



SOCIAL SCIENCES

Investigating accessibility in Latin American science museums and centers

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Abstract: Science museums are powerful places not only for science communication, informal science teaching, and leisure but also for promoting science and technology in an equitable, diverse, and inclusive mode. The paper presents an overview of accessibility in Latin American science museums and centers, based on a questionnaire comprised of open and closed questions in Portuguese and Spanish. The answers received from directors and other personnel responsible for 109 institutions in twelve countries were analyzed using an accessibility indicator tool. The findings suggest that these institutions generally offer some physical accessibility resources and fewer communicational and attitudinal accessibility resources. Data also show that there is an absence of institutional practices that might underpin any endeavor to take into consideration the inclusion of people with disabilities. More funding must be made available for practices and research in this area. We also recommend that persons with disabilities play a greater role as protagonists and professionals and likewise as a research public in the realm of science communication and at the region's science museums and centers.

Key words: accessibility, inclusion, science communication, science museums.

INTRODUCTION

Science museums are powerful places not only for science communication, informal science teaching, and leisure but also for promoting science and technology in an equitable, diverse, and inclusive way. Social inclusion is, therefore, an emerging concern in the science communication field (Massarani & Merzagora 2014). It is particularly important that every opportunity offered by science museums and centers benefit all members of society.

However, to guarantee accessibility and inclusion at museums and institutions devoted to science communication, we know it is not enough simply to adapt physical premises for the entrance of people with disabilities

or mobility impairments. An essential part of their experience is also shaped by engagement, participation, empathy, and emotional, affective, and intellectual factors, as pointed out by Cohen and Duarte (2013, p. 2):

The concept of full accessibility is grounded in the principle that good physical accessibility alone is not enough to ensure that a space can actually be understood and used by everyone. Full accessibility means considering more than just the physical aspect of accessibility and distinguishes itself by taking into account emotional, affective, and intellectual aspects, indispensable to enabling a place to engage its visitors and foster skills that

can instill empathy in its users (Cohen & Duarte 2013, p. 2).

Complementarily, Sarraf writes that for museums to be accessible, “their services must be equipped so any person can reach, activate, use, and experience them, whatever his or her physical or communicational condition” (Sarraf 2008, p. 38). Along the same lines, Reich et al. (2010, p. 10) explain that:

Inclusion in [informal science education] goes further than ensuring that people with disabilities can enter the buildings or use the exhibits, programs, and technologies that deliver such experiences. It also requires that people with disabilities are able to learn from such experiences and participate as a part of, and not separate from, the larger social group and community (Reich et al. 2010, p. 10).

This also means it is vital to remember that people with disabilities come from all social backgrounds. They include children, young people, adults, and the elderly who may have congenital or acquired disabilities; they are students, professionals, researchers, freelancers, leaders, and opinion shapers; and, like everyone else, they have rights and duties. At the same time, people with disabilities are not the only ones who benefit from strategies of accessibility and inclusion at museums and institutions devoted to science communication. Whether public or private, these spaces should be ready to welcome, engage, and provide experiences to diverse audiences, given the diversity of society and its members.

ACCESSIBILITY POLICIES ACROSS LATIN AMERICA

In 2006, the United Nations organized the Convention on the Rights of Persons with Disabilities (CRPD) and its Optional Protocol to “promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity” (UN 2006, article 1). According to the UN, “the Convention is intended as a human rights instrument with an explicit, social development dimension” and “is the first comprehensive human rights treaty of the 21st century” (UN 2006).

Some authors (e.g., Meekosha & Soldatic 2011) believe that these two UN documents represent the disability movement’s greatest victory. According to Ollerton and Horsfall (2013), the convention “works alongside the Universal Declaration, articulating an explicit, social dimension to human rights and emphasizing the obligation of states to promote and protect the rights and dignity of disabled people” (Ollerton & Horsfall 2013, p. 619).

Initiated in Mexico in 2001 (Meekosha & Soldatic 2011, Harpur 2012), the convention drew the immediate support of many countries. Following its publication in 2006, 162 countries, including Brazil and all Latin American nations, signed and ratified it. Cuba, Mexico, Nicaragua, and Argentina added their signatures in 2007; Brazil, Chile, Costa Rica, El Salvador, Ecuador, Honduras, Panama, Paraguay, and Peru, in 2008; Bolivia, Guatemala, the Dominican Republic, and Uruguay, in 2009; Colombia, in 2011; and Venezuela, in 2013 (Ferreira & Norberto Rocha 2017). Signatory countries have committed to implementing actions to promote both equal access and the rights of people with disabilities.

The convention underscores the right to participate under conditions of cultural equality, especially as regards access to cultural life and scientific and cultural spaces. Signatories have agreed to undertake all appropriate measures to ensure that people with disabilities: “a) Enjoy access to cultural materials in accessible formats. [...] c) Enjoy access to places for cultural performances or services, such as theatres, museums, cinemas, libraries and tourism services, and, as far as possible, enjoy access to monuments and sites of national cultural importance” (UN 2006, art. 30).

A survey conducted by Ferreira and Norberto Rocha (2017) identified eighteen Latin American countries that have laws aimed at the inclusion of people with disabilities, plus one country with an action plan (Cuba). Drawing from this study, the authors note that fourteen of the eighteen countries passed laws after 2006, the year of the UN Convention. Table I lists the laws identified in the study.

We recognize that advances have been made in the legislative arena in Latin America. However, in and of itself, the UN convention could not be expected to occasion any substantial or rapid changes. As Meekosha & Soldatic (2011, p. 1394) point out, “the lived reality is often distant from the legal rhetoric.” Access to culture, museums and to other scientific and cultural spaces is an essential part of every person’s life, which means the rights of people with disabilities should be clearly expressed in official documents. When this type of accessibility concern is embodied in an official document, it endows all citizens with legally binding rights, responding to a social demand that has often been preceded by a complex history of struggle, resistance, paradigm shifts, and victories.

Over the past decade, museums have developed many strategies for making themselves more inclusive, yet much remains

to be done. The present study offers an overview of accessibility at science museums and centers across Latin America, as identified through a pioneer survey of accessible practices, such as the availability of inclusive, adaptive spaces; specific accessibility features and accommodations; and supportive human resources and institutional policies. The study is also intended as a resource when designing future initiatives and public policy aimed at the inclusion of people with disabilities.

MATERIALS AND METHODS

The study was an initiative of the research group Accessible Science Museums and Centers (Museus e Centros de Ciências Acessíveis, or MCCAC), which focuses on the development of theoretical and empirical studies on accessibility and social inclusion at science museums and centers and in science communication activities, in partnership with the UNESCO-sponsored network RedPOP (Rede de Popularização da Ciência e da Tecnologia na América Latina e no Caribe). Development of the research project “Diagnóstico de Acessibilidade em Museus e Centros de Ciências no Brasil e na América Latina” (Diagnosis of accessibility in science museums and centers in Brazil and Latin America) received the support of the Brazilian Association of Science Museums and Centers (Associação Brasileira de Centros e Museus de Ciência, or ABCMC); Mexican Society for Science and Technology Communication (Sociedad Mexicana para la Divulgación de la Ciencia y la Técnica, or SOMEDICYT); House of Science (Casa da Ciência) from the Federal University of Rio de Janeiro (UFRJ); Cecierj Foundation and other organizations. Funding was provided by Brazil’s National Council for Scientific and Technological Development (CNPq) and by the Department

Table I. Laws aimed at the inclusion of people with disabilities.

Country	Law	Year
Argentina	Law No. 3.307	2009
Bolivia	Reglamento de la Ley n. 223 DS n. 1893 - Ley General para Personas con Discapacidad [Regulation of Law No. 223 DS No. 1893 - General law for people with disabilities]	2014
Brazil	Law No. 13.146 - Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência) [Brazilian law on the inclusion of people with disabilities (Statute on people with disabilities)]	2015
Chile	Law No. 20.422 - "Establece Normas sobre Igualdad de Oportunidades e Inclusión Social de Personas con Discapacidad" [Defines standards on equal opportunities and the social inclusion of people with disabilities]	2010
Colombia	Law No. 1618 - "Por medio de la cual se establecen las disposiciones para garantizar el pleno ejercicio de los derechos de las personas con discapacidad" [Sets out legal provisions to guarantee the full exercise of rights by people with disabilities]	2013
Costa Rica	Law No. 7600 - "Ley de Igualdad de Oportunidades para las Personas con Discapacidad" [Law on equal opportunities for people with disabilities]	1996
Cuba	"Plan de Acción Nacional para la Atención a las Personas Discapacidades" [National action plan for attention to people with disabilities]	2006 - 2010
Dominican Republic	Law No. 42-00 - "Ley General sobre la Discapacidad en la República Dominicana" [General law on disability in the Dominican Republic]	2000
Ecuador	Law No. 180 - "Ley sobre discapacidades" [Law on disabilities]	2012
El Salvador	Decree No. 888 - "Ley de Equiparación de Oportunidades para las Personas con Discapacidad" [Law on equal opportunities for people with disabilities]	2000
Guatemala	Decree No. 135-96 - "Ley de Atención a las Personas con Discapacidad" [Law on attention to people with disabilities]	1997
Honduras	Decree No. 160 - "Ley de Equidad y Desarrollo Integral Para las Personas Con Discapacidad" [Law on equity and integral development for people with disabilities]	2005
Mexico	"Ley General para la Inclusión de las Personas con Discapacidad" [General law for the inclusion of people with disabilities]	2011
Nicaragua	Law No. 763 - "Ley de los Derechos de las Personas con Discapacidad" [Law on rights for people with disabilities]	2011
Panama	Law No. 15 - "Que reforma la Ley 42 de 1999, que establece la equiparación de oportunidades para las personas con discapacidad" [Revises Law 42, of 1999, which establishes equal opportunities for people with disabilities]	2016
Paraguay	Law No. 3540 - "Que aprueba la Convención sobre los Derechos de las Personas con Discapacidad y el Protocolo Facultativo de la Convención sobre los Derechos sobre las Personas con Discapacidad." [Approves the UN Convention and Optional Protocol]	2008
Peru	Law No. 29973 - "Ley General de la Persona con Discapacidad" [General law on people with disabilities]	2012
Uruguay	Law No. 18651 - "Protección Integral de Personas con Discapacidad" [Full protection for people with disabilities]	2010
Venezuela	"Ley para las Personas con Discapacidad" [Law for people with disabilities]	2006

Source: Ferreira and Norberto Rocha 2017, p. 4.

for the Popularization and Communication of Science and Technology, which was formerly part of Brazil's Ministry for Science, Technology, Innovation, and Communications (MCTIC).

The survey was conducted between July and December 2016. A list of the region's scientific and cultural spaces was compiled based on *Guia de Centros e Museus de Ciência da América Latina e do Caribe* (Massarani et al. 2015) and other resources. We then sent a message to some 500 organizations, inviting them to fill out an online questionnaire in Portuguese or Spanish, which posed sixty open and closed questions about physical, communicational, and attitudinal accessibility and about institutional programs, projects, and funding sources in support of inclusion initiatives.

We received replies from 109 institutions. In evaluating the weight of this response rate, we need to bore in mind that accessibility is guaranteed by law in the majority of these countries, so if an institution felt it might not be in compliance, it might hesitate to respond. While this means our findings cannot be generalized to all scientific and cultural spaces in Latin America, they can still be considered indicative of regional tendencies in accessibility and can help us better understand many of the key challenges faced.

The questionnaires were filled out by directors, managerial staff, coordinators, museologists, educators, and other individuals who answer for their institutions. Closed questions were processed using SPSS software in order to ascertain simple frequencies and total percentages for the universe of respondents and valid percentages for the sample that answered any given question. Results were put into table and graph form and run through an analytical tool, which is explained in the next section.

ANALYTICAL TOOL

Inacio (2017) developed the analytical tool Indicators of Accessibility in Science Museums and Centers (in Port.), which can be used to analyze and diagnose accessibility potential and thus identify fundamental features of inclusion, particularly the inclusion of people with disabilities. According to Inacio, these indicators, which encompass architectural, attitudinal, design, and communicational accessibility, were devised to identify the accessibility resources that a given institution affords its audience. In recent years, research groups working in science communication and education have used different indicator-based frameworks and tools to analyze science communication exhibitions and initiatives based on the relevant characteristics to be identified. In addition to Inacio (2017) and De Abreu et al. (2019), these studies include those by Cerati (2014), Norberto Rocha (2018), and Marandino et al. (2018).

In analyzing our data and evaluating accessibility at the responding institutions, we adapted three indicators originally developed by Inacio (2017): Physical Accessibility, Attitudinal Accessibility, and Communicational Accessibility. Each indicator was in turn broken down into two attributes, as it is shown in Table II.

Two things to bear in mind: first, because we examined data on the institution's point of view rather than the audience's, our data express only the potential for accessibility; second, we recognize the limitations of data collection through surveys and also of self-reporting in and of itself.

1) Physical Accessibility: This indicator encompasses two attributes, one related to physical accessibility to the premises and the other to the design of objects and exhibitions. These attributes refer to

features that allow for mobility and barrier-free accessibility to ensure the autonomy and safety of visitors throughout the institution's buildings and premises. They also include the physical features and resources of exhibitions and objects that take into account, respect, and valorize visitors' differing abilities and characteristics (Inacio 2017, Cohen et al. 2012, National Museums of Scotland 2002, Aragall et al. 2013, ABNT 2015). These two attributes are called (1a) physical access, accommodations, and use of space and (1b) design and use of objects.

2) Attitudinal Accessibility: This indicator reflects attitudes and initiatives aimed at overcoming biases, stereotypes, and stigmas regarding persons with disabilities. It also refers to policy matters, such as institutional missions to foster accessibility through human resource training, incentives, funding, programs, and initiatives to foster accessibility. Likewise included here are inclusive practices and interventions intended to create space for diversity (Inacio 2017, Sarraf 2013, Tojal 2015, Corpas & Lyton 2016). The two attributes are (2a) inclusive practices, welcome, and engagement and (2b) institutional policy.

3) Communicational Accessibility: This indicator refers to the equipment and resources that make it possible to overcome barriers in interpersonal communication, including written and informational material. It covers onsite communication as well as external communications, which includes visitor information on scheduling, ticket prices, exhibitions, location, and accessibility initiatives and which may take place over an institutional website, through informational folders or pamphlets, or by telephone. The two attributes are called (3a) communications (onsite and external)

and signage and (3b) media, equipment, resources, etc. to enhance communications (Inacio 2017, ABNT 2015, Minelo 2004, Sarraf 2013, Smithsonian Accessibility Program 1996, Tojal 2007, 2015, W3CBrasil 2013).

In order to reflect each attribute of the accessibility indicators, we chose five or six questions from the questionnaire used in the research study "Diagnosis of accessibility in science museums and centers in Brazil and Latin America" (in Port.). Table III shows which questions were associated with each attribute.¹

Drawing inspiration from the Indicators of Scientific Literacy scale devised by Norberto Rocha (2018), responses were assigned values of 2, 1, and 0 to express the degree to which accessibility features or strategies were present at the science museums and centers. On this scale, 0 means that a given accessibility feature or strategy was "completely absent," 1 means it was "present in part," and 2 means it was "completely present." After assigning a value to each answer, we tallied how many times 0, 1, and 2 applied to each indicator. We then calculated percentages to determine the accessibility level for our sample.

In the next section, we discuss our findings. For each attribute, we provide one example that best illustrates the set of five or six associated questions.

RESULTS

We received 109 replies from science museums and centers located in twelve countries: Brazil (67), Colombia (14), Argentina (8), Mexico (7), Nicaragua (3), Chile (2), Uruguay (2), Panama (2), Costa Rica (1), Puerto Rico (1), Bolivia (1), and Venezuela (1).

¹ In some cases, two complementary questions were used to assess an attribute.

Table II. Accessibility indicators.

Physical	Attitudinal	Communicational
1a. Architecture, physical Access, accommodations and use of space	2a. Inclusive practices, welcome and engagement	3a. Communication (onsite and external) and signage
1b. Design and use of objects and facilities	2b. Institutional policy/ mission	3b. Media, equipment, resources, etc

Source: Adapted from Inacio (2017).

In terms of types of science museum or center, the responding institutions declared themselves to be: interactive science or science and technology museum or center (57); institution of higher education (12); planetarium (14); natural history or anthropology museum (18); traveling science museum or center (11); environmental education center (8); astronomical observatory (8); history museum (7); zoo (7); aquarium (5); botanical gardens (4); or other (11), that is, butterfly center, vivarium, memory museum, bio-park, or archeological site.²

Application of the accessibility indicator scale showed that, in general, these 109 institutions afforded physical accessibility resources to a greater extent and communicational and attitudinal accessibility resources to a lesser extent.

In terms of attribute 1a of the Physical Accessibility indicator (Architecture, physical access, accommodations, and use of space), most answers indicated partial or complete presence (41.7% and 25.1%); in other words, this attribute was present to some degree at 66.8% of the facilities. In terms of attribute 1b (Design and use of objects and facilities), 20.2% of the answers corresponded to complete presence

and 37.6% to presence in part, totaling 57.8% (see Figure 1).

The following question, which pertains to attribute 1a, illustrates these data: “Are all entrances and exits free of changes in level or have access ramps or electromechanical equipment for the mobility of people with disabilities?” Forty-four institutions (40.3%) answered “yes” and 40 (36.6%) answered “yes, in part.” Only 23 (21.1%) said “no,” while two (1.8%) checked “I don’t know.” One of the five questions pertaining to attribute 1b was: “Does your science museum or center have replicas that people with visual impairments can touch?” Fifty-four institutions (49.5%) answered “no”; 24 (22.0%) answered “yes, in part”; and only 20 (18.3%) said “yes, totally.” The remaining 11 (10.0%) indicated they did not know or marked the question as not applicable.

In relation to Attitudinal Accessibility (Figure 2), the survey suggested that few initiatives are being taken to prepare these institutions to serve the audience with disabilities and that such measures have not been incorporated into institutional policy.

In the case of attribute 2a (Inclusive practices, welcome, and engagement) of Attitudinal Accessibility, we assigned a value of 0 (completely absent) to 56.5% of the answers; a value of 2 (completely present) to 16.9%; and a value of 1 to 26.6%(present in part). When we asked, for example, “Are there guided visits for

² Institutions were allowed to check more than one option here, resulting in N=162.

Table III. Indicators, attributes, and associated questions.

Indicator	Attribute	Questions
Physical Accessibility	1a. Architecture, physical access, accommodations, and use of space	21 & 22
		27
		25
		28
	1b. Design and use of objects and facilities	35
		41
		42
		32
Attitudinal Accessibility	2a. Inclusive practices, welcome, and engagement	33
		26.1
		36
		39
		47
	2b. Institutional policy/mission	48
		50
		18
		52
		53
Communicational Accessibility	3a. Communications (on site and external) and signage	54
		56
		8
		19 & 20
	3b. Media, equipment, resources, etc. to enhance communications	40
		44
		45
		43.1
		43.2
	43.3	
	46	
	49	

people with disabilities?” and “Is it necessary to schedule a visit?” 57 (52.2%) said their facility had no such adaptations for people with disabilities, while 47 (43.1%) said it did. However, of those facilities offering adapted visits, 28 (59.6%) said visits must be scheduled. If a person with a disability must make prior arrangements to visit a facility, it has a significant negative impact on personal autonomy and, therefore, effectively constitutes partial presence.

The finding for attribute 2b (Institutional policy/mission) of this category was that only 29.4% of facilities scored 2, while a mere 4.6% received a score of 1; 66.1% reported an absence

of any such initiative. For example, 71 institutions (65.1%) said they had no project or program in place to promote accessibility, and 97 (88.9%) also had no specific funding for this purpose.

Our analysis of data on Communicational Accessibility also showed that these institutions still have much to accomplish (Figure 3). In the case of attribute 3a (Communications and signage), a scant 4.8% of the institutions presented a value of 2, with another 26.8% scoring 1, whereas 68.4% said their facility lacked any of these features. The finding was similar for attribute 3b (Media, equipment, resources, etc.),

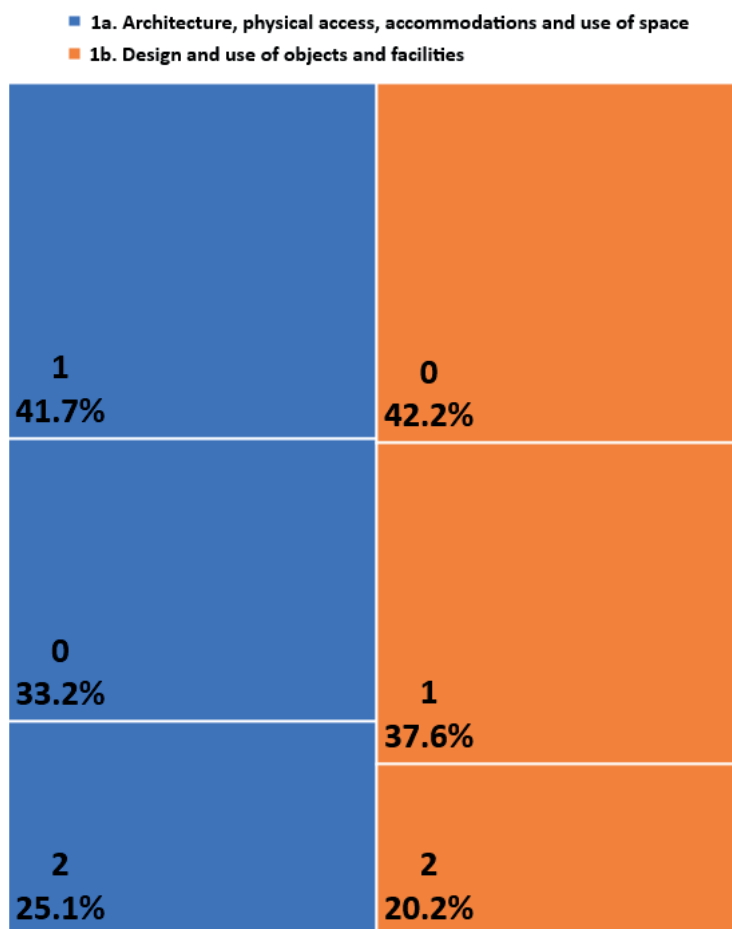


Figure 1. Physical accessibility.

where only 6.2% and 11.4% of answers ranked as 2 and 1, while 82.4% reported total absence.

This becomes evident when we evaluate onsite and external communications and signage. Only 87 (79.8%) of the institutions have websites and only 35 (32.1%) have websites that provide some type of accessibility option, such as changes to screen contrast. Many values of 0 were also awarded in the case of onsite communication. Asked whether their institution has signage in International Symbols of Access (ISA), only 18 (16.5%) said it does; 39 (35.7%) said it has some; and 49 (44.9%) reported having none. Additionally, 82 (75.2%) said they have no signs in Braille or large print, while 88 (80.7%) said they offer no graphics, pamphlets, or institutional maps or catalogs with these features.

In regards to attribute 3b (Media, equipment, resources, etc.), when asked if videos, apps, or software were available for exhibition guidance/mediation in sign language, only 3 (2.7%) answered “yes,” while 12 (11%) said “yes, in part” and 93 (85%) said “no.”

Of the 80 (73.3%) institutions that reported having video exhibitions, 51 (63.7%) provided no videos with audio description, a fundamental accessibility feature for people with visual disabilities like blindness or poor vision. The figures are even more alarming when it comes to signed language: 68 (85%) of these 80 institutions offer no signed videos.

Figure 4 illustrates the distribution of these findings according to accessibility indicator.

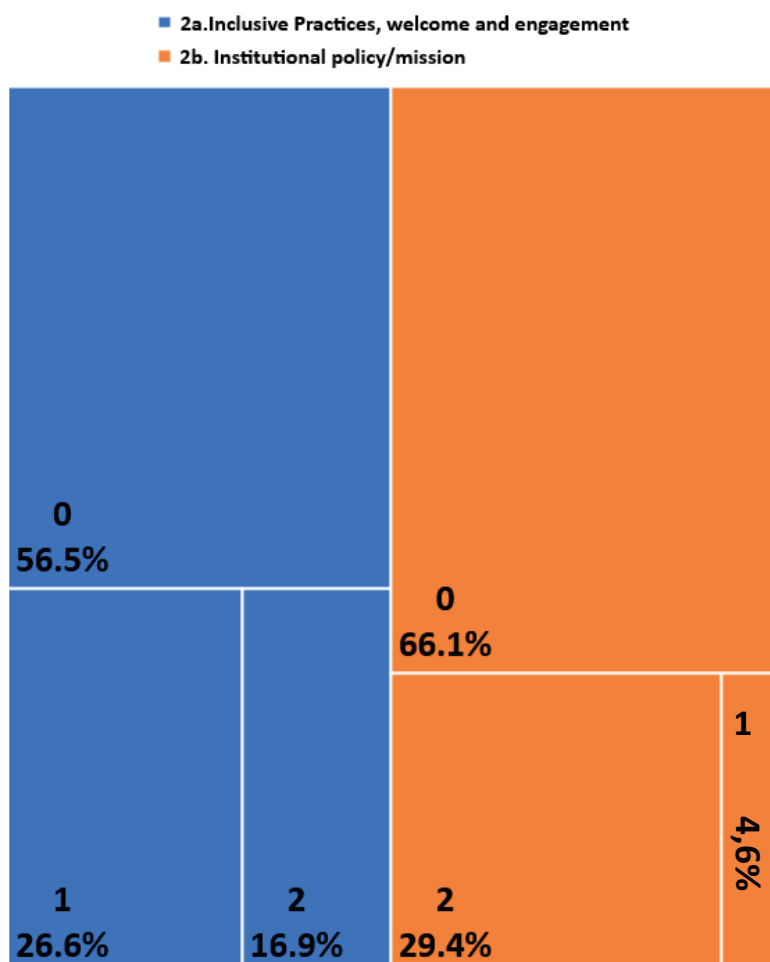


Figure 2. Attitudinal accessibility.

Based on the application of accessibility indicators, the majority of accessibility initiatives fall within the category Physical Accessibility, although most are only present in part. In the categories of Attitudinal and Communicational Accessibility, 61.3% and 75.4% of the institutions reported offering none of these features.

DISCUSSION AND CONCLUSIONS

Using accessibility indicators adapted from Inacio (2017), the present study analyzed all data gathered from 109 questionnaires completed by representatives of science museums and centers in Latin America. One of our key findings is that, on the one hand, this study showed that more than

one hundred Latin American science museums and centers are concerned about accessibility and inclusion and are implementing strategies to those ends; on the other hand, there are few active and systematic practices for promoting full and equal enjoyment, showing a significant gap between policies and good intentions.

We observed that much is left to be done, particularly in terms of strategies for overcoming communicational and attitudinal barriers and ensuring visitor autonomy. We agree with Duarte and Cohen (2012), who argue that accessibility must move beyond the physical, that is, beyond the elimination of architectural barriers. This means “having access to and [being able to] roam through, see, hear, touch, and feel cultural

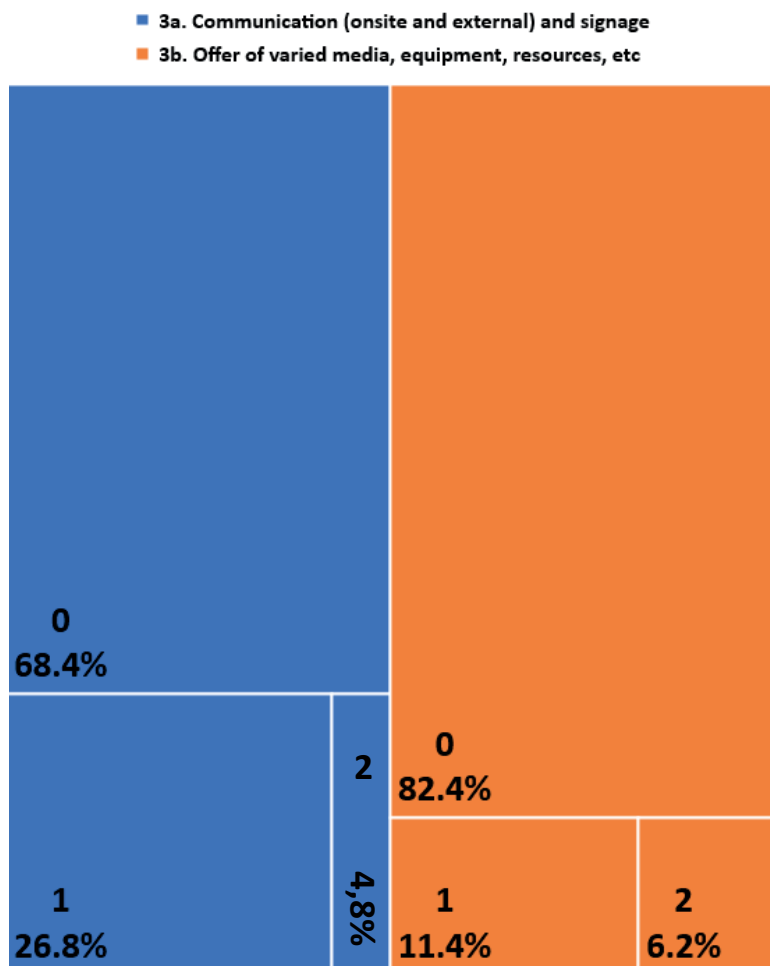


Figure 3. Communicational accessibility.

assets” (Cohen et al. 2012, p.22), as well as taking emotional, affective, and intellectual aspects into account (Cohen & Duarte 2013, p.2).

While most of the initiatives that were aimed at promoting accessibility involved physical infrastructure, this strategy alone does not guarantee active inclusion. Few of the institutions reported having sign language interpreters, or audio descriptions, a shortcoming that greatly hampers the experiences of people with hearing loss and visual impairments. Additionally, the facilities lacked other professionals specialized in serving people with disabilities and most reported that they are not training any of their staff or personnel to promote accessibility.

The fact that these science museums and centers devoted greater attention to the physical aspects of accessibility may be explained in a few ways. The physical aspect of accessibility may be the most visible and broadly understood, so an institution that wishes to seem concerned with accessibility, either because it wants to comply with laws or for other reasons, may make physical accessibility its primary focus. Another possible explanation is that staff is simply unaware of all that goes into making a public institution accessible, so they fail to take all steps ideally needed to address other dimensions of accessibility.

Indeed, there is evidence that staff at many science museums and centers realize they are

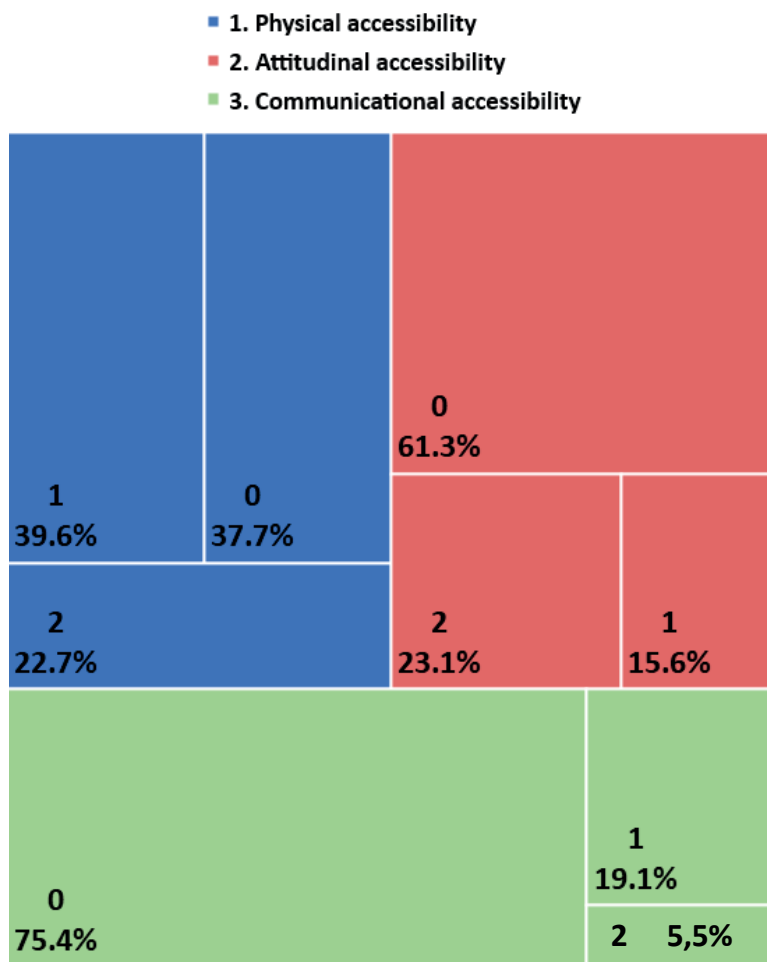


Figure 4. Total distribution by indicator.

ill-equipped to effectively meet the needs of people with disabilities. One of the first questions on our survey was “Do you believe your science museum/center is accessible?” Fifteen of the 109 reporting institutions said “yes, completely” (13.7%); 79 said “yes, in part” (72.4%); 14 said “no” (12.8%); and one did not know (0.9%). At the end of the survey, respondents were asked: “After answering the questionnaire, do you believe your science museum/center is accessible?” Seventy-seven said “yes, in part” (70.6%); 30 said “no” (27.5%); and two did not know (1.8%). In other words, 13.7% of those who had first said their facility was fully accessible changed their minds, most likely after reaching the conclusion that some elements essential to accessibility were missing. Accordingly, the rate of those who felt

their facility was not accessible doubled, from 14 to 30, that is, from 12.8% to 27.5%. Another striking finding was that 24 (22.9%) of the responding managers, directors, museologists, educators, and so on said they were unfamiliar with their country’s laws on accessibility and inclusion of people with disabilities. This leads us to believe that in promoting accessibility and inclusion at these institutions, it would be important to train staff and personnel, increase management and decision-maker awareness, and foster initiatives that familiarize people with local and national laws and standards that guarantee the rights of people with disabilities and their access to these public facilities.

We also recognize that awareness of legal protections does not assure their enforcement,

something that would require a series of investments, plans, programs, and initiatives. Once a law has been passed, it needs funding, government infrastructure, planning, and investment in order to generate results. Furthermore, after implementation, enforcement of a law must also be monitored and assessed.

It is likewise crucial that more funding be made available so institutions can make changes and undertake initiatives to increase accessibility. The high proportion of answers in each category that indicated a total absence of the associated accessibility feature suggests that the reporting institutions need to implement a greater number of initiatives focused on attitudinal and communicational accessibility and must have related institutional policies in place.

Our study was interested in institutional responses rather than in analyzing to what extent the staff who interact with the public feel they have been prepared to serve people with diverse disabilities. This topic was addressed in a survey of mediators at Brazilian science museums, who said they felt unsure about how to serve this audience (Carletti & Massarani 2015). Workshops should be held or other strategies used to empower mediators and educators to take more assertive initiatives to include diverse audiences.

These data reinforce the lack of any institutional practices that might contribute toward a learning experience in efforts to include people with disabilities. Instead, the inclusion of these individuals at science museums and centers is still a sporadic rather than routine practice. If these institutions are to become more inclusive, organizational change is needed so that accessibility and social inclusion become part of their missions, more than just the sum of individual's learning. As some authors have pointed out, "knowledge generated through

organizational learning can become ingrained within the organization's memory and persist beyond the organizational life span of any one group of individuals" (Reich 2014, p. 16-17).

Furthermore, greater funding is needed for research and academic studies. While the number of studies exploring accessibility in museums has grown since the turn of this century, as shown by Sarraf (2008), little has been published in Latin America (Norberto Rocha et al. 2017a). Researchers need both to explore a broader gamut of topics, accessibility strategies, and disabilities in their studies and also to explore the area in more depth, while publishing in journals of greater impact and fostering the consolidation of the region's scholarship (Norberto Rocha et al. 2017a).

This means further research is needed to generate an understanding of the institutional contexts and learning processes that support practices of inclusion of people with disabilities at science museums and centers. Clearly, the present study is just one small, first step on the pathway to understanding how to implement effective accessibility practices at science museums and centers. For example, future research should investigate the extent to which the self-reporting of accessibility actually matches observable reality.

Moreover, a number of studies, such as those by Hein (2003), Levent and Reich (2013), and Reich (2014), have pointed out that:

Learning directly from visitors is essential, as only they are truly aware of what their needs are, what assets they bring with them to the museum, and what they are looking for from a museum experience. Learning by working with people with disabilities has been shown to have a profound impact on the work of education professionals (Levent & Reich 2013, p. 219).

In this regard, we suggest that people with disabilities should play a greater role as protagonists, professionals, and consultants and also as a research public, since research into their perspectives would cast much light on accessibility, or the lack thereof, in science museums and centers. Ultimately, one of the best indicators of whether a person with a disability has had a positive inclusion experience at a museum is to ask her or him. To borrow the argument of O'Neil (2008, p. 29), in an article on disability and advancing museum practice: "No one can imagine another's life well enough to develop services for them without involving them directly in that development. [...] True empathy means knowing the limits of empathy and the need to learn from witnesses."

Lastly, we would like to point out that the data gathered in this survey were also used to compile the *Guia de Museus e Centros de Ciências Acessíveis da América Latina e Caribe* (Norberto Rocha et al. 2017b), a guidebook that provides the public with information on accessibility and that therefore encourages visits, especially by people with disabilities, to the institutions that kindly agreed to participate. This publication also intends to encourage science museums and centers to implement accessibility strategies. Our team curated the information gathered from the questionnaires and highlighted the features offered by each science museum or center; the institution was then asked to review and endorse the text. Some museums asked that their data not be published, while some of those who had not replied to the questionnaire learned of the intended publication and asked to be included; therefore, the institutions covered in the guidebook differ somewhat from those covered in this study. The guidebook itself presents information on 110 institutions in ten countries. It is an online, open-access resource, with text in both Portuguese and Spanish; it

is accessible by screen readers, offers audio descriptions of all images, and is interpreted into Brazilian sign language (Libras) by a virtual avatar.

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