6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015

The usability of architectural spaces: objective and subjective qualities of built environment as multidisciplinary construction.

Maria Cristina Bittencourt[a]*, Vera Lúcia Duarte do Valle Pereira[b], Waldemar Pacheco Júnior[b]

[a]*Department of Architecture and Urbanism - Universidade do Vale do Itajaí - Balneário Camboriú - 88337-300-Brasil*
[b]*Department of Prodution Engineering and Systems - Universidade Federal de Santa Catarina - Florianópolis-88040900 Brasil*

Abstract

"Usability" is present in all interactions between user and object. As well as a product, for the built environment this concept has been presented throughout history by different classifications, such as functional, technical, aesthetic and economic architectural qualities. Architecture expresses its three-dimensional condition through the man possibility of entering the interior and moving to perform daily activities. Ergonomics in architecture arises by the possibility of knowing the users, their biological, social and psychological aspects, and contributes to planning, design, evaluation of tasks, jobs, products, environments and systems. In several areas of knowledge, "usability" is a research object, named "ease of use" in response to the trinity "user - task - physical environment". Since the lack of specific measurement techniques, was perceived, this article introduces the concept of "usability of architectural spaces" as a multidisciplinary construction. Held through the literature review in "architecture, ergonomics, environmental psychology, engineering, interior design, accessibility and universal design". This work presents the analysis, selects and organizes the main dimensions (objective and subjective) and spatial categories of the built environments. Aims to contribute to usability assessments, as support for new environment projects and readjustment of existing ones, such as theoretical and technical grant to scientific research.

*Keywords:*usability, architectural space, multi-disciplinarity, dimensions & categories, built environment

* Corresponding author. Tel.: +55-48-3225-3888; fax: +55-48-3333-1726.
  E-mail address:arqcrisb@gmail.com

1. Introduction

Usability is present in everything that requires the interaction between user and object, in order to adapt projects and perform adjustments, which can be anything from an internet site or the built environment occupied by human being. Their roots are in cognitive science, psychology and ergonomics and the human-computer interaction study. In the ' 80, the term "usability" replaced the "use-friendly" expression. Nielsen [68] points that "usability andusefulness" are complementary to compose the "quality of use". Bevan (1995) [1]defines as "the highestinteractivity level afforded to a product with respect to the user", wich attributes can be verified in the project stage, was summarized as "the ease in using particular product", or defined as "the measure in which a product can be used by specific users in order to achieve the specific goals with effectiveness, efficiency and satisfaction in a specified context of use"[68, 67].Currently, "usability" is inserted into different contexts, as socio-political issues, trade and production quality standards, consumer satisfaction and responsibility of the supplier; the user interaction with desktop environments, education, health, leisure and community and technological context [3].

Within the framework of the architectural space, the concept is not unknown, and came throughout history as architectural qualities, functional, technical, aesthetic and economic boundaries of the built environment [4,5,6,7,8,9,10]. However, researches involves mostly working environments, information engineering dimensions, interaction design, product evaluation and ergonomic analysis [11,12,13,10].Given the lack of specific measurement instruments, new usability precepts could be transported to architecturalscale in order to suit the in response to individuals needs and skills [13,11,10,14].

2.Usability and architectural space: amultidisciplinary construction

The space is one of the architectural properties and the architectural space expresses the condition of this three-dimensional, through the man possibility ofentering and moving himselfin this interior [44]. Vitruvian architectural thought based onmultidisciplinarity was considered universal during different approaches and epochs [5]. The usability concept of built environment, was first discussed in the treatise entitled "De Architectura", at the beginning of the Roman Empire, in which Vitruvio describes on three qualities served by architecture systems: "firmitas, venustas and utilitas" - "solidity, usefulness and beauty" [5,10].

"Solidity" focuses on the constructive aspect, the structural system on physical wrap, technologies and the quality of the materials [5,8]. "Usefulness"is about creating spaces and scales to meet usersrequirements and how they relate to spaces. According to Vitruvius, "when the arrangement of the environments is correct and does not present obstacles to use, and each building category is assured its suitability and property" [5,8]; "beauty"refers to aesthetic concerns, in order to encourage contemplation and enjoyment [5].In this context, architectural quality is presented as integration between the functional quality (spatial organization of activities) and technique, which treats of climate regulation (environmental comfort), aesthetics as a symbolic function associated to form, yet,the economy [10]. The "built environment" refers to the building or public space, covered or uncovered environment [15] organized and animated, constituted a kind of aesthetic and physical, psychological and informative, designed to please, serve, protect and unite the people in the exercise of its activities [9]. Usability in architecture is often understood as the functionality or the buildings ability to carry out the tasks envisaged for it, to its efficiency, practical utility or value to the user, considering the financial resources available.

Recent surveys identified factors, cultural, situational and contextual user experience important to base the understanding of usability of the built environment [11,10,16, 17, 19,5,18]. In this perspective, space usability becomes more comprehensive, to assess how people utilize the functions to meet their needs and your experiences [20,21,22] adding to functionality, technological and climatic constraints, symbolic, aesthetic and ergonomic,user needs and expectations, the economic issues and investment returns.Thus, the construction of a static image or constant of built environment usability study would be impossible, which reaffirms its multidisciplinary scope.Some specific aspects are of man & built environment have been structured over time with different names and methodologies, but common goals [23,3,20,10].

2.1. POE - Post occupation evaluation

The meeting between architecture and engineering evaluation method, applied for buildings, furniture, equipment, with systematic and rigorous evaluation process performance of environments in use. Involves objective and subjective criteria, assessed in terms of performance and suitability in accordance with the activities carried out [24,25,26]. Assess technical aspects, quantitative and qualitative, functional and behavioral characteristics as flows of people, materials, activities, organizational performance and accessibility, and meeting with the ergonomic analysis allows to recognize the user's subjectivity, determine and construct the problem, programs and draw guidelines for the project design [26,27].

2.2. Ergonomics of the built environment

Architecture arises as the means of knowing the user and the task, contributing to the planning, design, evaluation of tasks, jobs, products, environments and systems, through interdisciplinary studies and dimensional assessments, physical data, anthropometric, biological, physiological and psychosocial. The studies heading into the interior spaces of work, services and leisure critical to daily functioning and quality of life, and environmental comfort, safety requirements and functionality, presented as the variables involved in the adaptation of the built environment: environmental comfort, perception (cognitive), anthropometric measurements (accessibility, scaling) and the adequacy of materials (coating and finishing) [28,29,30].

2.3. Environmental psychology

As "psychology of architecture", " place design" or "pro-environmental architecture", is a young discipline expanding multidisciplinary character, in which people are seen as components with their individual psychological characteristics. The analysis is carried out through the studies of perception (how the individual perceives the environment), cognition (how the mind of an individual absorbs and structure the information received) and the behavior (as the individual understands, reacts and modifies the environment) about the influence of the process in human behavior [32] integrating the environmental stimulus perception. Also, aspects such as readability, orientability, and from experiences and expectations such as identity, familiarity, attachment to the place and satisfaction [31,32,9, 33,34,35,36].

2.4. Interior design

The importance of integration between Design and Architecture respect to project the realization of projects with a view to optimizing the space, environmental comfort and well-being.The functionality of any nature internal environment valuing the emotions and positive experiences of your user [37]. This association involves accessibility, readability, orientability studies, with the functional organization, and the composition of ambiences and its elements, that have objective characteristics, related to constructive aspects and regarding the subjective qualities that depend on the user perception from the environment [7,9]. However, these two characteristics may be present on the same element.

2.5. Universal design

The design for diversity arises to gather and systematize concepts and embrace broadly many disciplines in order to reduce the distance between the functional elements and the people capacity to enjoy the atmosphere without a personal characteristics discriminatory treatment [38]. The principles of Universal design supports the creation of environments or products which may be used by as many people as possible [39,40,38] - Equality of possibilities of use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Error Tolerance, Minimal Physical Exertion, the design of spaces for access to and use of all users. Focus simply on Universal design principles is not enough to ensure adequate solutions project. The application of usability in the architecture requires the integration

of accessibility restrictions of buildings since the beginning of the process [41]. Thus, the term "universal usability", was used to express the more universally usable buildings project, regardless of age, size, strength or health conditions, experiences and abilities of users [42,20].

3. Dimensions and categoriesof architectural space

According to literature, spaces and ambiences must respond to functional, formal, technological issues (architecture and construction) to psychological and social (the user) [43], which originates the "space programs, architectural, functional, or user needs" that define the object being designed [6] .Figure 1 presents a hierarchical scale of dimensions and categories organizingprocess.
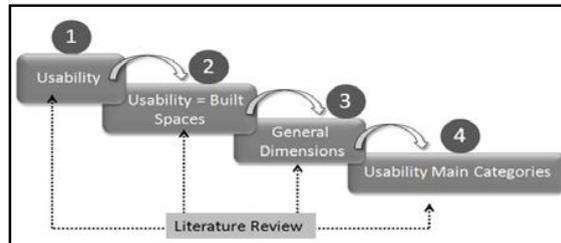

Fig. 1.Usability of architectural spaces – definition process – dimension and categories.

The "dimensions" relate to "elements or factors that constitute a complete entity" [44]. Each dimension consists of a categories set, which are composed of elements or attributes, which represent the most peculiar qualities of environments presented in literature. The overall dimensions are "objective and subjective", composed of elements in the environment, which form the whole of architecturalcomposition[6,9] and can be categorized according to their common qualities. Based in Lynch [34], Ornstein [24], Mallard [9], Gurgel [7], the dimensions were defined as "physical or objective" when relate to main space categories that can be evaluated quantitatively or qualitatively. These can be objectively grouped by their functional, technological content, formal, aesthetic, that guide the design and construction [6]. "Subjective" dimensions are composed of elements whose analysis can be evidenced from the psycho-social and cognitive aspects of the user [9,45]. The Figure 2, presents the main "physical / objective" categories of architectural spaces collected in literature.

Fig. 2.Physical and objective categories of built environment.

3.1. Accessibility

The ease of access and use of environments, products and services by any person and in different contexts, when people in normal physical condition or with varying limitations can experience the built environment so full and complete [46].It can be "determined by the spatial distribution of potential destinations, its easy to reach and the proportion, quality and characteristics of the activities there found"[52].Dischinger and Ely [28] defined important accessibility principles in the built environment, as the guidance, the displacement, the use, and communication.

3.2. Readability, orientability and safety

Readability is related to "the possibility of organize the environment within a pattern of consistent image generation" [34]. This process evolves the obtaining and mental processing of spatial information and its importance to orientation and displacement in the search for references which helps to build the user spaceperception [47, 49,50,51, 52] which directly depends on the degree of legibility of space [47]. It happens at known or unknown places or based on three main components, which are the engine of "wayfinding," a "reorientation" and the "exploitation of the environment", which involves cognitive aspects how to plan routes and acknowledge the references [47].

3.3. Environmental comfort

The study of environmental comfort aims to provide the built environment the conditions of habitability, respecting thermal conditions, ventilation, insulation, acoustic and visual, and others able to change the performance of the building in its context, and the rational use of available resources. The comfort as "a feeling of physical and mental well-being" [53].

3.4. Functionality

It happens when activities are located in their own places, which determines that every building to be functional, must have felt and method [54], the configuration and position of spaces depend on the purpose of use of the building, followed by the architectural program and also of the general arrangement of functions, dimensions and conferred by the shapes. The creation of the whole depends on the suitability of different systems that make up the building, which are constructive, that contains the distributive schema or spatial organization, whithaccess mechanisms and the relationship with the outside world [6].

4. Subjective dimensions: cognitive and psycho-socialaspects from user in relation to builtenvironments

The "subjective" dimensions are composed of psycho-social and cognitive user aspects [9,45]. The relationship between user and environment is reciprocal and bidirectional, since we have established specific areas of use and occupation [55]. There is an interdependence among the questions: how the behavior impacts the environment?how the environment impacts the behavior? Sauvé [69] defines the concept of "environment", as "a place to live, to learn, to take care, and our daily environment, wich its socio-cultural, technological and historical components" [56].

TheEnvironmental Psychology, defines the environmental as a "multidimensional" and explains "the concrete physical environment, as natural or built is inseparable from social economic, political, cultural and psychological conditions, formed by everything in it is present, this includes people, also influenced by how people perceive, feel and behave in that context [31];experienced by person as a whole, where the phenomenological nature of experience provides a sense of unit field.Among the aspects presented in literature some are emphasized as determinants in the quality of life and could be considered in the projects of spaces-Figure 3.
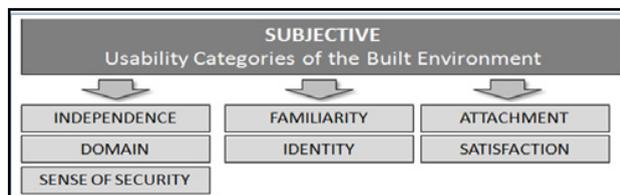

Fig. 3.Subjective Categories of built environment Psycho-cognitive aspects: user/built environment.

4.1. Affection or attachment - "place attachment"

It´s a complex concept defined as a link between the person and specific places or emotional involvement with the places [57], in attention to physical-spatial characteristics, as well as affective and symbolic meanings of individuals or groups, which theory comes from studies of child development, defines the attachment by the behavior of get and keep close to another individual, as structured environment that fosters comfort, safety, security and self-confidence [58]. Tuan (1980, 1983) [61] relates the geographical space to affective binding as a way to turn this space into place through the experience, embraced by three dimensions: functional, symbolic and relational. The functional respect to the role of the physical space as attractor, encouraging or inhibitor of movements, which interfere with behaviors that occur there [59] which can generate as much well-being, as frustration and stress.The symbolic has a socio-cultural content and individual,influences the way each person acts on the different situations. The relational dimension concerns the sense of cognitive and emotional connection between people and environment characteristics, where the individual is perceived as belonging to the group and a specific place, identifying a unique relationship between them [60]. Thisconcept requires an understanding of the "past" and "interrational potential of place", related to experiences and expectations or memories about the environment. The feeling of affection with the place is also coupled to others, such as spatial identity, space, appropriation - topophilia.

4.2. Identity

The "differentiation and individuality of each place to the user" [34] related to significant places, which emerge in a social, cultural and economic context and provide individuals a sense of belonging to a place [62].This sense has the function of "describe and socialize the person through their interactions with the physical world" what happens from memory-related cognitions, the attitudes, values, preferences, the meanings and behaviour, as well as to experience linked to daily life [35]. However, these meanings are not static and neither the same for all people, but constructed and deconstructed continuously, working variously in the thoughts, feelings, in the state of humor, social interactions and physical well-being [63].Tuan (1983)[61] places space and points out that a "place" is related to security and stability, while "space" means the freedom and movement, and the space is more abstract, with movement and transformation, while the place corresponds to a process of appropriation of space, the subject prints its mark, assigns new meanings identifying with this environment.It is noteworthy that, the physical scenarios alter their ability to satisfy the needs and user desires, as this also changes the internal physical scenario toideal according to cycle and interests [64].

4.3. Independence

The possibility of defining their own activities and destinations for as long as possible.A good environment and equipment design facilitates activities independently, which requires to be free of obstacles and easy maintenance to avoid accidents; attractive for all and according to biomechanical features of anthropometric and user population. Many measures can be considered, such as presence of ramps in circulation with gaps, which facilitates the displacement, banks with backrests, armrests and seats well dimensioned [66, 45].

4.4. Familiarity

Identification and affection to the place can interfere positively in their skills and abilities. Thus, the positive mental representation about environments could be facilitated and since it involves the reciprocal interaction between the user and the space, relates directly to the place appropriation process.The mutual influence between user and space is the reason people and groups are, or not, feel identity in various places in which they live, so, the ambience is what makes this communicative process [10]. Environments with historical references and based on tradition solutions and regional customs, may also offer some sense of familiarity and continuity.

5. Conclusion

In view of the reduced researches involving usability in architecture, the choice by the qualitative model with multidisciplinar focus involved definitions and precepts of various knowlege areas. Aimed tounderstand about the emergence of different usability concepts over time, to achieve the built spaces. This research led at first toidentify and classify the key aspects to consider in the design of architectural spaces in general, and demonstrate their close relationship with the users requirements and their capabilities in order to reach their goals as satisfactorily as possible.The multidisciplinary literature review was important for structuring the main spatial aspects - objectives(functional and technological) and subjective (the user expectations related to the environment) determining greater consistency of general space dimensions and categories.

These result forms the initial lead, to be unfolded to more comprehensive searches, directed to specific groups of people and different buildings types, through case studies in order to measure the perceived importance and satisfaction about the categories identified in the literature review.Since accessibility and inclusion are qualities to be studied in addition to the internal scope of buildings, it is suggested for future researches, to include a reassessment of the communication between internal and external spaces in order to create new deploymentand more permeable patterns, and ensure better connectivity between building and environment, aiming at the quality of the urban places, and planning quality of life to be offered by the cities to its in habitants. In this sense, rethink the usability studies in extended scales as its direct interference in the landscape, mobility, maintenance of quality and interactivity between the architectural and urban functions in its area of influence.

References

[1] N. Bevan,.Measuring usability as quality of use. Software QualityJournal, 4, 115-150 (1995)
[2] W. A Cybis, H. S. Betiol.Ergonomia e usabilidade, Ergonomia e Usabilidade Conhecimentos, Métodos e Aplicações, Novatec, São Paulo, 2007.
[3] A. R. J.; Nicholls, J. J Boueri Filho. O Ambiente que Promove a Inclusão. Conceitos de Acessibilidade e Usabilidade. Assentamentos Humanos. Vol. 3, N. 2, Dezembro 2001.
[4] H. Hetrzberger, Lições de Arquitetura. São Paulo: Martins Fontes, 1999.
[5] S. Colin. Uma Introdução à Arquitetura, 2ª. Edição, UAPÊ, Rio de Janeiro: 2002.
[6] E. Mahfuz. Reflexões Sobre a Construção da Forma Pertinente. Arquitextos- 0 45.02 - ano 04, fev 2004.
[7] M. Gurgel. Projetando Espaços, Guia de Arquitetura de Interiores para Áreas Comerciais ; São Paulo: SENAC, 2010.
[8] G. Dziura. Três Tratadistas da Arquitetura; Ênfase no uso do Espaço. Da Vinci, vol. 3, n. 1, Curitiba, 2006.
[9] M.L .Mallard, As aparências em Arquitetura. Ed. UFMG, Belo Horizonte, 2006.
[10] A. Munter. Usability and User driven innovation unity or clash? Paper for 13 th International FM&REM-Congress, Kufstein, January 19-21, 2011
[11] K. Alexander, M. Fenker, J Granath, Å. Hauten, T, K. Vissanen. Usability of Workplaces – Phase 2, CIB Report, Publication 316, 2008.
[12] Y. Afacan, C Erburg. An Interdisciplinary Heuristic Evaluation Method for Universal Building Design. Applied Ergonomics, v. 40, 2009. p. 731-744.
[13]Rasila H; Roth, P; Kerosuo, H. Dimensions of Usability Assessment in Built Environments. Journal of Facilities Management, 2002.
[14] J. Pfautz, E.Roth. Using cognitive engeneering for system design and evaluation. Journal of Usability Studies 2, 102–111 (2007)
[15] A. C Penna M., Lacerda, J. A. Castro, H. S. Rodrigues, I. S. Soares., P. A Rehingantz. Avaliação Pós Ocupação (APO) em Edificações da Fundação Oswaldo Cruz (FIOCRUZ) - O caso do Instituto Fernandes Figueira, NUTAU – UFJR, Rio de Janeiro, 2002.
[16] Jensen, P A, Management for usability of the built environment. in Usability of Workplaces - Rotterdam: CIB- (2010).
[17] P.A. Jensen, P. Oesten. Evaluation of Utterslev School.Research Report. Technical University of Denmark, June 2010.
[18] G. Riva. Virtual Reality in Psichoterapy: Review Cyberpsychology&Bahaviour -220-231
[19] A. Meharabian, J. A. Russel. An Approach to Environmental Psychology. Cambridge: MIT Press, 1974.
[21]C. Baber. Subjective evaluation of usability. Ergonomics 45 (14) 1021-1025
[22] J Clarkson, R Coleman, I., Hosking, S. Waller. Inclusive Design Toolkit.Cambrige Engineering Design Center Press, 2007.
[23] H. Gunther. Como Elaborar um Questionário- Planejamento e Pesquisa para as Ciências Sociais. n. 01. Brasília- DF: Laboratório de Psicologia Ambiental UNB - 2003.
[24]- S. Ornstein, M. Romero. Avaliação Pós-Ocupação do Ambiente Construído. São Paulo: Studio Nobel, Edusp, 1992.
[25]. Ambiente Construído & Comportamento, Avaliação Pós-Ocupação e Qualidade Ambiental. Fupam-USP. São Paulo: Studio Nobel, 1995.
[26] S. Ornstein,C. M Andrade, B. C Leite. C. Assessing Brazilian Workplace Performance In: Assessing Building Performance, Elsevier Butterworth Heinemann, p. 128-139,Oxford, 2005.
[27]P.A. Reingantz, D Alacantara, V.Del Rio, A influência do Projeto na Qualidade do Lugar. Sociedade e Território-Revista de Estudos Urbanos e Regionais, dezembro, 2005, p.p. 01-18.

[28] M Dischinger, V. H. M. B. Ely. A importância dos processos perceptivos na cognição de espaços urbanos para portadores de deficiência visual. Tipo da publicação: tese, capítulo de livro, artigo etc., Florianópolis, UFSC, 1999.

[29] V. H. M. Bins Ely, Ergonomia + Arquitetura: Buscando um Melhor Desempenho do Ambiente Físico. Anais do 3º Ergodesign. Rio de Janeiro: LEUI/PUC - RIO, 2003.

[30] H Gunther, G. Elali, J. Q Pinheiro, Abordagem Multimétodos em Estudos Pessoa- Ambiente, em: Métodos de Pesquisa nos Estudos Pessoa Ambiente. São Paulo: All Books & Casa do Psicólogo, 2008.

[31] L. Rivlin. Olhando o Passado e o Futuro: Revendo Pressupostos Sobre as Inter-relações Pessoa-ambiente. City Universityof New York, em: Estudos de Psicologia, Natal, vol 8/ no. 2, maio/agosto, 2003.

[32] V. Del Rio, P. D. Rheingantz. Projeto do lugar: Colaboração entre Psicologia, Arquitetura e Urbanismo. Rio de Janeiro, 2002.

[33] R.G.C. Melo. Psicologia Ambiental: Uma Nova Abordagem da Psicologia. São Paulo: Psicologia USP (1/2): 85-103, 1991.

[34] K. Lynch. A imagem da Cidade; The Imageof The City. Massachusets Technology Institute, and Harward College, Tradução: Maria Cristina Tavares Affonso. Lisboa: Edições 70, 1960.

[35] R. Sommer. Espaço pessoal; São Paulo: Edusp,1973.

[36] A. Rapoport. Aspectos Humanos De La Forma Urbana. Barcelona: Gustavo Gilli S.A., 1982.

[37] A. de Moraes, Ergonomia do Espaço Construído- Ergodesign do Ambiente Construído e Habitado: AmbienteUrbano, Ambiente Público, Ambiente Laboral. Editora: iUsEr, Rio de Janeiro, 2004.

[38] S. Cambiaghi. Desenho Universal, Métodos e Técnicas para Arquitetos e Urbanistas. Senac, São Paulo, 2007.

[39], M.F. Story, J.F. Mueller, R.L Mace. Universal Design File.Designing for People of All Ages and Abilities.NC State University.The Center for Universal Design, North Carolina, 1998.

[40] W. Preiser, J.L Nasar. Assessing Building Performance: Its Evolution from Post-Occupancy Evaluation. Archnet-IJAR, International Journal of Architectural Research - Volume 2 - Issue 1 - March 2008.

[41]- Uniform Federal Accessibility Standards (UFAS)- Advancing Full Access and Standart for Alls- United States Access Board.- Washington DC- 2009

[42] J.C. Vischer. Post-Occupancy Evaluation: A Multi-facetted Tool For Building Improvement. In: Learning from our Buildings: A State-of-the-Practice Summary of Post-Occupancy Evaluation - National Academy Press, 2001.

[43] C. L. Souza. Cognição Ambiental e as Relações:Mapas Cognitivos, Ambiente Construído e A.P.O. Textos do Laboratório de Psicologia Ambiental, vol. 4, n. 8, Brasília-DF: Instituto de Psicologia Ambiental, Universidade de, 1995.

[44] Michaelis. Dicionário online da Lingua Portuguesa. em: http://michaelis.uol.com.br/moderno/portugues/index.php - acesso em 2012

[45] V . Dornelles. Acessibilidade para Idosos em Áreas Livres Públicas de Lazer. Dissertação de Mestrado. Programa de Pós-Graduação em Arquitetura e Urbanismo - UFSC. Março, 2006.

[46] M. P. Guimarães, Acessibilidade ambiental para todos na escala qualitativa da cidade. Topos-Revista de Arquitetura e Urbanismo, Belo Horizonte, v. 01, n.01, p.p 124-133, jul/dez- 1999.

[47] D. E Onder, E. Koseoglu,.Subjective and Objective Dimensions of Spatial Legibility.Pocedia.Social and Behavioral Sciences.Elsevier.

[48]- G. Cullen. Paisagemurbana. São Paulo: Martins Fontes, 1983.

[49] M. E. Hunt. The design of supportive environments for older people. In: Congregate Housingfor the elderly. Haworth Press, 1991.

[50] T. R Herzog, O. L Leverich,.Searching for Legibility.Environment and Behaviour – maio 2012, 44 (3).

[51] G.F Filho. Ergonomia do Objeto. Sistema Técnico de Leitura Ergonômica. São Paulo: Escrituras, 2003.

[52] M. Dischinger,.Designing for allsenses: accessiblespaces for visuallyimpairedcitizens In: DISCHINGER, Marta; ELY, Vera B. Acessibilidade e Orientabilidade no Terminal Rodoviário Rita Maria. Florianópolis: Grupo PET/UFSC, 2001- p.23

[53] R Lamberts, L Dutra, F. Pereira. O. Eficiência Energética na Arquitetura. 2. ed. São Paulo: ProLivros, 2004.

[54] F Holanda, G. Kholsdorf. Arquitetura como Situação Relacional. Sobre o Conceito de Arquitetura. Anais do Seminário Nacional – O Estudo da História na Formação do Arquiteto, São Paulo: FAUSP/FAPESP, 1995, pp. 196-203.

[57] G.A Elali,S.T.F Medeiros. Apego ao Lugar (Vinculo ao Lugar – PlaceAttachment). em: C. S. Cavalcanti, G.A Elali. Temas Básicos em Piscologia Ambiental. Vozes, Petrópolis, 2011. 318p.

[58] L. Kruse. Compreendendo o ambiente em Psicologia Ambiental. Psicol. USP, São Paulo, 16, em: Revista USP, 2011

[59] M. C Hidalgo.; B Hernandez. Place Attachment: Conceptual and Empirical Questions. Journal of Evironmental Psychology.21, p. 273-281, 2001, Academic Press.

[60] I. Altman, S.M. Low. Place Attattchment. 1992, Plenum Press. N.Y.

[61] Y. F. Tuan. Topofilia. São Paulo: Difel, 1980.

[62]- I Gunther, H. Gunther (organizador). Lugares Favoritos dos idosos no Distrito Federal, Brasília-Lab. de Psicologia Ambiental UNB, 2005.

[63]- P. Gustafson, Meanings of Place: Everyday Experience and Theoretical Conceptualizations. Journal of Environmental Psychology, 21, 5-16, (2001).

[65] A.R.T., Mourão, S Cavalcante. Identidade de Lugar. em: C. S. Cavalcanti, G.A Elali. Temas Básicos em Piscologia Ambiental. Petrópolis: Vozes, 2011. 318p.

[66]V. H. M Bins E., A. S. D Oliveira. A. Acessibilidade em Edifício de Uso Público: Contribuição de Projeto de Extensão na Elaboração de Dissertação. in: PROJETAR 2005 – II Seminário sobre Ensino e Pesquisa em Projeto de Arquitetura, Santa Catarina, 2005.

[67] P Jordan. AnIntroductiontoUsability. Philadelphia: Taylor & Francis Group, 2002.

[68] J Nielsen. What is usability? In: W. Chausney - User Experience Re-Mastered. Your Guide to Getting Right Design. San Francisco: Morgan Kaufmann, 2009, p. 3-22.

[69] L. Sauvé. Educação ambiental: possibilidades e limitações. Educação e Pesquisa, São Paulo, v. 31, n. 2, p. 317-322, maio/ago. 2005.