4 and 5 were used for data collection. It is noteworthy that in step 3, the documents were collected from the VLE TelEduc, a virtual learning environment used for the application of the course to teachers.

The main results refer to the lack of security on the part of educators in working with students with disabilities in their classes, as well as disbelief and professional unpreparedness, resulting from the inadequate initial training, which did not contemplate the real dilemmas experienced in the classrooms; beyond the fear of facing different and challenging situations. However, it is worth mentioning that this course influenced teachers to have new attitudes and behavior towards the process of school inclusion of students with disabilities, also contributing to the reflection on the importance of the role of the teacher as mediator of the relationships established in the classroom. Finally, it was found that some resources such as VLE TelEduc, pedagogical mediation and the approach about being together virtually provided situations of reflection in the action and on the action of teachers, emerging new postures, practices and feelings.

Mari (2011) elaborated a paper to analyze the interface from the perspective of usability, ergonomics and accessibility in order to facilitate the access of People with Visual Impairment (PVI) to the virtual learning environment, aiming to answer the following questions:

- a) Does Moodle Virtual Learning Environment (VLE) have accessibility features for PVI? b) What are the needs of the PVI for them to have access to DE going Moodle? (c) Are the existing resources in Moodle sufficient to enable desirable accessibility in the environment? Otherwise, there is the possibility to complement Moodle’s existing accessibility features to fully meet the needs of PVI? (MARI, 2011, p. 21)

This qualitative case study work with direct observation was carried out at the Moodle VLE of the Federal University of São Carlos. Direct observation was performed with the help of Morae software (performs usability tests of software and website). A user with total blindness and who used the JAWS screen reader was selected for this study.

At the end of the research, the author concludes that Moodle is a safe and reliable system. It has accessibility and usability resources for the inclusion of PVI, although some technological, pedagogical and instructional adjustments are needed. The author reinforces the importance of evaluating usability and accessibility with other groups considering visual people and people with visual impairments.

## 4. Discussion

The inclusive process is a way of achieving equal conditions and equity in educational, social and labor opportunities. Inclusion represents the elimination of social, educational, cultural, linguistic, political barriers and the insertion of people with disabilities and/or special needs in all contexts of society, welcoming and recognizing each one in peculiarities, as subjects with rights to be together, learn, develop and participate as citizens (LORENSI, 2014). In this sense, technological tools can provide elements and instruments that contribute to the elimination of physical, social, cultural and educational barriers and, thus, guarantee the right to education, participation, interaction of subjects with disabilities.

Developing proposals of DE is a task that involves multidisciplinary team, with pedagogical, technical knowledge, knowledge of ATs and accessibility guidelines of W3C and WCAG. This implies concern not only with accessibility in the VLE, but also, and with the same importance, one should think about accessibility in the production of textual and audiovisual resources produced as didactic support material. This is because an accessible AVA is not effective for the inclusion of people with disabilities if the didactic material made available in it does not also meet the accessibility criteria (SILVA, 2016).

**Table 2:** Similarities and differences between the studies analyzed

	Paper title	Graduate Program	Survey participants	Types of VLE	Guidelines
1	Accessibility in Moodle virtual learning environment for the visually impaired.	Professional Education in Health	Visually Impaired Person	Moodle	WCAG
2	Accessibility in virtual learning environments: possibilities for visually impaired students.	Education	Visually Impaired Person	Moodle	WCAG
3	From accessibility to autonomy of visually impaired users in virtual learning environments.	Education	Visually Impaired Person	Moodle	W3C
4	Systematic for the development of guidelines in the design of graphical interfaces on tablet PCs aimed at typical users.	Production Engineering	Visually Impaired Person	Moodle	W3C, WCAG MWBP
5	Extension of the INTERA methodology for the development of educational resources accessible to people with visual impairment.	Computer Science	Visually Impaired Person	Moodle	WCAG, IMS, PDF/UA
6	Accessibility of visually impaired people in Distance Education: guidelines for creating teaching materials in virtual learning environments.	Technology and Management in Distance Education	Visually Impaired Person	Moodle	WCAG 2.0 e e-MAG 3.0
7	AVAVOZ - mediating the navigability and interaction relationships of visually impaired people and Moodle.	Computational Modeling and Industrial Technology	Visually Impaired Person	Moodle	WCAG
8	Accessibility for visually impaired people in Moodle courses: a guide for teachers.	Networking Technologies - Professional Master	Visually Impaired Person	Moodle	WCAG

9	Educational inclusion and Higher Education: reality and perspectives in Distance Education.	Education	Mental disability and deafness	Moodle	Not mentioned
10	Assessment of virtual teaching and learning environments accessible through usability tests with emotions.	Engineering and Knowledge Management	Deaf	Accessible WebGD (Moodle)	Not mentioned
11	Accessibility for the deaf, in cyberculture: everyday life in networks and online Higher Education.	Education	Deaf	CEDERJ/ Moodle	WCAG 2.0 e e-MAG
12	Analysis of isotropic pathways adopted by people with visual impairment in distance education course from an inclusive perspective.	Education	Visually Impaired Person	TelEduc	Not mentioned
13	Continuing education and school inclusion of students with disabilities: conceptions, feelings and practices of educators of the municipal school system of Presidente Prudente - SP.	Education	Several	TelEduc	Not mentioned
14	Evaluation of accessibility and usability of a virtual learning environment model for the inclusion of visually impaired people.	Production Engineering	Visually Impaired Person	Moodle	WCAG

Source: Prepared by the authors

The results of the papers presented provide selection of the most important points of the guidelines for the creation of accessible teaching materials, as well as an awareness of all professionals in the field of education, not only those who work in DE, who need to be prepared to work in an inclusive school, either with the construction of accessible teaching materials or with actions that can make these materials and environments more accessible to people with disabilities. They point out that most of the studies were concerned with the PVI and, with regard to the VLE used, we highlight that, of the 14 studies analyzed, two were carried out in the TelEduc environment, and the rest, in Moodle. We also highlight that only six studies were developed within the scope of graduate programs in Education, which shows a concern of other areas with the inclusion of people with disabilities through the DE.

The conclusions of the studies provide recommendations and perspectives for an inclusive educational proposal within the scope of DE, among which we can highlight the clarity of the theoretical conceptions of learning that underpin the action of teachers and tutors, considering the aspects related specifically to the teaching action in DE; the design of online teaching strategies and methodology that help to understand the inherent vicissitudes to work in the VLE; the focus on teacher training programs to know the characteristics of teaching in DE for the development of skills and competencies; the promotion of integrated and permanent actions for the technological preparation of educational purposes, involving all course participants: students, teachers, tutors and managers; the provision of support and guidance to face-to-face support centers, aiming at attention to the needs of students with disabilities; the organization of the didactic material of the disciplines, incorporating audiovisual language to meet the needs of deaf and visually impaired students; the development of training programs in the area of AT, mainly on resources related to computer use, encompassing students with disabilities, course managers, teachers and tutors in person and distance.

It is important to highlight that the present study gathered the most recent studies that were found

in the database used, and that, although the need for the inclusion of people with disabilities in DE is increasing, published studies that included the descriptors used by us in the years 2019 and 2020 were not found in the database consulted, which evidences the importance of our study. We are living an important moment of reflection on DE (Distance Education) in every way, in which digital accessibility in VLE is also an important part of this discussion. Inclusion needs to go beyond theoretical issues, so that everything that has been built over the years in the face of the challenges of the time in which we live is applied in practice, and that ensures access, as well as the permanence and participation of people with disabilities in DE.

## 5. Conclusions

Today's society is undergoing major transformations, not only in relation to the use of technological resources, but also in the inclusion of people with disabilities. In this way, education must be inclusive. DE can be another resource for access to permanent learning. Virtual Learning Environments can be planned to incorporate accessibility features, expanding educational inclusion.

Several educational institutions are researching how to make virtual learning environments with accessibility resources so they can serve more people. The research shows that the audio description, the window in Libras, the recommendations of the W3C and the incorporation of ATs are being employed in the courses.

Planning inclusive courses is a complex process because there are several types of deficiencies and, as a consequence, specific resources that must be adopted in each case. It is necessary a multidisciplinary team that has knowledge of the content that will be taught, technical and technological knowledge. Some courses are also evaluated by people with disabilities before being deployed. Prioritizing the implementation of accessibility since its conception creates the culture of inclusion in the preparation of courses, reduces cost and rework.

The articles analyzed focus on visual and hearing impairments, but it is necessary to evaluate that there are several deficiencies that also need to be studied. It is worth remembering that the world population is aging and, in some situations, it will be necessary to use ATs so that they can access digital media and online courses.

Accessibility in digital environments will still go a long way, but the evaluation of the articles signals that some educational institutions are drafting proposals that are collaborating so that the DE can be an increasingly inclusive learning process.

## References

- ARAÚJO, J. F. **AVAVOZ - mediando as relações de navegabilidade e interação de pessoas com deficiência visual e o Moodle**. 2015, 88 f. Dissertação (Mestrado em Modelagem Computacional e Tecnologia Industrial) - SENAI CIMATEC, Salvador, 2015. Disponível em <<http://repositoriosenaiba.fieb.org.br/handle/fieb/772>>. Acesso em 11 jul. 2020.
- BATALIOTTI, S. E. **Da acessibilidade à autonomia do usuário com deficiência visual em ambientes virtuais de aprendizagem**. 2017. 170 f. Tese de Doutorado (Programa de Pós-Graduação em Educação da Faculdade de Ciências e Tecnologia) - Universidade Estadual Paulista (UNESP), Presidente Prudente, 2017. Disponível em <<http://hdl.handle.net/11449/150937>>. Acesso em 10 jul. 2020.
- BERG, C. H. **Avaliação de ambientes virtuais de ensino aprendizagem acessíveis através de testes de usabilidade com emoções**. 2013, 79 f. Dissertação (Centro Tecnológico, Programa de Pós-Graduação em Engenharia e Gestão do Conhecimento) - Universidade Federal de Santa Catarina, Florianópolis, 2013. Disponível em <<https://repositorio.ufsc.br/handle/123456789/107560>>. Acesso em 10 jul. 2020.

- CHILINGUE, M. B. **Acessibilidade no ambiente virtual de ensino aprendizagem MOODLE para deficientes visuais**. 2018, 165 f. Dissertação (Mestrado Profissional em Educação Profissional em Saúde) - Fundação Oswaldo Cruz. Escola Politécnica de Saúde Joaquim Venâncio, Rio de Janeiro, 2018. Disponível em <<https://www.arca.fiocruz.br/handle/icict/30891>>. Acesso em 14 jul. 2020.
- COLACIQUE, R. **Acessibilidade para surdos, na cibercultura: os cotidianos nas redes e na educação superior online**. 2013, 166 f. Dissertação (Programa de Pós-Graduação em Educação) - Universidade do Estado do Rio de Janeiro, Rio de Janeiro, 2013. Disponível em <[http://www.proped.pro.br/teses/teses\\_pdf/2009\\_1-560-ME.pdf](http://www.proped.pro.br/teses/teses_pdf/2009_1-560-ME.pdf)>. Acesso em 14 jul. 2020.
- GAKIYA, S. M. C. **Formação continuada e inclusão escolar de alunos com deficiência: concepções, sentimentos e práticas de educadores da rede municipal de ensino de Presidente Prudente-SP**. 2012. 203 f. Dissertação (Programa de Pós-Graduação em Educação) - Universidade Estadual Paulista, Presidente Prudente, 2012. Disponível em: <<http://hdl.handle.net/11449/92301>>. Acesso em 12 jul. 2020.
- GOMES, I. S.; CAMINHA, I. O. **Guia para estudos de revisão sistemática: uma opção metodológica para as Ciências do Movimento Humano**. 2014. Movimento: Revista da Escola de Educação Física, Porto Alegre, v. 20, n. 01, p. 395-411, jan/mar de 2014. Disponível em <<https://seer.ufrgs.br/Movimento/article/viewFile/41542/28358>> Acesso em 12 jul. 2020.
- KENSKI, V. M. **Grupos que pesquisam EaD no Brasil**. Disponível em <[http://abed.org.br/congresso2017/Grupos\\_que\\_pesquisam\\_EAD\\_no\\_Brasil.pdf](http://abed.org.br/congresso2017/Grupos_que_pesquisam_EAD_no_Brasil.pdf)> Acesso em 01 dez. 2020.
- KULPA, C. C. **Sistemática para o Desenvolvimento de Diretrizes no Design de Interfaces Gráficas em Tablet PCs voltadas a Usuários Típicos**. 2017, 305 f. Tese (Programa de Pós-Graduação em Engenharia de Produção) - Universidade Federal do Rio Grande do Sul, Porto Alegre, 2017. Disponível em <<http://hdl.handle.net/10183/163912>>. Acesso em 11 jul. 2020.
- LEMOS, E. S. **Acessibilidade para pessoas com deficiência visual em cursos no Moodle: guia para professores**. 2015, 181 f. Dissertação (Mestrado em Educação) - Universidade Federal de Santa Maria, Santa Maria, 2015. Disponível em <<https://repositorio.ufsm.br/handle/1/10674>>. Acesso em 13 jul. 2020.
- LORENSI, V. M. **A Inclusão educacional e Educação Superior: Realidade e perspectivas na Educação a Distância**. 2014. 212 f. Dissertação (Mestrado em Educação) - Universidade Federal de Santa Maria, Santa Maria, 2014. Disponível em <<https://repositorio.ufsm.br/handle/1/7135>>. Acesso em 13 jul. 2020.
- MARI, C. M. M. **Avaliação da acessibilidade e da usabilidade de um modelo de ambiente virtual de aprendizagem para a inclusão de deficientes visuais**. 2011, 96 f. Dissertação (Mestrado em Ciências Exatas e da Terra) - Universidade Federal de São Carlos, São Carlos, 2011. Disponível em <<https://repositorio.ufscar.br/handle/ufscar/3670>>. Acesso em 11 jul. 2020.
- MELO, A. M. **Acessibilidade em EaD mediada pela web: um convite à ação**. In: Maciel, C. (Org). **Ambientes Virtuais de Aprendizagem**, 2012. Disponível em: <[https://edisciplinas.usp.br/pluginfile.php/129865/mod\\_resource/content/1/Ambientes%20Virtuais.pdf](https://edisciplinas.usp.br/pluginfile.php/129865/mod_resource/content/1/Ambientes%20Virtuais.pdf)>. Acesso em 09 jul. 2020
- MOREIRA, J. R. **Usabilidade, Acessibilidade e Educação a Distância**, 2011. Disponível em: <http://www.abed.org.br/congresso2011/cd/13.pdf>. Acesso em 11 jul. 2020.
- MOREIRA, W. **Revisão de Literatura e Desenvolvimento Científico: conceitos e estratégias para confecção**. 2004. Janus, Lorena, ano 1, nº 1, 2º semestre de 2004. Disponível em <[https://files.cercomp.ufg.br/weby/up/19/o/Revis\\_o\\_de\\_Literatura\\_e\\_desenvolvimento\\_cient\\_fico.pdf](https://files.cercomp.ufg.br/weby/up/19/o/Revis_o_de_Literatura_e_desenvolvimento_cient_fico.pdf)> Acesso em 12 jul. 2020.
- OLIVEIRA, B. T. de; SILVA, A. R. L. da. **Audiodescrição: Acessibilidade para Cursos EaD**. In: Revista Brasileira de Aprendizagem Aberta e a Distância, [S.l.], v. 18, n. 1, 2019. ISSN 1806-1362. doi:<http://dx.doi.org/10.17143/rbaad.v18i1.321>. Disponível em: <http://seer.abed.net.br/index.php/RBAAD/article/view/321>. Acesso em 09 jul. 2020.

- PEREIRA, K.; SILVA, R. **Acessibilidade em ambiente virtuais de aprendizagem em apoio ao uso de tecnologias na educação de forma inclusiva**. In: Escola Regional de Computação Bahia, Alagoas e Sergipe (erbase), 2019, Ilhéus. Anais da XIX Escola Regional de Computação Bahia, Alagoas e Sergipe. Porto Alegre: Sociedade Brasileira de Computação, dec. 2019. p. 457-466. Disponível em: <https://sol.sbc.org.br/index.php/erbase/article/view/9008>. Acesso em 11 jul. 2020.
- QUEIROZ, A. C. de. **Tecnologias Assistivas na Educação a Distância**. In: Em Rede Revista de Educação a Distância, v. 6, n. 2, 2019. Disponível em: <https://www.aunirede.org.br/revista/index.php/emrede/article/view/445>
- SALTON, B. P.; AGNOL, A. D.; TURCATI, A. **Manual de Acessibilidade em Documentos Digitais**, 2017. (falta complementar: ano, link ou editora etc)
- SAMPAIO, R. F.; MANCINI, M. C. **Estudos de revisão sistemática: Um guia para síntese criteriosa da evidência científica**. 2007. Rev. bras. fisioter., São Carlos, v. 11, n. 1, p. 83-89, jan./fev. 2007. Disponível em <<https://www.scielo.br/pdf/rbfis/v11n1/12.pdf>>. Acesso em 11 jul. 2020.
- SCHLÜNZENJUNIOR, K.; MALHEIRO, C. A. L.; SCHLÜNZEN, E. T. M.; VIGENTIN, U. D. **Acessibilidade em Cursos Abertos e Massivos**, 2016. Disponível em: <<https://onlinelibrary.wiley.com/doi/full/10.1111/1471-3802.12135>>. Acesso em 10 jul. 2020
- SILVA, C. J. F. **Acessibilidade de pessoas com deficiência visual na educação a distância: diretrizes para criação de materiais didáticos em ambientes virtuais de aprendizagem**. 2016, 138 f. Dissertação (Programa de Pós-Graduação em Tecnologia e Gestão em Educação a Distância) - Universidade Federal Rural de Pernambuco, Recife. Disponível em <<http://www.tede2.ufrpe.br:8080/tede2/handle/tede2/7982>>. Acesso em 10 jul. 2020.
- SIQUEIRA, A. L. F. C. **Acessibilidade em ambientes virtuais de aprendizagem: possibilidades para estudantes com deficiência visual**. 2017, 115 f. Dissertação (Mestrado em Educação) - Universidade do Oeste Paulista, Presidente Prudente, 2017. Disponível em <<http://btdt.unoeste.br:8080/jspui/handle/jspui/1026>>. Acesso em 13 jul. 2020.
- SOUZA, B. B. de; NAZARIO, K. R. P.; LIMA, E. N. Acessibilidade digital no ambiente virtual de aprendizagem: recursos e ferramentas. In: **CIET: EnPED: 2018 – Educação e Tecnologias: Aprendizagem e construção do conhecimento**, 2018. Disponível em: <<https://cietenped.ufscar.br/submissao/index.php/2018/article/view/538>>. Acesso em 10 jul 2020
- TRENTIN, D. G. **Análise dos caminhos isotrópicos adotados por pessoas com deficiência visual em um curso de Educação a Distância na perspectiva inclusiva**. 2013. 142 f. Dissertação (Programa de Pós-Graduação em Educação) - Universidade Estadual Paulista Júlio de Mesquita Filho, Presidente Prudente, 2013. Disponível em: <<http://hdl.handle.net/11449/92254>>. Acesso em 14 jul. 2020.
- VAZ, P. T. **Extensão da metodologia INTERA para o desenvolvimento de recursos educacionais acessíveis a pessoas com deficiência visual**. 2017, 168 f. Dissertação (Programa de Pós-Graduação em Ciência da Computação) - Universidade Federal do ABC, Santo André, 2017. Disponível em <[http://biblioteca.ufabc.edu.br/index.php?codigo\\_sophia=106585](http://biblioteca.ufabc.edu.br/index.php?codigo_sophia=106585)>. Acesso em 10 jul. 2020.
- VIEIRA BARROS, D.; GUERREIRO, A. Novos desafios da educação a distância: programação e uso de Chatbots. In: **Revista Espaço Pedagógico**, v. 26, n. 2, p. 410 - 431, 10 maio 2019. Disponível em: <<http://seer.upf.br/index.php/rep/article/view/8743>>. Acesso em 10 jul.2020.