Ergonomic Considerations for the Inclusive Communication of Low Vision People in Academic Spaces

Rojas R. Claudia Isabel[1(✉)] and Luna Rodríguez A. Sofía[2]

[1] Universidad Pedagógica y Tecnológica de Colombia, Tunja, Boyacá 150003, Colombia
claudia.rojas@uptc.edu.co
[2] Universidad Autónoma de Nuevo León, San Nicolás de los Garza, Nuevo León, Mexico
sofia.lunard@uanl.mx

Abstract. Educational institutions must embrace public policies that guarantee the social inclusion of all people without discrimination of any kind. To achieve this objective, the diversity of needs and abilities of the people must be considered, favoring them full access and effective interaction with the spaces. In response to these challenges of inclusion, and particularly considering people with low vision (Clasificación Internacional del Funcionamiento CIF de la OMS), this project was proposed to explore from three Latin American universities (Universidad Pedagógica y Tecnológica de Colombia; Universidad Autónoma de Nuevo León, México; Universidad de Bueno Aires, Argentina), the communication needs of this population group, from the three indispensable categories to achieve autonomy within the university space: Informative, guiding and directional signage. This is due to the fact that from some previous studies, important differences in behavior and response have been found during the interaction with open spaces and closed spaces between people with low vision and people with total blindness. From this perspective, the research proposal seeks to establish through an exploratory study and an experiential process, the conceptual elements that from the ergonomic perspective are required to develop efficient alternatives of signage and signaling that use new technologies and facilitate orientation, information, and displacement of people with low vision inside the academic spaces.

Keywords: Inclusion · Ergonomics · Signaling · Low vision · Design University

1 Introduction

International policies and guidelines confirm the need to address inclusion in the higher education level of all people under special conditions. Thus, UNESCO affirms that all children have the right to education, including child populations, homeless, workers, disabled, indigenous and rural. This "inclusive" perspective focuses on the basic education system, without considering young people in the middle and upper levels;

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even when the same institution states, that only in Latin America for the year 2004 were enrolled 15 million students in Institutions of Higher Education, and that, in the last 15 years, there has been an increase in the participation of the university population.

In the same sense, the World Declaration on Higher Education in the 21st century, in its vision and framework of priority action for the change and development of higher education, emphasizes "the need to guarantee minimum benefits for the entire population that allows them to live with dignity, valuing diversity and respecting the rights of all people" (Unesco 1998: 68). On the other hand, the fourth objective of sustainable development (UN 2000) focused on providing quality education and the OECD area (2007) establishes education for people with disabilities as a line of work; in accordance higher education embraces inclusive education policies, accepting the responsibility to develop and implement inclusive and accessible academic spaces for all persons independent of their individual condition. Consequently, all the institutions that offer higher education have the responsibility to develop and implement academic spaces that favor inclusion and accessibility for all people regardless of their individual condition (Ocampo 2011). Addressing global policies in the field of inclusion presents especially for public universities in Latin America great challenges because according to Ocampo universities must compose spaces that validate, integrate and recognize the differences of its population, within a context common and transversal.

According to the Clasificación Internacional del Funcionamiento CIF de la OMS, disability is a term that includes deficiencies, limitations on activity and restrictions on the participation of people; and it refers mainly to the difficulties that are generated during the interaction between an individual with some limitation and the factors of the context in which it operates (CONADIS 2011, p. 10). From this organization, three general categories of disability are considered: physical, cognitive and sensory. The condition of visual impairment is a modality of the category of sensory disability, as well as the auditory disability and other conditions related to the decrease in the perception of the individual. According to this classification, in the condition of visual impairment are people who are blind or have a total loss of vision and people with low vision.

This second group is made up of those people who, without total blindness, their visual impairment or insufficiency persists at a low average despite optical aids, in reference to a person with a full vision and therefore they require other types of support, such as signs, canes, languages, and communication systems that guarantee an autonomous and independent orientation and mobility. In the world, there are approximately 285 million people with visual impairment, of which 39 million are blind and 246 million have low vision (Organización Mundial de la Salud 2014).

In Colombia in particular, norms have been issued ranging from the Political Constitution of 1991, which consolidates a legal framework that determined in a general way the rights of the population with disabilities, and the obligations of the State and society with this population, up to the law 361 of 1997 also known as "Clopatofsky law", which consolidates a legal framework that determines the rights of the population with disabilities, and the obligations of the State and society with this population. This legal framework has given rise to various rules related to the regulation of access to physical space, however, there is not yet a compendium of standards

or recommendations from the field of signage and signage that consider the correct information and necessary to travel safely on a university campus, signage was used as a discipline responsible for the design, creation, and planning of structural systems developed from signals, which aim to guide people in his usual mobility in complex environments; to approach this research project through design, which explored the physical spaces of three Latin American universities, as case studies.

Through an exploratory process of a comparative and complementary nature, it was proposed to establish, through the design of experiences and life histories, the conceptual foundations and design criteria necessary for the development of signposting informative alternatives, guiding and directional signage, which favors autonomous mobility for people with low vision, in higher education spaces. Likewise, it was proposed to identify through the process the main areas of general interest, as well as barriers and facilitators of the external physical space in the three Latin American universities that can be generalized, and to identify the communicative elements that are required to develop a signage for people with low vision.

Finally, it is expected through exploration with some developed prototypes, it is expected to make use and usability experiences with people in full conditions and with low vision, which facilitate the determination of the common elements of design that should be incorporated as a system for guarantee an inclusive communication specifically for people with low vision both in spaces of common use and in the social places offered by the academy; from 3 where ergonomic recommendations and useful accessibility will be formulated to design information for people with low vision within university academic spaces.

1.1 State of the Art

In a first approach to the state of the art, several studies at national and international level are visualized aimed at the inclusion on campus of higher education institutions of students in full conditions and with low vision as a group, in order to detect specific needs and provide solutions through the improvement, implementation and development of generic tools accompanied by traditional signage and signage aids. Within the subject are studies aimed at different public sectors, some that explore the service offered by public transport companies, which provide necessary adjustments for an autonomous and safe use, as in the case of (Acevedo and López 2006) who propose a designed system that uses tactile, visual and auditory signage, in accordance with the difficulties detected in passengers with visual limitations, to improve their orientation, sense of movement and for the prevention of accidents; Obtaining greater independence in the use of mass transport systems.

The method used is based on direct interaction with the user, through interviews, graphic records and usability tests with the alternatives, allowing to obtain solutions based on direct translations of the suggestions expressed by the users themselves. In addition, research such as that of (López 2008), has focused on creating systems and tools for signage aimed at the blind and seer population, providing inclusive functional solutions. Visual information criteria are combined with tactile information such as braille, floor textures, high relief figures easily understood and understood by the blind. This type of studies has been based on understanding the world of the blind, their

perception towards objects, the way information is taken from the outside world, in order to be able to mobilize.

Similarly, in the topic of inclusion of people with visual disabilities that has been explored from the theoretical in the academic context, with studies such as (Zuñiga et al. 2012), which focuses on diagnosing the educational supports that are required to meet the needs of this population, here it is presented as a cross-analysis, the degree of vision as an incident element in their trajectories, and the need for support in three categories: architectural accessibility, technological and personnel.

Finally, authors like (Sanabria 2007) do not focus on the development of design solutions that favor the accessibility and inclusion of people with visual disabilities; the spatial reasoning process is studied to understand how space is conceived for these users, through a "cognitive mapping", a process composed of a series of psychological transformations that an individual is acquiring, storing, recovering and decoding information about the aspects that intervene in the surrounding environment (Down and Stea 1973), which allows knowing the information required for their mobility and how it is distributed in the environment.

1.2 Conceptual Elements

Signage: According to Costa (2007), the development of a signal system seeks to apply the generalized economy principle, which consists of using the maximum amount of information provided with the minimum elements, implying a minimum effort of localization and understanding on the part of the receiver. The purpose of any signal is information, which must be unambiguous and instantaneous. Sims (1991) states that, in most signal systems, the following types of signals can be highlighted:

Orienting: They serve to situate users in an environment. They include maps, schematic views, plans at points of entry and at crucial points.

Informative and Identifying: Designation instruments that confirm destinations or establish recognition of a specific location. They are designation signs that are usually of an exclusive or individual nature. They can be located anywhere in the environment. Such information can refer to opening hours, merchandise, etc.

Directional: Explicit circulation instruments. In this case, they are part of a signaling system in a closed environment.

Regulators: They exhibit rules of order, such as driving or prohibiting activities, prescribed by ordinances or specific authorities, whose main mission is the safeguarding and protection of people against danger. They include legal announcements, safety regulations, safety control instruments, traffic control instruments and signals or exit signs. Any type of signal used by the general public should be concise, understandable, providing accurate information and instantly, that should be distinguished without effort within a space, avoiding energy and/or emotional expenditure of the person performing the action.

Signaling: (Quintana 2010) establishes that signage contains a self-taught character in the way in which users relate to their environment, and is useful for guiding people in spaces, allowing greater security in travel to access them. required services.

Accessibility: defined as the degree to which all people can use an object, visit a place or access a service, regardless of their technical or physical capabilities.

Inclusive higher education: "It is a process aimed at providing an appropriate response to the diversity of characteristics and educational-formative needs of students" (Moriña 2004).

People with low vision: Pérez (2016), presents this condition as a diminished or insufficient visual perception, which, despite the optical aids that the student can use, is still below the average of a normal vision, many of them they will be able to write and read printed texts, generally amplified, supported by the optical aids that are necessary in each case, such as magnifying glasses, lenses or other instruments necessary to magnify the characters and images that they wish to see.

1.3 Approach Method to the Field

The proposed method to approach the fieldwork was based on the Research-Action RA, because this, as a transformation tool, seeks not only to obtain a clear description of the problematic situation, but also to explore especially the most appropriate way to determine the activities necessary to solve the problem in relation to the interests of comprehensive type. Consequently, a flexible methodological scheme was proposed that would help to permanently direct the theoretical-methodological decisions and actions in search of the fulfillment of the objectives.

This proposal in coherence with the postulates of the action-based methods was interested in favoring the relevant participation of people in each of the stages, and collect their appreciation within the dynamics that were generated around the object of study. The study aimed to deepen the research modality through RTD design with a phenomenological approach. It is research through design since according to Zimmerman et al. (2010) the RTD is an intentional path directed to the establishment of theories, the construction of conceptual frameworks and philosophies that guide the profession towards preferred states, where the designed artifact helps refine the knowledge and the theories that generate it, especially when it involves concerns of the human and cognitive sciences where the path to theoretical construction becomes evident.

And from the phenomenological cut, since it described the meaning of the experiences lived by the people in full conditions or with low vision, through the document of the history of life that was applied in the three selected universities.

1.4 Phases of the Project

For the development of the project, four phases were proposed: diagnosis, formulation, evaluation and research through design, and a final stage of validation.

Phase 1 Diagnosis: The purpose of this moment was to determine the participating population, people in full conditions and with low vision. Determine and diagnose the areas that require signaling and establish the communication elements to develop a proposal of signage and signaling for people with full abilities and low vision in three Latin American universities.

Phase 2 Formulation: Through the Analysis of the results obtained in the previous stage and through meetings with the participating population, this phase was aimed at formulating the elements of signaling and signage, which is expected to guarantee

personal autonomy and the development of the people with or without low vision within the university, through the design of formal and alternative solutions.

Phase 3 Assessment: Development of prototypes, and design of experiences for the application of joint discovery protocols and manifested thinking. This stage seeks to evaluate the experiences of people in full conditions and people with low vision with the prototypes developed within the universities, and validate the levels of effectiveness and understanding of the design.

Phase 4 Validation: Determination of ergonomic considerations for the design of proposals that promote the autonomous mobility of people with low vision in university institutions, and of generalized conceptualizations for the design of signaling and signage for low vision university students.

1.5 Methodology and Participants

The participants until the moment of the development of the research have been people of different ages, all with low vision that use educational spaces in the three countries that were taken as case studies. As with any other qualitative research procedure, the results are not based mainly on statistical and sampling techniques, but on the actions and tasks jointly carried out by the design researchers with the participating community to collect the data of interest. The data collection lasted four months, carried out in a systematic way until it met the sample ethnographic criterion due to saturation of information, according to Guber (2006).

The final sample consisted of 45 people with low vision, 15 from each of the participating countries: Colombia, Mexico, and Argentina; professors and students of university academic centers or students of last years of basic education.

1.6 Information Gathering Instruments

For the development of this research, life histories were used to collect the data that served as a basis to determine the categories and requirements that technological developments should meet. For the stages of validation and exploration of the use of the proposals and prototypes, the protocols of joint discovery and protocols of manifested thought will be applied.

1.7 Partial Results

To date, the data corresponding to stages one and two have been collected and analyzed: diagnosis and formulation, in the three study universities. These data are listed below and their main preliminary conclusions are also indicated. The information was collected through 52 life history formats, which was organized and analyzed under the categories established by the types of communication required. From this analysis came the inductive categories that favored the appearance of similarities, generalities, and differences between the social and cultural contexts of the three universities. In this sense, some general and other categories emerged that will allow adapting the technological development to the needs of each academic campus.

Figure 1 shows the data referring to the general data of the participants for each country, where the age range is shown, divided between the percentage related to the male gender and the female gender, in addition to their schooling reached. Here a significant difference of ages and levels of schooling among the participants could be evidenced, denoting the low attendance to the higher education degrees in the participating groups of Colombia and Mexico.

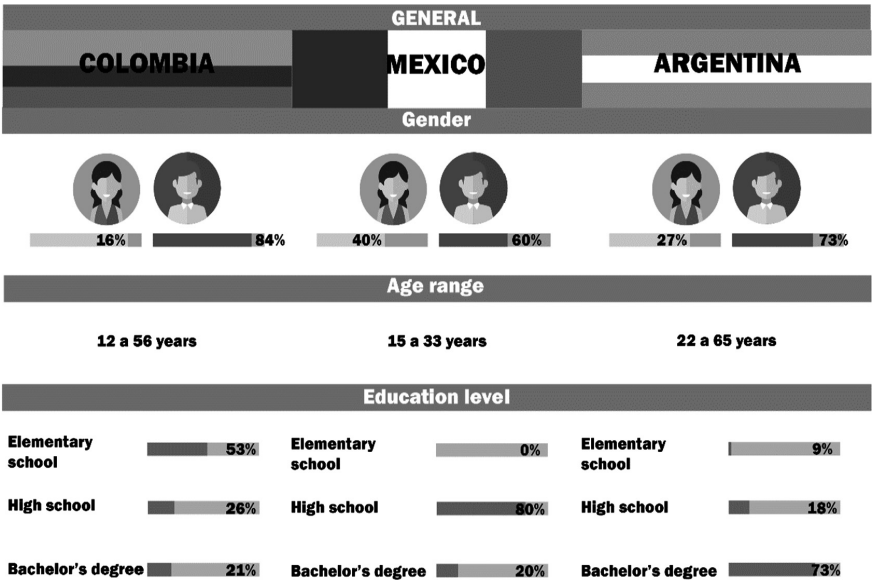

Fig. 1. General information about three countries, created by authors.

Figure 2 shows the inductive analysis of the interviewed users, where the percentages of use of aid and assistive devices are analyzed and evaluated, against the sensory guides they need to travel and interact with their environment, in addition to the level of perception in terms of colors, visual information, and lighting.

The three signature establishes a summary of the deductive analysis, in which the difficulties and facilitators with whom they interact are evaluated in order to be able to move in their environment. This Fig. 3 also presents the requirements that were considered common to the three groups to some extent, and necessary for the development of the design proposal object of stage three of the project.

Currently, the project is in the development of stage three: Assessment and research through design, which will be supported for the collection of data in the protocols of manifested thinking and joint discovery during experimentation tests. For this stage, two models have been developed from the participating universities, with the aim of testing and evaluating the effectiveness and/or sufficiency of the information provided through the designed contents, which will favor the formulation of ergonomic requirements and the theoretical formulations of support for.

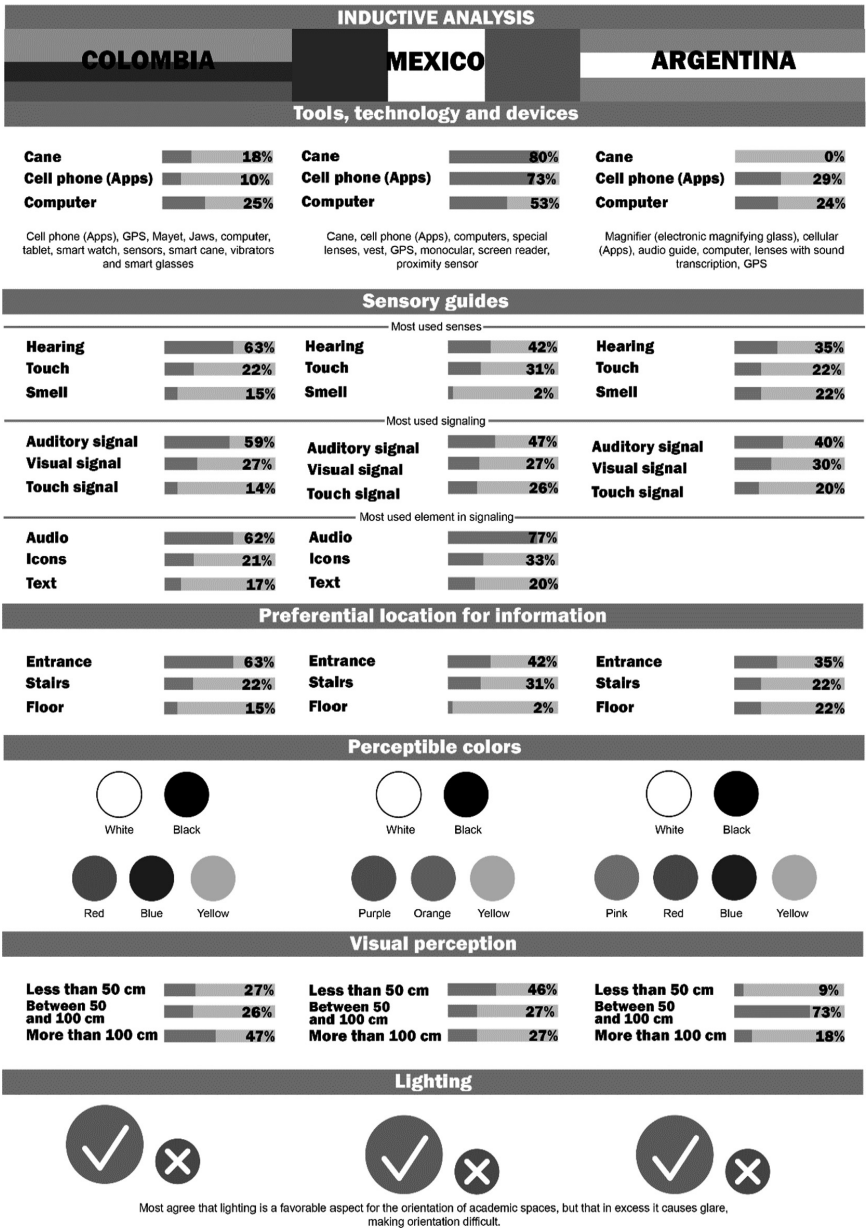

Fig. 2. Inductive analysis, created by authors.

2 Conclusions

- It can be concluded from this investigative moment that people with low vision have marked differences with those of total blindness, mainly because the group of

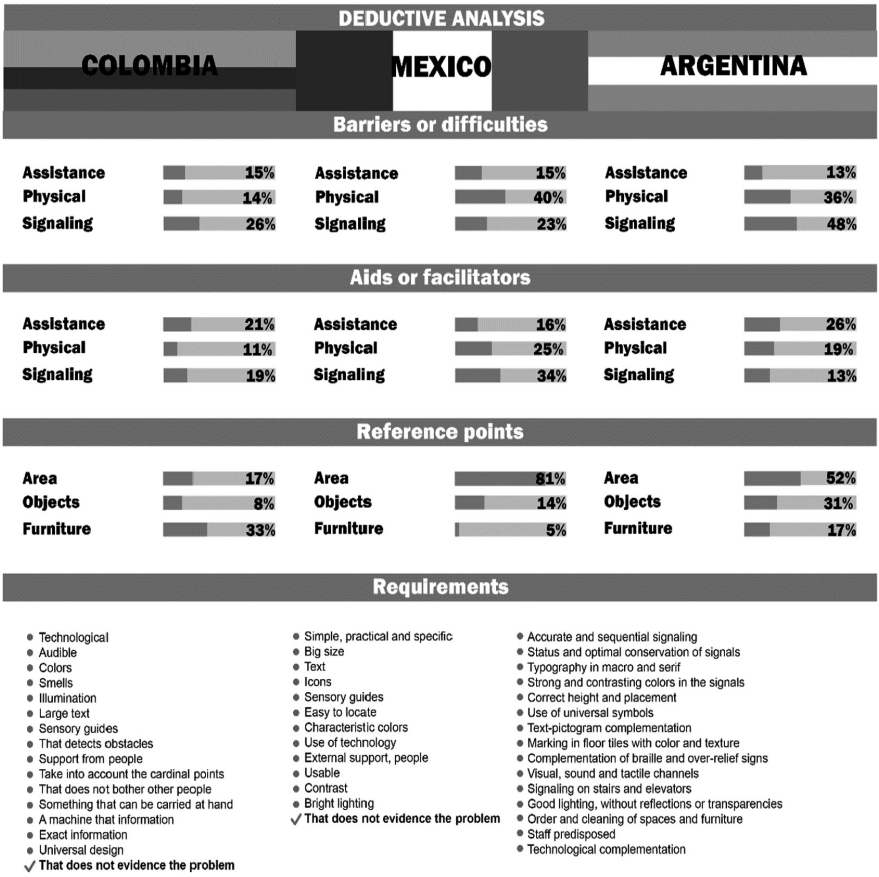

Fig. 3. Deductive analysis, created by authors.

interest makes evident their desire to maintain in use the residual function of their organ of visual perception.

- In all cases, the desire to obtain guiding information is privileged, especially the points of entry, followed by the directional information and the last place of the general information although they emphasize the need to obtain preventive information.
- The type of signals of greater comfort would be those supplied through the sense of the ear and secondly of visual signals of high contrast. Discarding almost completely the acceptance of the use of the tactile system, contrarily very used for people with total blindness. In this regard, Munari (1977) always emphasized the tendency of designers to project with a strong inclination towards the sense of sight.
- Regarding the use of color, all participants prefer the contrasts between black and white colors, followed by the use of shades of red, and in the same order blue, and finally yellow. In relation to the illumination, the pleasure of receiving luminous

signals is manifested, although for these it is also specified that its use must be discreet since the excess generates confusion.

- Concerning the use of new technologies that facilitate the development of novel proposals, it is shown that people not only use these technologies to a large extent, mainly the group from Mexico, but that they are also willing to learn how to interface with these new technologies if they offer efficient information and communication systems.
- Nowadays the practice of Industrial Design is in a process of expansion, the limits of the discipline vanish and it begins to take responsibilities in lands where previous decades were not imaginable. It is the same way designers work which has attracted the attention of private and public sector organizations, being companies, educational institutions, and/or civil associations who have implemented general principles of the design process.
- New advances and trends in technology and accessibility to information will be taken into account so that the system to be designed is able to connect with other systems and similar devices, able to receive orders, commands and give feedback; for this, it will be necessary to implement mobile devices, audio, GPS systems and digital sensors, among others; that they will be able to measure and communicate the positioning and movement of the user, allowing their orientation inside and outside the educational facilities, taking advantage of and promoting the use of Big Data and the Internet for the analysis and communication of information between devices, in addition to designing a device that is able to communicate on par with this system and the user.

References

DATUS (2003) Cómo obtener productos con alta usabilidad? Guía práctica para fabricantes de productos de la vida diaria y ayudas técnicas. Instituto de Biomecánica de Valencia

Downs RM (1973) Cognitive maps and spacial behavior: process and products. In: Image and Environments, pp 8–26

Guber S (2006) La etnografía, método, campo y reflexividad. Ed. Grupo Editorial Norma, Colombia

López O (2008) Señaletica para no videntes y videntes (con énfasis semiótico): plan piloto de señalización para no videntes y videntes en la ciudad de Quito en el tramo Av. Amazonas desde Av. Patria hasta Av. Orellana (Tesis de pregrado). Pontificia Universidad Católica del Ecuador, Quito, Ecuador

Moriña A (2004) Teoría y práctica de la educación inclusiva. Editorial Aljibe, Málaga

Munari B (1977) Lo Intangible del Diseño Tangible. En: Nasser Farías J, Lo tangible e intangible del diseño de evaluación de objetos, mensajes, espacios, p. 246. Universidad Autónoma Metropolitana Azcapotzalco, Ciudad de México

Organisation de Coopération et de Développement Economiques (2006) Revised Field of Science and Technology (FOS) classification in the frascati manual. https://www.oecd.org/science/inno/38235147.pdf. Accessed 2018

Organización de las Naciones Unidas (2000) Objetivos de desarrollo sostenible. Homepage. http://www.cepal.org/es/acerca-de-la-agenda-para-el-desarrollo-post-2015. Accessed 2018

Organización de las Naciones Unidas (2006) Compendio Mundial de la Educación 2006. Comparación de las estadísticas de educación en el mundo. Homepage. http://www.uis.unesco.org/Library/Documents/ged06_es.pdf. Accessed 2018

Organización Mundial de la salud (2014) Salud ocular universal. Un plan de acción mundial para 2014–2019. Homepage. http://www.who.int/blindness/AP2014_19_Spanish.pdf. Accessed 2018

Ocampo A (2011) Inclusión de estudiantes en situación de discapacidad a la educación superior. Desafíos y oportunidades. Revista Latinoamericana de Educación Inclusiva 6(2):227–239

Pérez C (2016) La respuesta educativa a los estudiantes con discapacidad visual. Organización de Estados Iberoamericanos

Quintana R (2010) Diseño de sistemas de señalización y señalética. Universidad de Londres

Sanabria RLB (2007) Mapeo Cognitivo y exploración háptica para comprender la disposición del espacio de videntes e invidentes. TED: Tecné, Episteme y Didaxis (21):45–65. Homepage. http://revistas.pedagogica.edu.co/index.php/TED/article/viewFile/359/336. Accessed 2018

Sims M (1991) Gráfica del entorno: signos, señales y rótulos, técnicas y procedimientos. Gustavo Gilli

Zimmerman J, Stolterman F, Forlizzi J (2010) An analysis and critique of research through design: towards a formalization of a research approach DIS 10. In: Proceedings of the 8th ACM conference on designing interactive systems, pp 310–319

Zuñiga S, Martínez V, Izquierdo J (2012) La inclusión educativa de ciegos y baja visión en el nivel superior. Un estudio de caso. Sinéctica Revista electrónica de educación 39(1):1–21