Journal of Accessibility and Design for All

Volume 8, Issue 1. (CC) JACCES, 2018. ISSN: 2013-7087

MEASURE OF ENVIRONMENTAL ACCESSIBILITY (MEA): DEVELOPMENT AND INTER-RATER RELIABILITY

Stéphanie Gamache[1,2,3], Ernesto Morales[1,2],Luc Noreau[1,2], Israël Dumont[2], Jean Leblond[2]

[1]Department of Rehabilitation, Faculty of Medicine, Université Laval, Québec, Québec, Canada; [2]Centre for Interdisciplinary Research in Rehabilitation and Social Integration, Centre intégré universitaire de santé et de services sociaux de la Capitale-Nationale (CIUSSS-CN), Institut de réadaptation en déficience physique de Québec, Québec, Québec, Canada; [3]Centre intégré universitaire de santé et de services sociaux de la Capitale-Nationale (CIUSSS-CN), Institut de réadaptation en déficience physique de Québec, Québec, Québec, Canada.

[1]Mail: stephanie.gamache@cirris.ulaval.ca

Received: 2017-08-21 | Accepted: 2018-02-15 | Published: 2018-05-31

***Abstract*:** The Measure of accessibility to urban infrastructures for adults with physical disabilities was first published in 2012 and proved to have good inter-rater reliability. Yet, the format (more user-friendly) and content (updated references and labels) of this instrument needed to be improved. Therefore, a new version, now entitled Measure of Environmental Accessibility (MEA), was developed to provide professionals and individuals defending the rights of persons with disabilities with a more user-friendly, objective measure of accessibility of exterior and interior urban infrastructure for individuals with motor, visual, hearing, cognitive and intellectual disabilities. The aim of this paper is to present the improvements made in this new version and to evaluate its inter-rater reliability. This cross-sectional study for inter-rater reliability was conducted by a student in occupational therapy and a student in architecture who performed 30 MEA evaluations of public infrastructures. Inter-rater reliability was evaluated using Gwet's AC1 statistic. Most items (71%, 626/882) had AC1 values ranging from good to excellent. Some items had lower inter-rater reliability coefficients (12%, 108/882, p-value <0.05) and a few had non-significant coefficients (6%, 52/882, p-value ≥0.05). These items are distributed unevenly in the MEA. Thus, it

Gamache, S., Morales, E., Noreau, L., Dumont, I., & Leblond, J. (2018). Measure of environmental accessibility (MEA): development and inter-rater reliability. Journal of Accessibility and Design for All, 8(1), 1-32. doi:http://dx.doi.org/10.17411/jacces.v8i1.141

is impossible to predict which items are less appropriate. Another 96 items (11%) did not have a Gwet's AC1 value since both raters did not observe the evaluated element. The MEA is a reliable accessibility measure for urban built environments. Its new content and format make it a useful tool for individuals involved in the design or renovation of the built environment to improve accessibility and, therefore, inclusion of individuals with disabilities.

Keywords: accessibility; assessment; motor disabilities; visual disabilities; hearing disabilities; intellectual disabilities; cognitive disabilities.

Introduction

It is not uncommon for able-bodied individuals to have problems getting to a particular place because of the configuration of the environment, whether because there is insufficient space to manoeuvre, the information provided for orientation purposes is unclear, or it is too strenuous to interact with the environment to take part in activities. For people with disabilities, this can be an everyday situation. Individuals with physical disabilities (IPD), including motor, visual and hearing disabilities, experience various well-documented disabling situations when accessing public environments, whether outdoors (Clarke, Ailshire, Nieuwenhuijsen, & Vrankrijker, 2011; Giesbrecht, Ripat, Cooper, & Quanbury, 2011; Jenkins, Yuen, & Vogtle, 2015; Rosenberg, Huang, Simonovich, & Belza, 2013) or indoors (Dos Santos & de Carvalho, 2012; Martins & Gaudiot, 2012; Mcintyre & Hanson, 2014). For IPD, the environment is an essential component of actions to improve health conditions, prevent impairments, and improve their outcomes (World Health Organization & The World Bank, 2011). Thus, inaccessibility of public environments can have very damaging social, emotional and financial consequences (Deliot-Lefevre, 2006; McClain, Medrano, Marcum, & Schukar, 2000; Shumway-Cook et al., 2005) because it limits social participation. Everyone who wishes to should have equal opportunities to access public environments. Laws and recommendations are present in many countries to ensure access but are not always applied. As mentioned previously, obstacles

are present and their removal requires a thorough assessment to ensure accessibility.

When assessing public environments, particular attention should be paid to the conflicting needs of different groups of individuals to ensure access for the greatest number. For example, individuals with visual disabilities interpret the environment more easily if tactile information is provided on the ground (e.g. distinct lip between the road and the sidewalk). On the other hand, wheelchair users prefer uniform surfaces that are easier to travel on. A compromise, a way to accommodate for the varying needs of IPD, should be reached to ensure that all groups, which have different preferences and needs, can use the environment efficiently and safely. Moreover, both exterior and interior environments should be assessed to ensure that the entire mobility chain for performing a task/activity is considered. Such an assessment tool has been developed, the *Measure of accessibility to urban infrastructures for adults with physical disabilities* (MAUAP), the content of which was validated by experts (users, clinicians, municipal representatives) and proved to have good inter-rater reliability indicators (Gamache et al., 2016a, 2016b). However, the format of this tool needed to be improved to make it shorter and more user-friendly. Moreover, its content, dating from a literature review performed in 2010 (Gamache et al., 2016a), needed to be reviewed to better represent the advancements in the field of accessibility for IPD. In addition, several partners interested in the use of the MAUAP mentioned certain difficulties in implementing it, which limited its integration into good practices. Thus, the objective of this study was to update the MAUAP's content and format and to evaluate the inter-rater reliability of the updated version. The research protocol was reviewed and approved by the ethics committee of the Institut de réadaptation en déficience physique de Québec (Quebec City, Canada, project #2010-218).

Volume 8, Issue 1. (CC) JACCES, 2018. ISSN: 2013-7087

Methodology

Content modification

The content of the first version of the MAUAP was not underpinned by a standardized vocabulary and conceptual model. A choice needed to be made in that regard to provide a stronger, more logical basis for the MAUAP. After an in-depth reflection process by the research team regarding the format and the content of the MAUAP for its conviviality, the new *Measure of Environmental Accessibility* (MEA) is now based on two concepts: universal accessibility and the *Human Development Model - Disability Creation Process* (HDM-DCP). *Universal accessibility* aims to eliminate artificial restrictions on opportunities to use the environment.(Steinfeld & Maisel, 2012) Hence, the goal is to create accessible environments which can include additions or adaptations.(Steinfeld & Maisel, 2012) The HDM-DCP maps out the interaction between personal factors (identity factors, organic systems, capabilities), environmental factors (social and physical, considered as either facilitators or obstacles at various scales (micro, meso, macro)) and life habits (daily activities and social roles).(Fougeyrollas, 2010) This interaction can result in either a disabling situation or social participation, depending on the level of adequacy and congruence between these factors. As an explanatory model of disability and scientific classification of personal and environmental factors, the HDM-DCP provides a nomenclature ensuring a mutually exclusive conceptualization of what belongs to the person and to the environment. It is formulated in positive terms and attributes the responsibility of accomplishing or not life habits to the interactions with environmental factors, rather than to people and their disabilities.(Fougeyrollas, 2010) This nomenclature provides a common language for professionals in various domains. As an anthropological model of human development, it makes it possible to conduct an analysis of interactions between the person and the encountered environments that is applicable to everyone whether or not the person has disabilities, and regardless of the person's life context. Since it is

impossible to develop an environmental measure of existing environments that respects the principles of universal design, the concept of universal accessibility has been identified as adequate. However, if possible, the principles of universal design should be respected when improving environments, and the consideration of all users in the concept remains present in the proposed labels. Finally, the HDM-DCP provides a nomenclature; the vocabulary used ensures uniform terminology, with the objective of facilitating exchanges with all groups of individuals who can benefit from the use of this new measure.

In order to update the MAUAP's labels and improve its content, a literature review was carried out. In December 2012, a first review of the scientific literature regarding accessibility for individuals with cognitive and intellectual disabilities was performed using the keywords presented in table 1. This was a main concern because the authors wanted to provide a more inclusive assessment of accessibility by considering the highest number of users possible. The MAUAP lacked this information.

Table 1. Scientific literature review regarding accessibility for individuals with cognitive and intellectual disabilities

Databases	Keywords
Pubmed	Cognitive impairment; Assessment tool, assessment instruments; Accessibility; Information access
Pubmed	MeSH : Architectural accessibility; Access to information; Mental disorders / Intellectual disability / Cognition disorder
Cinahl	Cognitive impairment, Intellectual disability, Accessibility, Access, Assessment, Environment, Service utilization, Information
Cinahl	Others : Community assessment, Clinical assessment tools, Research instruments

Databases	Keywords
Psychological abstracts	Intellectual disability, Cognitive impairment, Accessibility
Psychological abstracts	Descriptors : Cognition, Intelligence, Mental health, Access, Information technology/sources/society
PsycINFO	Cognitive impairment, Intellectual development disorder, Access, Access to information, Accessibility, Assessment tool
PsycINFO	Descriptors : Cognitive impairment, Intellectual development disorder, Community facilities/involvement/services, Information

In addition, from September 2012 to September 2015, the MAUAP's labels were continuously updated via the consultation of varied online sources and regular updates from the databases consulted in the development of the first version of the MAUAP (Gamache et al., 2016a). To facilitate the analysis of the information we collected, a document summarizing the information according to environmental element was developed to link the existing content of the MAUAP with new elements. The objectives of this process were to:

- **Identify information** (new or complementary) that could improve the MAUAP. Such information could add precision to an already-considered aspect or represent an entirely new element to be considered. Elements on accessibility for individuals with cognitive and intellectual disabilities (ICID) were added.
- **Confirm the validity** of certain already-proposed elements. The presence of a recommended element in many sources represented a certain level of agreement in the scientific literature.
- **Confront certain elements**. A great diversity of recommendations indicates a lack of certainty or consensus in the literature.

All the proposed accessibility practices identified in the literature review were analyzed to determine which ones were the most applicable and/or represented a good compromise to enable IPD of all types (motor, visual, hearing), as well as ICID, to access the environment. Each section's content was validated by the authors through work discussions, working in the fields of architecture, rehabilitation and access for IPD.

Format modifications

Since the first version was not particularly accessible in terms of presentation, as some partners willing to include the MAUAP in their practice pointed out, the format had to be completely rethought. The levels of information presented in the first version were complex and contributed to the lengthiness of the assessment. Levels of information were created to shorten labels, by creating categories or groups of elements to consider and placing the emphasis on specific words. As for the rating scales, it was found that the four-level rating scale for accessibility in the MAUAP, which proposes percentage ranges of checked characteristics to accommodate the varying numbers of labels per item, was not user-friendly. It did not provide a meaningful and representative evaluation of accessibility. Therefore, the rating scales were also rethought.

Inter-rater reliability study

Sample

A convenience sample of public infrastructures was identified to evaluate all types of environments evaluated in the MEA (pedestrian, public, commercial, financial, health care, learning (educational), leisure, etc.). A diversified sample of infrastructures was chosen and buildings of various types and styles were visited. The number and types of assessed infrastructures are presented in table 2.

Table 2. Convenience sample of evaluated infrastructure

Types of infrastructures	Specific types of infrastructures	n
Learning (educational) infrastructures for adults	Professional training center	1
Learning (educational) infrastructures for adults	CEGEP (non-university postsecondary institutions)	5
Learning (educational) infrastructures for adults	University building	19
Leisure infrastructures for adults	Sports center	6
Leisure infrastructures for adults	Community and leisure center	9
Leisure infrastructures for adults	Library	18
Commercial infrastructures	Shopping center	5
Financial institutions	Credit union or bank	6
Health care institutions	Hospital or rehabilitation institute	2
Pedestrian facilities	Curb ramps, crosswalks, sidewalks	30

Procedure for inter-rater reliability evaluation

To evaluate the MEA's inter-rater reliability, a student in occupational therapy (master's level) and a student in architecture (undergraduate, one year

completed) performed the MEA evaluations in the same infrastructure at the same time but without consultation. After taking a one-hour training session with the first author (SG) and watching a tutorial about the MEA (including practical exercises validated with the first author (SG)), they independently performed 30 evaluations of public infrastructure in the summer of 2016 (there was an overlap in the infrastructures evaluated to complete the 30 evaluations). The infrastructures were chosen randomly through the list of municipal and educational infrastructures of Quebec City which present the elements that can be evaluated with the MEA (e.g., library, cafeteria, locker room). If these infrastructures did not prove to be sufficient to evaluate sections of the MEA, other public infrastructures close to those evaluated were targeted. The material used included a measuring tape, an inclinometer, a measuring wheel, a luxmeter, a sonometer, a chronometer, a calculator and the electronic version of the MEA on an electronic tablet.

Data analysis

Inter-rater reliability for each of the MEA's items, being each element to be evaluated described through the use of an element, a component and a criteria in the MEA, was analyzed. On the other hand, the MAUAP items were a checklist of many criteria. In a previous study, the Gwet's AC1s were therefore calculated according to the four-level rating scale which provided less precise results.(Gamache et al., 2016b) To make things simpler, more structured and precise, the MEA items are now more condensed and specific. What was considered a label in each MAUAP item is now an item in itself in the MEA. Gwet's AC1 statistic was used, which represents the conditional probability that two randomly selected raters will agree, given that no agreement will occur by chance (Jenkins et al., 2015; Wongpakaran, Wongpakaran, Wedding, & Gwet, 2013). Unweighted Gwet's AC1s were calculated for all items (dichotomous score). Gwet's AC1 values were interpreted as representing poor (0.00 to 0.40), moderate (0.41 to 0.60), good (0.61 to 0.80) or excellent (0.81 to 1.00) agreement between the raters. The higher the value, the higher the percentage

of agreement between raters is compared to the chance level (DeVellis, 2003). Data were analyzed with the Gwet's inter-rater reliability functions designed for the R statistical environment (http://www.agreestat.com/r_functions.html, R software version 3.3.2). Our objective was that all Gwet's AC1 values should be high (≥0.61; i.e., good or higher).

Results

Content and format modifications

In the literature review regarding accessibility for ICID, a total of 47 articles were identified as relevant. They covered topics such as visual barriers to prevent wandering, electronic technologies (e.g., web accessibility, computers, content), assistive devices, environmental barriers, physical access and information in the community, and the *Environmental Restriction Questionnaire* (tool). To update the labels, other references were added to the existing ones (first version of the MAUAP) in a document summarizing the information according to environmental element in order to link the existing content of the MAUAP to new elements. Here are the gathered references:

From the literature review regarding accessibility for ICID:

- Bartfai & Boman. (2011). Policies concerning assistive technology and home modification services for people with physical and cognitive disabilities in Sweden
- Boyden, Esscopri, Ogi, Brennan, & Kalsy-Lillico. (2009). Service users leading the way: focus group methodology in developing accessible information DVDs with people with learning disabilities
- Buchner. (2009). Deinstitutionalisation and community living for people with intellectual disabilities in Austria: history, policies, implementation and research

- Carey, Friedman, & Bryen. (2005). Use of electronic technologies by people with intellectual disabilities
- Casado & Lee. (2012). Access barriers to and unmet needs for home and community-based services among older Korean Americans
- Davies, Stock, King, & Wehmeyer. (2008). ‘‘Moby-Dick is my favorite:’’ Evaluating a cognitively accessible portable reading system for audiobooks for individuals with intellectual disability
- Diamond, Shreve, Bonilla, Johnston, Morodan, Branneck. (2003). Telerehabilitation, cognition and user-accessibility
- Felicetti. (2005). Barriers to Community Access: It’s About More Than Curb Cuts
- Feliciano, Vore, Leblanc, & Baker. (2004). Decreasing entry into a restricted area using a visual barrier
- Fichten, Barile, Asuncion, & Fossey. (2000). What government, agencies and organizations can do to improve access to computers for postsecondary students with disabilities: recommendations based on Canadian empirical data
- Ficocelli & Nejat. (2012). The design of an interactive assistive kitchen system
- Fortney, Chumbler, Cody, & Beck. (2002). Geographic access and service use in a community-based sample of cognitively impaired elders
- Fox, Moore, Ficka, Lemoncello, & Prideaux. (2009). Public computing options for individuals with cognitive impairments: Survey outcomes
- Garbutt. (2009). Is there a place within academic journals for articles presented in an accessible format?

- Godsell & Scarborough. (2006). Improving communication for people with learning disabilities
- Hammel. (2003). Technology and the environment: supportive resource or barrier for people with developmental disabilities?
- Hammel, Jones, Smith, Sanford, Bodine, & Johnson. (2008). Environmental barriers and supports to the health, function, and participation of people with developmental and intellectual disabilities: report from the State of the Science in Aging with Developmental Disabilities Conference
- Henderson & Fuller. (2011). Problematising' Australian policy representations in responses to the physical health of people with mental health disorders
- Hochhausen, Le, & Perry. (2011). Community-based mental health service utilization among low-income Latina immigrants
- Hornung. (2011). Towards a Design Rationale for Inclusive eGovernment Services
- Johnson, Douglas, Bigby, & Iacono. (2009). Maximizing community inclusion through mainstream communication services for adults with severe disabilities
- Kelly, Sloan, Brown, Petrie, Lauke, Ball, & Seale. (2007). People, policies and processes
- Kennedy, Evans, & Thomas. (2011). Can the web be made accessible for people with intellectual disabilities?
- Lubinsky. (2010). Communicating effectively with elders and their families
- Luedtke, Goldammer, & Fox. (2012). Overcoming communication barriers: navigating client linguistic, literacy, and cultural differences

- Namazi, Rosner, & Calkins. (1989). Visual barriers to prevent ambulatory Alzheimer's patients from exiting through an emergency door
- Nind & Seale. (2009). Concepts of access for people with learning difficulties: towards a shared understanding
- O'Regan & Drummond. (2008). Cancer information needs of people with intellectual disability: a review of literature
- Poncelas & Murphy. (2007). Accessible information for people with intellectual disabilities: Do symbols really help?
- Porter. (2005). Foreword
- Price, Hermans, & Evans. (2009). Subjective barriers to prevent wandering of cognitively impaired people (Review)
- Reagan. (2004). Perceived Mental and Physical Health: How Is It Influenced by Demographics, Health Behaviors, and Access to Health Care Resources?
- Rochette & Loiselle. (2012). Successfully performing a university student's role despite disabilities: challenges of an inclusive environment and appropriate task modification
- Rosenberg, Ratzon, Jarus, & Bart. (2010). Development and initial validation of the environmental restriction questionnaire
- Solway, Estes, Goldberg, & Berry. (2010). Access barriers to mental health services for older adults from diverse populations: perspectives of leaders in mental health and aging
- Spandler. (2007). From social exclusion to inclusion? A critique of the inclusion imperative in mental health

- Stock, Davies, Wehmeyer, & Lachapelle. (2011). Emerging new practices in technology to support independent community access for people with intellectual and cognitive disabilities
- Swedberg. (2001). Facilitating accessibility and participation in faith communities
- Thorpe, Houtven, & Sleath. (2009). Barriers to outpatient care in community-dwelling elderly with dementia : The role of caregiver life satisfaction
- Todis, Sohlberg, Hood, & Fickas. (2005). Making electronic mail accessible: Perspectives of people with acquired cognitive impairments, caregivers and professionals
- Torres & Berg. (2008). Effects of two applications on the success of E-mail access for an individual with acquired cognitive impairment [dissertation]
- Townsley, Rodgers, & Folkes. (2003). Getting informed: Researching the production of accessible information for people with learning disabilities
- Verdonschot, Witte, Reichrath, Buntinx, & Curfs. (2009). Impact of environmental factors on community participation of persons with an intellectual disability: a systematic review
- Vilar, Filgueiras, & Rebelo. (2007). Integration of people with disabilities in the workplace: A methodology to evaluate the accessibility degree
- Walsh, Scaife, Caitlin, Dodsworth, & Schofield. (2011). Perception of need and barriers to access: the mental health needs of young people attending a Youth Offending Team in the UK

Volume 8, Issue 1. (CC) JACCES, 2018. ISSN: 2013-7087

- Wennberg & Kjellberg. (2010). Participation when using cognitive assistive devices from the perspective of people with intellectual disabilities
- Williams & Nicholas. (2006). Testing the usability of information technology applications with learners with special educational needs

From existing MAUAP references:

- Adaptive Environments Center & Barrier Free Environments. (1995). ADA accessibility checklist for existing facilities
- Arizona State University & Herberger Center for Design Excellence. (2005). The community survey. Liveable communities : an evaluation guide
- Bennett, Kirby, & Macdonald. (2009). Wheelchair accessibility: descriptive survey of curb ramps in an urban area
- Don MacDowall of Bass International Consulting for People Outdoors. (2004). Accessibility checklist – a self-assessment tool
- Greater Toronto Hotel Association. (2003). Greater Toronto hotel association hospitality checklist
- Kerr & Rosenberg. (2009). Walking route audit tool for seniors [WRATS]
- McClain & Todd. (1990). Food store accessibility
- Measuring up program-2010 Legacies Now- Accessible Tourism Strategy. (2008). Non-accommodation checklist. Measuring up built environment self-assessment guidelines
- Research Alliance for Children with Special Needs. (2003). Physical accessibility measure for schools (PAMS)

- Research Alliance for Children with Special Needs and the School of occupational therapy & the University of Western Ontario. (2010). University campus accessibility measure (UCAM)
- Service de l'aménagement du territoire de la Ville de Québec. (2010). Guide pratique d'accessibilité universelle
- Stark, Hollingsworth, Morgan, & Gray. (2007). Development of a measure of receptivity of the physical environment
- U.S. Department of Justice. (2001). ADA checklist for new lodging facilities
- U.S. Department of Justice. (2004). ADA checklist for polling places

From other added references:

- Absolu System. Guide pratique couleur & accessibilité
- ArgoServices. (2011). Fiches pratiques
- Association des malentendants canadiens. (2008). Conception universelle et accès facile: lignes directrices pour les personnes malentendantes
- Canadian Heritage Parks Canada. (1994). Design guidelines for accessible outdoor recreation facilities
- CERTU. (2007). Une voirie accessible
- CERTU & CETE de Lyon. (2010). Zone de rencontre: Quels dispositifs repérables et détectables par les personnes aveugles et malvoyantes?
- Christiaen. (2004). Vivre mieux dans un environnement visuel adapté
- Comité régional du Tourisme Paris Ile-de-France - Maison de Victor Hugo. (2013). Accessibilité: Qualité de l'accueil à Paris Ile-de-France:

Concevoir un guide adapté pour les personnes en situation de handicap mental

- Commission canadienne des droits de la personne. (2007). Pratiques exemplaires de conception universelle à l'échelle internationale : examen général [International best practices in universal design]
- Confédération Française pour la Promotion Sociale des Aveugles et Amblyopes. (2010). Les besoins des personnes déficientes visuelles: Accès à la voirie et au cadre bâti
- Cunningham, Michael, Farquhar, & Lapidus. (2005). Developing a reliable Senior Walking Environmental Assessment Tool
- Davies, Stock, King, & Wehmeyer. (2008). ''Moby-Dick is my favorite:'' Evaluating a cognitively accessible portable reading system for audiobooks for individuals with intellectual disability
- Fédération française du bâtiment. (2009). Guide des bonnes pratiques de mise en couleur
- Figoni, McClain, Bell, Degnan, Norbury, & Rettele. (1998). Accessibility of physical fitness facilities in the Kansas City metropolitan area
- Godsell & Scarborough. (2006). Improving communication for people with learning disabilities
- ILSMH Association Européenne. (1998). Le savoir-simplifier: Directives européennes pour la Production d'Information en langage clair à l'usage des Personnes Handicapées Mentales
- Institut Nazareth et Louis Braille & Société Logique. (2003). Critères d'accessibilité répondant aux besoins des personnes ayant une déficience visuelle
- Kelly, Sloan, Brown, Petrie, Lauke, Ball, & Seale. (2007). People, policies and processes

- Ministère de l'écologie, Ministère du travail et des relations sociales et de la solidarité, & Ministère du logement et de la ville. (2008). Circulaire interministérielle no 2007-53 DGUHC du 30 novembre 2007 relative à l'accessibilité des établissements recevant du public, des installations ouvertes au public et des bâtiments d'habitation

- Ministère des Transports de l'écologie du Tourisme et de la Mer. (2012). Prescriptions techniques pour l'accessibilité de la voirie et des espaces publics

- ONIP, FAF, & Argos-Service. (2011). Contrastes & Harmonies

- OPHQ. (2009). À part entière : pour un véritable exercice du droit à l'égalité », Politique gouvernementale pour accroître la participation sociale des personnes handicapées

- Pôle ressources national sport et handicap. (2012). Accessibilité des équipements, espaces, sites et itinéraires sportifs: Les gymnases: Guide d'usage conception et aménagements

- Transports Québec. (2007). Normes de la construction routière MTQ – Normes

- UNAPEI. (2009). Guide pratique de l'accessibilité: Pour vous accompagner dans vos démarches en matière d'accessibilité en faveur des personnes en situation de handicap mental

- UNAPEI. (2012). Guide pratique de la signalétique et des pictogrammes

The seven existing sections (Gamache et al., 2016a) were reorganized to eliminate any redundant information and shorten the assessment. The *Canadian Standards Association*'s recommendations (CSA Group, 2012) were selected as the principal source of information since they are most representative of the possible progress in accessibility and of Canadian practices which can be applied in Nordic countries. Moreover, ISO recommendations (International Organization for Standardization [ISO], 2011) were also used, because of their influence and the

fact that they are produced by an issuer of controlled norms developed by a group of experts from different fields. Even so, all data gathered from other sources were considered in the development of the MEA and were added if relevant.

As in the first version, the MEA includes an introduction presenting the theoretical conceptualization and development of the assessment, a description of what can be evaluated with the MEA, instructions, measurement conversion tables and the use of colour and contrast. It is followed by the evaluation per se. So that each section can remain independent and be used only if necessary, each existing section was separated into smaller but more structured sections, each of which represents an environmental element, resulting in 29 sections in the MEA (see table 3).

Staircases have been added in the new version. Even though they are not inherently universally accessible structures (wheelchair users and severely mobility-impaired individuals do not usually use them), some IPD who use mobility-assistive devices (e.g. cane, walker) use them, and so they need to be accessible. As can be seen in table 3, the MEA contains a more significant number of items, most of the MAUAP items were modified or adapted.

As for the format, to shorten the presentation of the information, labels were deconstructed to form three categories of information: elements, components and criteria. Elements are the categories of information that are covered in the criteria that form the evaluated environmental element. For example, the first section regarding curb ramps includes elements such as surface, landing (top), transition, running slope, etc. The components are the subcategories that refine the elements' descriptions. Again in the curb ramps section, if we consider the element SURFACE, the related components are ground, obstacles, joints and alignment; they allow further deconstruction of the concept. Finally, the criteria indicate what needs to be measured precisely and objectively and which need to be rated. The presentation was therefore standardized to ensure that all sections are constructed in the same way so the information can easily be found. All the

items regarding the configuration of the evaluated element are presented first, followed by those related to signage, lighting and specific features. In order to better understand the origin and choices made for each of the proposed items, all references used are presented. Moreover, in the MAUAP, some items were identified as key points without which accessibility would be impossible or greatly hindered and which needed to be analyzed very carefully (indicated in bold). In the MEA, this feature was not replicated. Each item is considered to contribute to an interrelated assemblage of necessary characteristics that must be considered as a whole. Moreover, elements that cannot be objectively evaluated are presented in an ADDITIONAL INFORMATION section at the beginning of each section. This provides a better understanding of IPD and ICID's needs and improves access to the environment, but the items in question are not deemed necessary or objective enough to be evaluated. An example of the resulting format can be found in figure 1 (image provided: example of evaluated environment).

As for the rating scales, it was found that the MAUAP's four-level accessibility rating scale, which proposed percentage ranges of checked characteristics to accommodate the varying number of labels per item, was not very useful. It did not provide a meaningful, representative evaluation of accessibility. Since the content of this measure focuses on the acceptable middle-ground between the needs of individuals with motor, visual, hearing, cognitive and intellectual disabilities, the absence of a particular accessibility criterion might hinder access for some people but not for others. Priority should not be given to certain types of individuals; all have the right of access. Therefore, the rating scales were also changed. The first rating element is presented under ACTUAL MEASURES. This provides a specific space for the rater to compare the accessibility criterion for each item with what can actually be observed. In the previous version, this information could be entered in the OBSERVATIONS sections, but it seemed easier for raters to distinguish the measures from other observations. Another rating scale concerns the COMPLIANCE of the observed measure with the criterion found in each item. There are three options; the element presented in the item is

absent, it is there and is compliant or it is there but it is not compliant with the criterion. Finally, the last rating element provided is the OBSERVATIONS AND MODIFICATIONS section where the rater provides further explanations of the observations made and information on possible modifications to be implemented to improve accessibility.

The material required to perform the evaluation objectively was added for each section of the MEA to make it more user-friendly. At the top of each page, the required measurement instruments are listed (stopwatch, level, luxmeter, measuring wheel, measuring tape, sonometer, thermometer). Before completing an assessment, raters can therefore select the required sections concerned with the desired environmental elements. They can then identify the measuring instruments they need to perform the assessment and thus complete it by providing the objective actual measure, the actual measure's compliance with the proposed assessment criterion, and the observations and modifications they propose. Therefore, each section can be used independently and quite intuitively.

Table 3. Comparison of sections in the MAUAP and the MEA

MAUAP			MEA			
Sections	**Content**	**# items**	**Groups**	**Sections**	**Content**	**# items**
1. Parking lot		11	**Parking**	5. Designated parking		26
				6. Parking meter, Ticket machine or Toll station		25
2. Pedestrian facilities	Curb cut or sloped curb to access the sidewalk	11	**Pedestrian infrastructures**	1. Curb ramps/Curb cuts		23
	Sidewalk and pedestrian path			4. Sidewalk and pedestrian path		21
	Curb cut or sloped curb to leave the sidewalk					
	Pedestrian traffic light			3. Pedestrian signal		15
	Crosswalk			2. Pedestrian crossing		11
	Curb cut or sloped curb to access the sidewalk after crossing the street					
3. Building access from the exterior	Curb cut or sloped curb to access the building	17				
	Sidewalk or pedestrian path to access the building					
	Ramps to access the building					
	Exterior signage			7. Signage and outdoor access		6
	Entrance			8. Doors		44
4. Interior manoeuvring area	Global signage for the building	12		10. Signage		37
	Floor, walls and lighting		**Circulation**	14. Walls		9
				15. Obstacles		3
	Hallway			13. Accessible routes		42
	Environmental control			21. Manoeuvring devices		8
	Ramp		**Circulation**	17. Access ramp		21
				18. Handrails and guardrails		12

MAUAP			MEA		
	Elevator			19. Elevator	64
	Platform lift			20. Platform lift	17
				16. Staircase	35
5. Places for learning and leisure	Classroom, meeting room, multipurpose room, community hall and auditorium	33	**Learning and leisure facilities**	26. Room and auditorium	10
				29. Accessible seats	11
	Library/Resource center			27. Library and resource center	5
	Locker room entrance		**Locker rooms and toilets**	23. Locker rooms	39
	Dressing room			24. Toilet, changing and shower stalls	121
	Locker				
	Shower stall				
6. Services	Functional security of the building	26	**Learning and leisure facilities**	9. Security	29
	Reception desk at the entrance of the building			11. Desks	18
	Service signage				
	Door				
	Environmental control				
	Area with chairs and tables			12. Tables and chairs	24
	Cafeteria/snack bar			28. Cafeteria	18
	Phone			22. Equipment – Telephone	27
	Water fountain			22. Equipment – Drinking fountain	19
	Automatic teller machine			22. Equipment – Automatic teller machine	30
				22. Equipment – Trashcans, bins	11
7. Public restroom	With stalls	23	**Locker rooms and toilets**	25. Washrooms	101
	Accessibility				

MAUAP	MEA
Stall Use of the toilet Counter, sink and mirror Without stalls Accessibility Toilet without stalls Use of the toilet	

Note: Items of the MAUAP represent checklists of environmental characteristics (n=3 to 16 per item). Items in the MEA represent an environmental characteristic each.

Figure 1. Example of the MEA's format

1

1. Pedestrian infrastructures – Curb ramps/Curb cuts

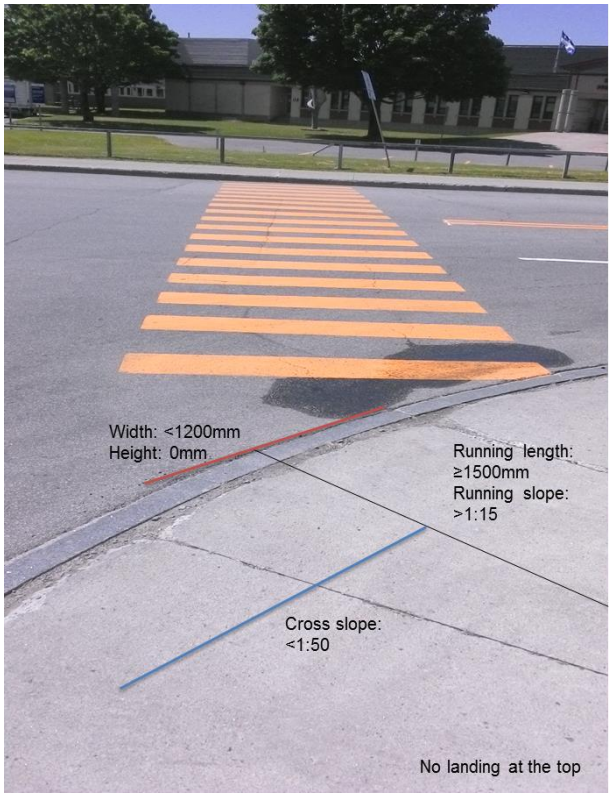
#	Elements	Components	Criteria	Actual measures	Absent	Compliance		Observations and modifications
1.	Surface	Ground	Level, continuous and slip-resistant even if wet[1]			☐	☐	
2.		Obstacles	No unevenness nor hole in front			☐	☐	
3.		Joints	Type: saw cuts[1]			☐	☐	
4.		Alignment	With the unimpeded pedestrian corridor on the sidewalk and guiding pedestrians to their reserved circulation area[1, 2]			☐	☐	
5.	Landing (top)	Depth	≥ 1200mm[2]			☐	☐	
6.	Transition	At the centre	Running length ≥ 1500mm[1, 3]			☐	☐	
7.	Running slope		≤ 6.66% (1:15)[2] • Where the curb ramp has flared sides: 6.66-10% (1:15-1:10)[2]			☐	☐	
8.	Cross slopes		• At junctions, intersections: < 2% (1:50)[2] • Where pedestrians are likely to walk across the curb ramp on vehicle traffic area: < 5% (1:20)[2]			☐	☐	
9.		Where there is a counterslope > 11% (sideways)	Transition starting at the ramp base and running over the entire width (sideways) on a distance ≥ 600mm in a street[2] and with a counterslope ≤ 2% (1:50)[2]			☐	☐	
10.	Curb cut width	Excluding flare sides	1200-1500mm[2]			☐	☐	
11.	Edge (lip)	Shape	Bevelled or round[1]			☐	☐	
12.		Height	≤ 20mm[4] with the pavement (≤ 13mm ideally) without being reduced to 0 to remain detectable[1]			☐	☐	
13.		Marking	Motif of contrasting colours (≥ 70%), decorative strip or granite curb[1]			☐	☐	
14.		Distance between 2 lowerings	> 2500mm[5, 6]			☐	☐	
15.	Tactile tiles	Distance from the edge	150-200mm[2]			☐	☐	
16.		Length	600-650mm[2]			☐	☐	
17.	Lighting		Directed toward the curb ramp or cut: ≥ 50 lux			☐	☐	
18.	Obstacles	Distance	≥ 900mm[7]			☐	☐	
19.	Bollards (if any)	Location	On both sides of the roadway[7]			☐	☐	
20.		Width	≥ 1400mm[2]			☐	☐	
21.		Height	1200mm[7]			☐	☐	
22.		Contrast	Contrasting top (≥ 70%)[7]			☐	☐	
23.		Chains	Bollards should not be linked with chains[8, 9]			☐	☐	

1. Pedestrian infrastructures – Curb ramps/Curb cuts

References

1. Service de l'aménagement du territoire de la Ville de Québec. Guide pratique d'accessibilité universelle. 2010 - [cited. Available from: www.ingo.qc.ca/communication/publications/guide_accessibilite/acces_Manuel_utilisation_2010.pdf.
2. CSA Group. *Accessible Design for the Built Environment*. Mississauga, Ontario: CSA Group; 2012.
3. City of Winnipeg. Accessibility design standards. Canada: City of Winnipeg. 2010 - [cited; pp 1-198]. Available from: http://www.winnipeg.ca/ppd/pdf_files/access_design_standards.pdf.
4. Ministère des Transports de l'écologie du Tourisme et de la Mer. Prescriptions techniques pour l'accessibilité de la voirie et des espaces publics. France: Ministère des Transports, de l'écologie, du Tourisme et de la Mer. 2012 - [cited. Available from: http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=2063DE928ED2B87A26719E370FA8D462.tpdjo14v_3?cidTexte=LEGITEXT000006055384&dateTexte=20130720.
5. Certu, Ministère de l'écologie et du Développement durable et de l'Aménagement du territoire. Une voirie accessible. 2007 - [cited. Available from: http://www.certu.fr/IMG/pdf/Voirie-accessible_2008-06.pdf.
6. Ministère de l'écologie du développement et de l'aménagement durables, Ministère du travail et des relations sociales et de la solidarité , Ministère du logement et de la ville. Accessibilité des établissements recevant du public, des installations ouvertes au public et des bâtiments d'habitation. 2008 - [cited. Available from: http://www2.equipement.gouv.fr/bulletinoff/ciel/fiches/bo200723/a0230052.htm.
7. Confédération Française pour la Promotion Sociale des Aveugles et Amblyopes. Les besoins des personnes déficientes visuelles: Accès à la voirie et au cadre bâti. 2010 - [cited. Available from: www.cfpsaa.fr/accessibilite.
8. Transports Québec. Normes de la construction routière MTQ – Normes. Québec 2007 - [cited. Available from: www.mtq.gouv.qc.ca/portal/page/portal/accueil/publications/normes.
9. Collectif Accessibilité Wallonie Bruxelle. Guide d'aide à la conception d'un bâtiment accessible. 2013 - [cited. Available from: https://sites.google.com/site/cawabab/.

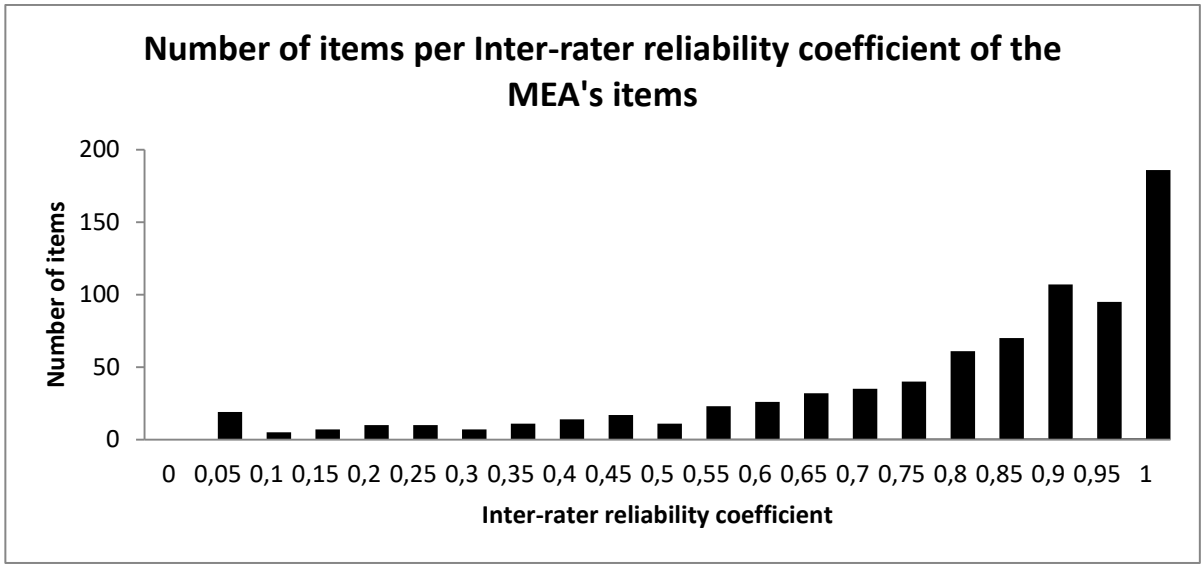
2



Inter-rater reliability study

Figure 2 shows the distribution of inter-rater reliability coefficients Gwet's AC1 values for all items. Most items (n=458/882) have a Gwet's AC1 greater than 0.80, meaning excellent agreement between raters beyond the chance level. Many others have good Gwet's AC1 values (0.61 to 0.80) (n=168/882). Some items have lower inter-rater reliability coefficients (n=108/882, p-value <0.05 significantly different from 0) and a few have non-significant coefficients (n=52/882, p-value ≥0.05). Another 96 items did not have a Gwet's AC1 value since both raters did not observe the evaluated element since the accessibility feature has not been observed within the sample.

Figure 2. Distribution of inter-rater reliability coefficients of the MEA's items



Note: A few items have non-significant coefficients (n=52/882, p-value ≥0.05 – items 1.07, 1.09, 1.12, 1.17, 1.18, 4.07, 4.12, 5.09, 5.25, 6.15, 6.25, 8.16, 8.37, 8.43, 10.15, 10.16, 11.08, 12.08, 12.10, 12.13, 12.16, 12.17, 12.18, 13.09, 15.02, 16.01, 16.03, 16.08, 16.13, 16.19, 16.25, 16.26, 16.27, 16.31, 19.24, 19.37, 19.61, 21.02, 22.21, 22.25, 22.34, 22.35, 22.39, 22.43, 24.117, 24.121, 22.67, 25.93, 26.03, 26.10).

Discussion and conclusion

The objectives of this study were to update the content and format of the *Measure of accessibility to urban infrastructures for adults with physical disabilities* and to

evaluate the inter-rater reliability of the updated version. The new version of this measure, the *Measure of Environmental Accessibility*, is based on the concepts of universal accessibility, and the HDM-DCP. A literature review was performed to update labels, and ICID were also considered as part of the target user population. As for the format modifications, the seven existing sections were reorganized to create 29 independent sections. The new version allows the evaluation of staircases, which the MAUAP did not allow. The labels were also deconstructed to create three categories of information: elements (what is going to be evaluated), components (subcategories refining the description) and criteria (what needs to be measured). Items are now better defined; one item is one criterion in the MEA, contrarily to the MAUAP items which are checklists of criteria. The references to the publications used to establish the evaluation criteria are provided for each label in the MEA. Key points (in bold in the first version to indicate essential elements) have been eliminated, since these points depended on the type of disability and thus may significantly vary from one person to the other. Elements that cannot be objectively evaluated are now presented in an ADDITIONAL INFORMATION subsection at the beginning of each section, which provides additional indications for people who wish to better understand the needs of IPD and ICID and improve access to the environment. As for the rating scales, the four-level rating scale of accessibility in the MAUAP, which proposed percentage ranges of checked characteristics to accommodate the varying number of labels per item, was changed to three types of rating: ACTUAL MEASURES (observable measures in the environment), COMPLIANCE (of an observed measure with the criterion provided for each item – absent, compliant, not compliant), and OBSERVATIONS AND MODIFICATIONS (explanations of the observations made and information on possible modifications to be made to improve accessibility). Additional information has been provided in the presentation of each section on the material required to perform the evaluation objectively (pictograms at the top of each page). Each section takes from two to ten minutes to complete, the rater only uses the sections concerned with the environmental elements he/she wishes to evaluate.

Inter-rater reliability was assessed using Gwet's AC1. Most items have good to excellent inter-rater reliability indicators (71%, 626/882), which meets our objective that the MEA items should have Gwet's AC1 values that are good or better. Another 96 items did not have a Gwet's AC1 value since both raters did not observe the

Volume 8, Issue 1. (CC) JACCES, 2018. ISSN: 2013-7087

evaluated element. Overall, the MEA is a promising measure for evaluating the accessibility of public environments for IPD and ICID. Nevertheless, some items have lower inter-rater reliability coefficients (n=108/882, p-value <0.05 significantly different from 0) and a few have non-significant coefficients (n=52/882, p-value ≥0.05). These items are distributed unevenly in the MEA, so it is impossible to predict which items are less appropriate. Many of the disagreements found within the judges' ratings for these items seem to relate to their ability to classify whether an item was absent or non-compliant; in either case, the item represents an inaccessible situation. The MEA allows a better understanding of what needs to be considered in the environment to provide one that is more congruent with the person's characteristics and the activity taking place in the environment.

Limits of the study

The sample size (infrastructure) used for evaluating inter-rater reliability was limited and extreme levels of accessibility (e.g., exemplary cases) may not have been observed. However, it respected the requirements for obtaining statistically significant results. All evaluations were performed in Quebec City and therefore might not have provided enough diversity. Even so, a variety of types of structures were evaluated which had been built at different times and in different contexts. Moreover, the number of evaluators (n=2) was small and might not have been representative of all possible types of users; still, the evaluators came from different backgrounds and this brought a certain diversity among raters.

Statistically speaking, a high agreement was obtained when both raters believed that a characteristic was not present. This does not necessarily mean that their judgment was accurate. With the current MEA instructions, the characteristic may have been hard to detect, rather than absent. Moreover, when both raters detected a characteristic, we did not check to make sure their assessment was based on the observation of the same elements. Thus, the nature of the agreement between raters might be questioned.

Volume 8, Issue 1. (CC) JACCES, 2018. ISSN: 2013-7087

Future research

The format of the MEA could be further adapted to make it more accessible and usable by individuals with visual disabilities and other professionals concerned with accessibility (e.g., architects, groups defending the rights of IPD and of ICID). A co-design approach to the development of a new version by meeting with individuals with disabilities should also be considered. Inter-rater reliability should also be evaluated with more evaluators as well as with other professionals such as urban planners or individuals who are not experts in construction or rehabilitation (e.g. representatives groups of IPD or ICID). These individuals will then have access to a tool that can be used before renovations or at the beginning of a construction project to ensure that existing and future urban infrastructures are accessible. Future research could, therefore, include the use of the MEA by any individual wanting to improve the accessibility of public infrastructures for individuals with physical, cognitive and intellectual disabilities in order to create a common ground and vocabulary with which to work in urban projects.

Final remarks

The results of this paper show that the MEA is a promising measure of accessibility of exterior and interior urban infrastructures for individuals with motor, visual, hearing, cognitive and intellectual disabilities. Compared to the previous version (MAUAP), the MEA's content has been updated, the format has been improved to favor user-friendliness, and the rating scales have been modified to provide more adequate conclusions. Moreover, this measure showed good inter-rater reliability indicators in this study, with two evaluators from different backgrounds. It is available both in English and in French. This tool can highlight potential adaptations for improving accessibility; thus, it will promote the exchange of accessibility solutions with architects, urban planners, and decision makers. As of now, the MEA is intended for professional use by health clinicians and construction workers/planners. However, it could be envisioned that users with disabilities be involved in data collection to

provide feedback. The introduction of the MEA provides enough information to ensure its use. Nevertheless, further training is recommended.

Acknowledgements

First, we would like to thank the former scientific director of the CIRRIS, Luc Noreau, for his unconditional support in the development and refinement of the tool, along with Claude Vincent, Pascale Boucher, Élyse Saint-Georges Tremblay, Frédéric-Alexandre Morin and Claudia Poirier. In addition, we would like to thank the professionals from the CIUSSS-CN IRDPQ site, especially Sylvie Chénard for her financial contribution in the development of the project, as well as Maryse Beaudry and Johanne Lapierre. Moreover, we would like to thank the City of Québec who have been implicated in the project, namely Renée Fleury, Gilles Hamel, Marika Vachon, Sébastien Lebel, Annie Blackburn, and Odette Villeneuve, for their invaluable input during the whole process. Finally, we would also like to thank our community partners who participated in the development of the project for their much pertinent insights, Julie Montreuil (APDA), René Binet (RPHV-0312), Hélène St-Pierre (CAPVISH), André Hallé and Daniel Forgues (FSQ), as well as Olivier Collomb d'Eyrames (ROP 03).

References

[1] Clarke, P. J., Ailshire, J. A., Nieuwenhuijsen, E. R., & Vrankrijker, M. W. (2011). Participation among adults with disability: The role of the urban environment. *Social Science & Medicine, 72*(10), 1674-1684.

[2] CSA Group. (2012). *Conception accessible pour l'environnement bâti* (Vol. B651-12). Mississauga (ON): CSA Group.

[3] Deliot-Lefevre, P. (2006). L'accessibilité des cadres bâtis, des lieux publics et des transports. *Gérontologie et Société, 4*(119), 11-23.

[4] DeVellis, R. F. (2003). *Scale development. Theory and applications* (2nd edition ed. Vol. 26): Sage Publications.

[5] Dos Santos, L. N., & de Carvalho, R. J. (2012). Ergonomics and accessibility for people with visual impairment in hotels. *Work, 41 Suppl 1*, 1417-1424.

[6] Fougeyrollas, P. (2010). *La funambule, le fil et la toile. Transformations réciproques du sens du handicap*: Les Presses de l'Université Laval.

[7] Gamache, S., Vincent, C., Routhier, F., McFadyen, B. J., Beauregard, L., & Fiset, D. (2016a). Development of a measure of accessibility to urban infrastructures: a content validity study. *Medical Research Archives, 4*(5), 1-25.

[8] Gamache, S., Vincent, C., Routhier, F., McFadyen, B. J., Beauregard, L., & Fiset, D. (2016b). Measure of accessibility to urban infrastructures for adults with physical disabilities (MAUAP): inter-rater reliability study. *Medical Research Archives, 4*(5), 1-14.

[9] Giesbrecht, E. M., Ripat, J. D., Cooper, J. E., & Quanbury, A. O. (2011). Experiences with using a pushrim-activated power-assisted wheelchair for community-based occupations: a qualitative exploration. *Canadian journal of occupational therapy, 78*(2), 127-136.

[10] International Organization for Standardization [ISO]. (2011). *Construction immobilière — Accessibilité et facilité d'utilisation de l'environnement bâti*.

[11] Jenkins, G. R., Yuen, H. K., & Vogtle, L. K. (2015). Experience of Multisensory Environments in Public Space among People with Visual Impairment. *International journal of environmental research and public health, 12*(8), 8644-8657.

[12] Martins, L. B., & Gaudiot, D. M. (2012). The deaf and the classroom design: a contribution of the built environmental ergonomics for the accessibility. *Work, 41 Suppl 1*, 3663-3668.

[13] McClain, L., Medrano, D., Marcum, M., & Schukar, J. (2000). A qualitative assessment of wheelchair users' experience with ADA compliance, physical barriers, and secondary health conditions. *Topics in spinal cord injuriey rehabilitation, 6*(1), 99-118.

[14] Mcintyre, L. J., & Hanson, V. L. (2014). *Buildings and users with visual impairment: Uncovering factors for accessibility using BIT-Kit.* Paper presented at the Proceedings of the 16th international ACM SIGACCESS conference on Computers & accessibility.

[15] Rosenberg, D. E., Huang, D. L., Simonovich, S. D., & Belza, B. (2013). Outdoor built environment barriers and facilitators to activity among midlife and older adults with mobility disabilities. *Gerontologist, 53*(2), 268-279.

[16] Shumway-Cook, A., Patla, A., Stewart, A. L., Ferrucci, L., Ciol, M. A., & Guralnik, J. M. (2005). Assessing environmentally determined mobility disability: self-report

versus observed community mobility. *Journal of the American Geriatrics Society, 53*(4), 700-704.

[17] Steinfeld, E., & Maisel, J. L. (2012). *Universal design: Creating inclusive environments*. Hoboken, NJ: John Wiley & Sons.

[18] Wongpakaran, N., Wongpakaran, T., Wedding, D., & Gwet, K. L. (2013). A comparison of Cohen's Kappa and Gwet's AC1 when calculating inter-rater reliability coefficients: a study conducted with personality disorder samples. *BMC Medical research methodology, 13*, 61.

[19] World Health Organization, & The World Bank. (2011). *World report on disability*. Retrieved from http://www.who.int/disabilities/world_report/2011/en/.

Journal of Accessibility and Design for All

Volume 8, Issue 1. (CC) JACCES, 2018. ISSN: 2013-7087

Gamache, S., Morales, E., Noreau, L., Dumont, I., & Leblond, J. (2018). Measure of environmental accessibility (MEA): development and inter-rater reliability. Journal of Accessibility and Design for All, 8(1), 1-32. doi:http://dx.doi.org/10.17411/jacces.v8i1.141