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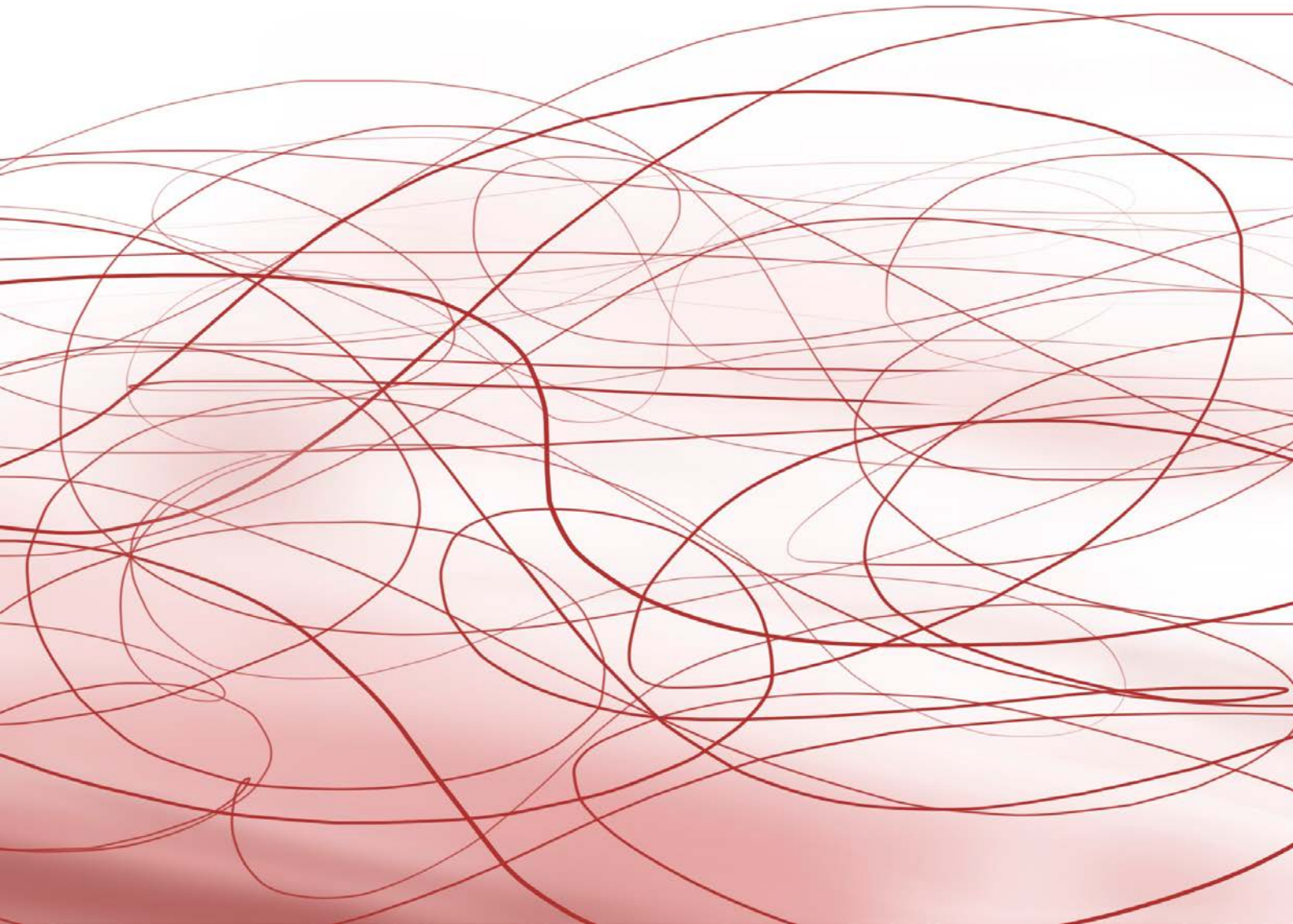

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Table of contents

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WEBSITE ACCESSIBILITY OF TRAVEL AGENTS: AN EVALUATION USING WEB DIAGNOSTIC TOOLS

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***Abstract*:** Travel agents (TA) play an important role in the tourism system, providing information and intermediating the purchase of tourism products. The relevance of these players is higher to the accessible tourism market, due to the various environmental, attitudinal and informational constraints that people with disabilities (PwD) face in carrying out a tourism trip. To overcome some of the information constraints, communication channels, such as websites, used by TA, should be accessible for all people, regardless of their psychological and physical abilities. To accomplish this aim, in this study the website accessibility of (TA) located in the Central Region of Portugal was examined. Based on the Web Content Accessibility Guidelines (WCAG) 2.0, a sample of 182 websites was analyzed, considering the three-conformance level of WCAG (A, AA and AAA) and using two automatic evaluation tools (AccessMonitor and "Test de Accesibilidade Web"—TAW). Results show that the websites of TA reveal several problems in relation to accessibility, particularly in the basic accessibility requirements (level A of the WCAG). Moreover, several problems were identified, mainly in the perceivable and robust principals. The paper ends with some guidelines to increase the level of web accessibility of TA.

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Keywords: Travel agencies, Accessible tourism, People with disabilities, Web accessibility.

Introduction

Although several international, European and national laws and regulations highlight the right of people with disabilities (PwD) to have access to tourism activities, unfortunately, "tourism for all" is still not a reality. There are a high number of PwD that face several travel constraints which prevent them from participating in tourism activities (Allan, 2015; Daniels, Rodgers, & Wiggins, 2005; Devile & Kastenholz, 2018; Evcil, 2018; Figueiredo, Eusébio, & Kastenholz, 2012; Mckercher & Darcy, 2018; Poria, Reichel, & Brandt, 2009; Portales, 2015; Smith, 1987; Tao, Goh, Huang, & Moyle 2019; Kong & Loi, 2017). To increase the participation of PwD in tourism activities, it is of utmost relevance that all tourism supply agents offer accessible services. Although various improvements in terms of accessibility have been included in the tourism products offered by supply agents in recent decades, there are still many barriers, mainly attitudinal and informational, that need to be removed to increase the participation of PwD in tourism activities (Figueiredo et al., 2012). Travel agents (TA) play a vital role in the tourism industry, through the commercialization of tourism products, as well as for their role in representing a relevant information source to plan a tourism trip. In the case of PwD, the importance of TA is higher when compared with people without disabilities, given that their risks related to tourism trips are higher, and they face higher travel constraints. Therefore, all TA must be committed to the accessibility of their products (McKercher, Packer, Yau, & Lam, 2003; Özogul & Baran, 2016; Ozturk, Yayli, & Yesiltas, 2008; Teixeira, Eusébio, & Silveiro, 2019). However, the limited literature published concerning the accessibility of products offered by TA (e.g. McKercher et al., 2003; Özogul & Baran, 2016; Ozturk et al., 2008; Teixeira et al., 2019) show that various improvements should be

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

introduced to make the services of these tourism supply agents accessible for all.

The accessibility of TA depends on the physical accessibility of their facilities and products, as well as of the accessibility of information that they disseminate. Nowadays, the Internet is one of the most often used channels to disseminate information and to communicate with potential consumers in all tourism activities (Dinis, Eusébio, & Breda, 2020), including TA. Therefore, studies that analyze the accessibility level of information that TA disseminated through the Internet should be developed to identify improvements that are required to make this information accessible for all, independently of the personal and functional characteristics of the users. However, the studies in this field are very scarce (Teixeira et al.,2019; Dinis et al., 2020; Silveiro, Eusébio, & Teixeira, 2019). To overcome the research gap in this area, this study aims to examine the website accessibility of Portuguese TA located in the Central Region of Portugal and, based on Web Content Accessibility Guidelines (WCAG), propose revisions that should be introduced by web designers and developers to increase the web accessibility level of TA. Therefore, this paper intends to contribute to expanding knowledge on web accessibility of one important tourism supply agents with a crucial role in the travel planning process. The identification of problems in terms of accessibility level provides relevant insights related to communication and interaction with people with disabilities. Based on the issues identified, it is possible to define strategies to overcome these problems, contributing to facilitate the travel planning process of people with disabilities, and consequently encourage tourism for all.

To achieve the objectives mentioned above, the present paper is structured into five sections. After this introduction, a literature review concerning the role of TA in the promotion of tourism for all and about the web accessibility level of TA is presented. In the third section, the methodology used to select the websites analyzed and to examine the accessibility level of these websites is described. Chapter four presents the results obtained in the empirical study

carried out and some suggestions for improving the web accessibility level of the TA analyzed. Finally, the paper ends with the most important conclusions obtained, theoretical and practical contributions, limitations and further research.

Literature Review

The role of travel agents in the development of tourism for all

Although tourism is currently one of the most important economic growth activities worldwide, contributing 10% of the total employment and 10.2% of the total gross domestic product (GDP) (World Travel &Tourism Council, 2018), there are a significant number of people who do not have access to tourism activities (Darcy, 2010; Devile & Kastenholz, 2018; Lee, Agarwal, & Kim,2012). However, when people have access to tourism experiences, their quality of life and well-being tends to increase (Eusébio & Carneiro, 2014). Therefore, all barriers that prevent people from participating in tourism activities should be removed, not only due to legal obligations and social responsibility, but also because it represents a significant business opportunity. Despite all people facing travel constraints when carrying out tourism trips, some groups, specifically people with disabilities (PwD), face a higher number of travel constraints that prevent them from enjoying tourism experiences. However, this is an important growth market, representing about 15% of the world population (WHO, 2011). According to a study carried out by the European Commission (EC, 2014), in 2011, the number of people with access needs in the European Union was 136.8 million. In Portugal, the latest census (2011) showed that about 17.8% of the population have some difficulties in carrying out their daily activities (INE, 2011). The current size of the group of PwD, as well as its growth forecast due to population ageing, show that this marked increase should not be ignored. Moreover, it is an essential market for decreasing the seasonality level of tourism destinations and increasing the

economic benefits of the tourism industry, given that it is a loyal market that frequently travels in groups in low season and for long stays (Daniels et al., 2005; Dickson, Darcy, Johns, & Pentifallo, 2016; Kastenholz, Eusébio, & Figueiredo, 2015; Ozturk et al., 2008).

Accessible tourism, also frequently labelled "tourism for all", was developed to increase the participation of PwD and other people with special needs in tourism activities. Therefore, "accessible tourism enables peoples with access requirements, including mobility, vision, hearing and cognitive dimensions of access, to function independently and with equity and dignity through the delivery of universally designed tourism products, services and environments" (Darcy & Dickson, 2009, p. 14). To promote accessible tourism, all tourism supply agents (e.g. accommodation, transport, restaurants, museums, monuments, theme parks, tour operators and travel agents) should be involved in the development of adapted environments, products and services. However, the literature has revealed that a significant number of tourism destinations and tourism products offered are not accessible (Darcy, 2010, 2012; McKercher et al., 2003; Ozturk et al., 2008). As Buhalis and Michopoulou (2011, 164) state PwD are "one of the market segments that have been neglected by the tourism industry is the accessibility market". Moreover, the promotion of accessible tourism also requires that the person responsible for the development and management of tourism destinations and the tourism supply agents of these destinations should provide detailed, accurate and comprehensive information concerning the level of accessibility of their environments and services (Buhalis & Michopoulou, 2011).

In the tourism industry, TA have an essential role in the development of tourism for all. As McKercher et al., (2003, p.445) mention, this tourism supply agent remains "the primary source for people with disabilities to purchase travel products". The high relevance of this intermediary in the purchase of tourism products to PwD is related to the fact PwD face higher risks than people without disabilities. Therefore, all TA should provide physical accessibility in their environments and products, as well as information about

their accessibility level. However, as Michopoulou and Buhalis (2013) emphasize, although there is legislation in many countries that establishes the minimum requirements for ensuring the accessibility of buildings, information concerning these issues is often lacking or neglected.

Despite the relevance of TA in the development of accessible tourism, the literature in this field is very scarce. The few studies published (e.g. McKercher et al., 2003; Kim & Lehto, 2012; Ozturk et al., 2008; Özogul et al., 2016) clearly reveal that PwD are largely dissatisfied with the performance of TA in terms of accessibility. Mckercher et al. (2003) investigate if TA in Hong Kong are prepared to meet the needs of PwD and show that the TA are not prepared to cater for the needs of these people. On the same line, the Ozturk et al. (2008) study examines the perspective of TA about the ability of the Turkish tourism industry to meet the needs of people with physical disability. It was observed that, despite Turkish TA being willing to play a part in accessible tourism, these tourism supply agents have several weaknesses in terms of accessibility (e.g. staff work have insufficient knowledge to serve people with physical disabilities, lack of detailed information on travel opportunities and about arrangements for people with disabilities on their web pages) that should be overcome. Finally, Özogul and Baran (2016) analyze the relevance of specialized TA in meeting the needs of PwD. No studies are known concerning the accessibility of the information that is disseminated by TA. With the development of information and communication technologies (ICT), specifically the Internet, tourism supply agents, including TA, started to use various online communication channels such as websites and social networks. Therefore, it is of utmost importance that these online communication channels may be used for all people, independently of their personal situation or conditions of access. Consequently, TA and their websites should be completely accessible to facilitate the purchase of tourism products by PwD. Thus, if TA use accessible online communication channels, this may contribute to increased participation of PwD in tourism activities. In contrast, a non-

accessible online communication channel of TA may create obstacles to this participation.

Web accessibility of travel agents

The growth of ICTs and their role in the world of business has justified their widespread adoption by different types of people. In the tourism industry, ICTs can represent an important driving force in the current information society, since they enable new distribution channels and consequently promote new business environments.

The Internet represents the universal technology used by the majority of the population in the most varied contexts, with the web being one of the most often used services as a source of information. Specifically, in the tourism industry, the Internet has a crucial role in the dissemination of information, providing their clients with details about destinations, accommodation, transport, activities and other kinds of attractions of interest to the tourists (Domínguez Vila, Alén González, & Darcy, 2017). Also, the easy access to online content through the web contributes to the growing use of this kind of ICTs by tourists to plan holidays, trips and/or activities in a more independent way. Thus, the web represents an opportunity for TA to promote their role as global intermediaries and consultants offering integrated, high-quality travel solutions (Manente, Minghetti, & Mangilli, 1998, in Lang, 2014), and to create an online presence, boosting the promotion of their products for a geographically broader market and at a relatively lower cost (Needham, 1996; Travelweek 1997; Glab, 1995; Sheldon, 1997, in Lang,2014).

According to the inventor of the World Wide Web—Tim Berners-Lee—the power of this high technology is in its universality and in the principle that all people, regardless of their condition and disability, must have access to the information made available therein (Shawn & McGe, 2020). However, the information on the web does not reach all users in the same way, with this difference being furthered not only by the technology used to visualize the

web content, but also by the physical and mental conditions of the web users. There are a significant number of people that have some kind of disability, including motor (e.g. limited use of hands), sensory impairments (e.g. hearing and vision), or cognitive (e.g. learning disabilities) (Lazar, Dudley-Sponaugle, & Greenidge, 2004), which makes access to some kind of web functionalities and information more difficult.

Web accessibility is defined as the degree to which a site allows access to the largest possible range of users, including PwD or people that experience some kind of environmental constraints (Akgul & Vatansever, 2016; Mankoff, Fait, & Tran, 2005). However, to correctly access information on the web, some groups of PwD need to use assistive or add-on technologies, such as voice recognition, alternative pointing devices, screen readers, refreshable braille displays, and alternate keyboards (Paciello, 2000 in Buhalis &, Michopoulou, 2011). When the content on the web (e.g. websites) are designed and developed appropriately, the accessibility level improves and PwD can access the information more easily, eliminating certain kinds of difficulties and barriers.

To help in this matter, the World Wide Web Consortium (W3C) (W3C, 2018) created the Web Content Accessibility Guidelines (WCAG), one of the most important standards to support developers in making their websites more accessible; these guidelines are available in several versions—WCAG 1.0 (published in May 1999), WCAG 2.0 (published in December 2008), and WCAG 2.1 (published in June 2018) (W3C, 2018). The first public working draft of WCAG 2.2 has already been announced in February 2020 (W3C, 2020). Following these guidelines, it is possible to make web content more accessible to more people, regardless of their skills or knowledge, including people that may have some kind of disability or technical limitations (Akgul & Vatansever, 2016).

Especially in the case of WCAG 2.0, it was approved as an ISO/IEC 40500 international accessibility standard in October 2012 and is composed of 12

guidelines that are grouped into four general principles, i.e., perceivable, operable, understandable and robust (Akgul & Vatansever, 2016; W3C, 2018; Domínguez Vila et al., 2017; Mankoff et al., 2005; Domínguez Vila, González, & Darcy, 2018).

- Principle 1 (perceivable): the information and the components of the user interfaces must be present in a perceivable format to users, in ways they can perceive, regardless of their condition.
- Principle 2 (operable): the navigation process and the user interface components must be operable.
- Principle 3 (understandable): the operation of user interface and the information must be comprehensible.
- Principle 4 (robust): the content on the web must be robust enough in order to facilitate the integration of a wide variety of user agents, including assistive technologies.

Each of these principles has several guidelines, and each guideline can be evaluated using one or more success criteria, according to one of the three levels of conformity: (i) A—the minimum level with basic accessibility; (ii) AA—intermediate accessibility, which includes level A and adds the AA success criteria; and (iii) AAA—high accessibility, when it satisfies all of levels A and AA and adds a set of requirements related to AAA success criteria (W3C, 2018).

In order to assess good practices in web design and programming, there are a significant number of automatic tools, that represent software programs that can be used to check the website's accessibility level, considering the WCAG (Akgul & Vatansever, 2016). In fact, it is possible to find a vast number of automatic tools, commercial or open access, for analyzing websites, such as AccessMonitor, A-Prompt 1.0, AChecker, Amp, Bobby, EvalAccess 2.0, eXaminato, HERA, MAGENTA 2.0, TAW, WAVE, among others (Domínguez Vila et al., 2017). A list with 140 accessibility evaluation tools can be found in W3C (W3C, 2019).

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

Despite the vast number of automatic assessment tools, few studies have been carried out on this subject, specifically in the tourism field (Shi, 2006; Mills, Han, & Clay, 2008; Kuzma, Yen, & Oestreicher, 2009). However, more recently, some relevant studies have emerged which analyze website accessibility (Akgul & Vatansever, 2016; Domínguez Vila et al., 2017, 2018) For example, the study by Domínguez et al. (2017) analyzes the accessibility of official tourism websites from 210 countries based on WCAG 2.0. The results revealed that, despite the effort to provide accessible websites, there are still countries that should rethink their strategy regarding online accessibility, particularly in terms of compatibility with assistive technologies, navigability, adaptability and textual alternatives. Also, the study of Domínguez et al. (2018), which analyzed the accessibility of official tourism websites in a group of European countries, based on WCAG 2.0, to examine whether the policies and regulations related to accessibility online information are applied correctly, concluded that the countries with the worst results in terms of online accessibility, in a decrease order, were: Norway, Germany, United Kingdom and Finland. Very few studies have been found on TA related to the accessibility of websites (Teixeira et al., 2019; Silveiro et al., 2019), which increases the need for studies on this area, such as that described in this paper.

Methodology

Data collection methods

To analyze the accessibility of TA websites, the methodology used followed a multistage procedure. First, to identify Portuguese TA, the National Register of Travel Agents and Tourism (RNAVT) database from the National Registry of Tourism of Portugal[1] was accessed. Based on this database, 2,557 TA located in Portugal were identified. From these, 289 (11.3% of the total) are located in the Central Region. Secondly, to collect the websites' URL of the 289 TA, a search was performed on Google through the name (and brand), the address and contacts (telephone/mobile and email). Only 192 out of 289, which represent 66.44%, have a website, while 41 TA (14.19%) have no websites but have a Facebook page. The remaining 56 TA, which represent 19.38%, have neither a website nor Facebook and are therefore not considered in this study. Finally, 12 websites were merged into two because they belong to a network of agencies that use the same platform (website). Therefore, a total of 182 websites were analyzed in the present study, in February of 2019.

Data analysis methods

To analyze the data for this study that aimed to analyze the website accessibility of the TA located in the Central Region of Portugal, a literature review of published scientific papers on website accessibility (Kuzma, Yen, & Oestreicher, 2009; Akgul & Vatansever, 2016; Domínguez Vila et al., 2017; 2018) was performed. Based on this result, the most referenced tools to evaluate website accessibility were obtained. To complement this approach, a search on Google to identify tools that have been used to examine the

[1] - https://rnt.turismodeportugal.pt

accessibility of Portuguese websites also was conducted. From these two steps, a set of tools with potential interest to be used in this research was examined. Thus, considering the features of the tools analysed, namely their representativeness in terms of use in this kind of studies (Mankoff et al., 2005; Domínguez Vila et al. 2018), their performance, and their free-access characteristics, AccessMonitor and the 'Test de Accesibilidad Web' (TAW) were selected to perform this study.

AccessMonitor[2] is an automatic tool provided by the Foundation for Science and Technology in Portugal that works according to WCAG 2.0, and the results are presented based on an accessibility report and a quantitative scale (AccessMonitor index). The values of the global index range from 1 (very poor web accessibility practices) to 10 (excellent web accessibility practices).

The TAW[3] is also an automatic online tool that checks the level of accessibility from a website based on WCAG 2.0 and presents the results in three categories: problems, warnings and not reviewed. In this study only problems and warnings were examined. To classify problems and warnings, the TAW tool uses the three conformance levels (A, AA, AAA), which were applied to assess web accessibility.

[2] - www.acessibilidade.gov.pt/accessmonitor/

[3] - www.tawdis.net/

Findings and discussion

Characterization of the websites analyzed

A sample of 182 websites of TA located in the Central Region of Portugal were analyzed in this study, using two automatic evaluation tools (AccessMonitor and TAW). The results presented in Table 1 show that the majority of TA are located on the coast (71%), while only 7% of TA are located inland (Beiras e Serra da Estrela and Beira Baixa). Concerning the year of registration on the RNAVT platform, after the year the platform was created (2011), it was in years 2013 and 2018 that more TA were registered. This increase may be related to the growth of tourism activity that occurred in Portugal in these two years.

Table 1: Location of the TA analyzed.

Location			**Registration in the RNAVT**		
NUTS III	**Number of websites**	**% of total**	**Year of registration**	**Number of websites**	**% of total**
Beira Baixa	4	2.20%	**2011**	83	45.60%
Beiras e Serra da Estrela	10	5.49%	**2012**	7	3.85%
Médio Tejo	25	13.74%	**2013**	20	10.99%
Oeste	36	19.78%	**2014**	9	4.95%
Região de Aveiro	22	12.09%	**2015**	11	6.04%
Região de Coimbra	*37*	*20.33%*	*2016*	*13*	*7.14%*

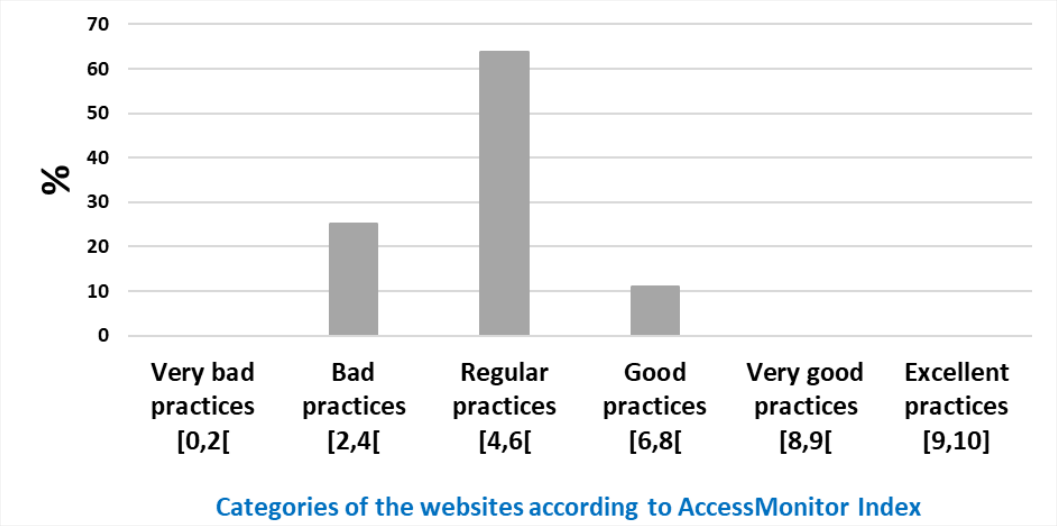
Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

Location			Registration in the RNAVT		
Região de Leiria	34	18.68%	**2017**	16	8.79%
Região Viseu - Dão Lafões	14	7.69%	**2018**	23	12.64%
Total	**182**	**100%**	***Total***	**182**	**100%**

Level of web accessibility of TA using AccessMonitor

The results of AccessMonitor (Table 2) reveal a low level of web accessibility of TA. The majority of websites analyzed do not meet the levels of web accessibility required to be used by PwD. The global AccessMonitor Index varies between 1 (very bad practices) and 10 (excellent practices) and in this study, 2.8 was the minimum value obtained and 7.3 was the maximum, with a mean of 4.77. As can be observed in Figure 2, a significant number of websites examined (64%) are classified as regular practice (index between 4 and 5), only a limited number of websites (11%) are classified as good practice (index between 6 and 7) and 25% of the websites analyzed are classified as a bad practice (index between 2 and 4). There are no websites classified as very good practice (index between 8 and 9) or with excellent practice (index 10).

Figure 1: AccessMonitor Global Index of Travel Agents' Websites



The number of errors identified on websites analyzed clearly reveal that PwD have great difficulty in obtaining information on the websites of TA. On average, 9.74 errors were detected on each website, with a maximum of 18 errors and a minimum of zero (Table 2). Regarding the degree of conformity (A, AA and AAA), the websites examined do not meet the minimum required in terms of accessibility (degree of conformity A), with an average of 7.14 errors for each website. Concerning the degrees of conformity AA and AAA, there is a maximum of 3 errors in both (and a minimum of zero). However, the degree of conformity AAA presents a higher average of errors for each website analyzed (1.57 errors).

Table 2: Results of AccessMonitor: Global Index and Errors

Stat.	AccessMonitor Index	Errors Level A	Errors Level AA	Errors Level AAA	Total (A + AA + AAA)
Mean	4.77	7.14	1.03	1.57	9.74
SD	0.982	3 090	0.783	0.849	3 696
Min	2.8	0	0	0	0
Max	7.3	14	3	3	18

From the 182 websites analyzed, results also reveal that 99.45% have type A errors,74.73% have type AA errors, and 86.26% have type AAA errors. Therefore, in terms of compliance with WCAG 2.0, only 0.55% of the websites analyzed (equivalent to only one website) are in accordance with the lowest level of accessibility (level A) of WCAG 2.0, revealing that all the remaining 181 websites present problems in terms of accessibility which make it difficult for PwD to access information when planning their tourism trips. These results are in line with other studies that have used the AccessMonitor to evaluate the level of web accessibility (e.g. CEFA, 2012; Unidade ACESSO, 2013; IPL, 2018), revealing that the designers and programmers of the websites of TA should comply with WCAG to reduce travel constraints that PwD face in terms of information to participate in tourism activities. The information divulged by TA through their websites should be accessible to all people, independently of their needs, preferences, skills, and personal situations or conditions of access. Moreover, these results are also in line with those found in the study by Akgul and Vatansever (2016). They concluded that the vast majority of the websites analyzed—from the Turkish government—did not meet the minimum levels of web accessibility requirements.

Level of web accessibility of TA using TAW

The results presented in Table 3 were obtained with the TAW, concerning the three conformance levels (A, AA and AAA) of WCAG 2.0. On average, in each website analyzed, 124.52 problems were identified, with a standard deviation (SD) of 183.47, and 256.35 warnings (a possible problem that requires a human review), with a SD of 306.87. All websites have problems and warnings that should be removed to make these websites accessible to PwD.

Concerning the four principles of the WCAG 2.0 (perceivable, operable, understandable and robust), the perceivable and robust principles reveal the highest average of errors identified, both in terms of problems and warnings. In contrast, the understandable principle presents the lowest mean in terms of problems detected (21.21) as well as in terms of warnings (20.60). These

results reveal clearly that various interventions should be carried out on the websites of TA to increase their accessibility level.

Table 3. Problems and warnings identified with TAW

TAW	Principles	Min	Max	Mean	SD
Problems	Perceivable	**0**	260	41.70	64.71
	Operable	0	164	22.19	28.23
	Understandable	0	218	21.21	53.12
	Robust	0	254	36.84	56.83
	Total	2	722	124.52	183.47
Warnings	Perceivable	0	1391	105.62	158.00
	Operable	1	256	38.76	43.64
	Understandable	0	96	20.60	18.48
	Robust	1	1287	77.08	169.77
	Total	1	2716	256.35	306.87

A more detailed analysis of the problems identified in the websites of TA analyzed (Tables 3 and 4) show that the perceivable principle is the most critical issue with an average of 41.70 errors for each website analyzed. The "text alternatives" and "adaptable" guidelines have several problems, with an average of 22.43 and 19.27 errors for each website, respectively. A high number of the websites do not accomplish the following success criteria: (i) non-text content of the pictures, (ii) no caption; (iii) no audio description or media alternative; (iv) no colour contrast; and (v) no sign language. Therefore, the programmers and web designers of these websites should urgently introduce changes in the websites regarding the information and user interface components to facilitate the access by PwD.

The robust principle was the second principle where more problems were identified (mean = 36.84), revealing, for example, that people that use

assistive technologies to access the content of websites have many difficulties accessing the information that travel agencies disseminate through their websites (Tables 3 and 4).

Table 4. Problems identified with TAW categorized in principles and guidelines

Principles	Guidelines	Min	Max	Mean
Perceivable	1.1. Text alternative	0	174	22.43
	1.2. Time-based media	0	0	0
	1.3. Adaptable	0	133	19.27
	1.4. Distinguishable	0	0	0
Operable	2.1.Keyboard accessible navigable	0	140	2.65
	2.2. Enough time	0	1	0.10
	2.3. Seizures	0	0	0
	2.4. Navigable	0	150	19.52
Understandable	3.1. Readable	0	1	0.51
	3.2. Predictable	0	14	0.59
	3.3. Input assistance	0	215	20.10
Robust	4.1 Compatible	0	254	36.84

Table 5: Warnings identified with TAW categorized in principles and guidelines

Principles	Guidelines	Min	Max	Mean
Perceivable	1.1. Text alternative	0	92	16.82
	1.2. Time-based media	0	9	0.50
	1.3. Adaptable	0	775	52.02
	1.4. Distinguishable	0	1172	36.74
Operable	2.1. Keyboard accessible navigable	0	140	53.75
	2.2. Enough time	0	0	0
	2.3. Seizures	0	0	0
	2.4. Navigable	1	256	36.15
Understandable	3.1. Readable	0	0	0
	3.2. Predictable	0	91	7.31
	3.3. Input assistance	0	82	13.29
Robust	4.1 Compatible	0	1289	77.08

The operable principle occupies the third position in terms of problems, with an average of 22.19 for each website. The user interface components and navigation of all websites must be operable to make information available to all people. However, the results obtained in this study reveal that the websites of TA present several problems concerning navigable guideline (mean = 19.52) and the "keyboard accessible navigable" guideline (mean = 2.65) (Table 4). Consequently, the users have several difficulties finding content and navigating the website. The "focus order", "link purpose" and "section headings" are the success criteria under the "navigable" guidelines with the most errors. Therefore, in terms of "focus order", when the users navigate sequentially through the content of the websites, they face constraints to finding information in a way that makes sense and has meaning for the user. Problems concerning the "link purpose" success criterion contributes to users

having difficulty understanding the purpose of each link to decide which link to use. Moreover, problems in this success criterion also hinder the use of assistive technology to provide users with the list of links that are on the website. Problems in terms of the "section headings" success criterion contribute to users having more difficulty understanding what information is available on the website and how this information is organized. Therefore, the headings on websites must be clear and descriptive to facilitate access to the information provided for PwD in TA websites.

Finally, although the understandable principle shows the lowest number of problems (mean = 21.21), the websites analyzed have several problems concerning the "input assistance" guidelines (mean = 20.10), specifically problems related to the success criterion "labels or instructions" (Tables 4 and 5). This success criterion intends to provide information or instruction to help users to explore the information provided on the websites without confusion.

The results obtained in terms of warnings are in line with those obtained in terms of problems (Tables 3 and 5). However, some differences may be identified again, the perceivable principle represents the highest average of incidents (mean = 105.62), followed by the robust principle (mean = 77.08), with the understandable principle emerging as that with the lowest number of incidents (Table 3). However, differences in the guidelines that are of the greatest concern were observed. For example, in the case of the perceivable principle (Table 4), no problems were detected concerning the distinguishable guideline; however, a significant number of warnings were detected (mean = 36.74) (Table 5). This result reveals that those responsible for the development of websites must introduce changes in TA websites to make it easier for PwD to see and hear the content of the websites, separating the foreground information from the background. When the websites permit users to separate foreground and background information, web-based information accessibility increases; for example, in the case of audio presentations, the foreground sounds should be louder than the backgrounds sounds, while in the case of visual presentations the information presented on the top of a

foreground must contrast with the information presented on the background. Compliance with this guideline is of utmost importance to facilitate access to TA websites, principally for people with visual disabilities as well as people with hearing disabilities.

Despite no study being identified that uses TAW to analyze the web accessibility of TA websites to compare the results obtained in this study, studies carried out in other types of organizations, such as the study undertaken by Domínguez et al. (2017) on official national tourism organizations and Adepoju, Shehu, and Bake 's (2016) study on government websites in Nigeria, also observed that the perceivable and robust principals were the most critical in terms of incidents registered. Moreover, the present results are also in line with those of the studies by Shi (2006) and Mills et al., (2008) who concluded that the websites analyzed failed in at least one WCAG criterion, making it difficult for users with some type of disability or special need to access and correctly navigate on the websites.

Although many countries have recently introduced specific legislation to implement web-based information accessibility (Roig-Vila, Ferrández, & Ferri-Miralles, 2014), their practical applications are still very unsatisfactory. Nowadays, a high number of web designers and programmers have been neglecting the principles of "design for all". This position has affected a large number of PwD who do not carry out a tourism trip because they face several constraints to obtaining the information they need from travel agencies' websites to plan their trips. In this context, as Roig-Vila et al. (2014) highlight, web-based information accessibility is "not only a necessity but also an ethical, social, political and legal commitment to be assumed by society".

Conclusions

This paper presented the results of an evaluation of the accessibility of 182 websites of TA located in the Central Region of Portugal using two automatic

evaluation tools. The findings show that a significant part of these websites does not address the issue of web accessibility, considering the conformance levels of WCAG, which include: (i) the basic requirements (A); the requirements that, although they do not represent a problem, can make access to information difficult (AA), and the requirements that may be addressed to web developers to improve access to website documents (AAA).

In general, the results revealed a low level of web accessibility of TA with the majority of websites analyzed without the accessibility which is required to be used by PwD. The results of AccessMonitor allow the websites to be classified as following regular practice, but there are a significant number of websites classified with bad practice, and no websites were classified as having very good practice or excellent practice. The results of TAW show a higher level of incidents in the principles: perceptible and robust, with understandable principle having the lowest average of errors identified, corroborating other studies in this field.

Given the conformance level, both tools used in this study detected a higher number of errors at level A (lowest level of compliance), followed by level AAA (highest level of compliance) and finally level AA. In fact, this reveals that many of the websites do not meet the basic requirements of web accessibility, which increases the difficulties and barriers for PwD using these websites.

In order to make the websites more accessible, complying with the requirements endorsed by the WCAG, and with some techniques considered as good practices (W3C, 2018), it is crucial to consider some recommendations, including: (i) providing text alternatives for any non-textual content to make the switch to other formats possible according to the needs of PwD (such as large print, braille, speech, symbols or simpler language); (ii) maximizing compatibility with current and future devices, including assistive technologies, and (iii) providing a mechanism to request a content update instead of automatically updating.

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Despite the recognised relevance of increasing the level of web accessibility in the tourism industry to promote tourism for all, the number of studies in this area is still very limited. Therefore, this study is considered to make significant theoretical contributions, increasing knowledge in this field, as well as considerable practical contributions. Therefore, the contributions are essentially related to understanding the state of accessibility of the websites of TA located in the Central Region of Portugal and consequently to identify some actions that can be implemented to increase the level of accessibility of TA websites. This study also provides important insights to designers and developers of TA websites to facilitate the access of contents for all people, independently of their needs, skills and conditions of access.

Although the study contributes to the diagnosis and global analysis of the accessibility level of TA websites, some limitations have been found. The first is related to the type of method used to analyze the websites, which were exclusively automatic. So, although this kind of tools makes analysis easy, they usually establish the presence of valid elements or attributes, ignoring the perspective of the people that experience those situations. Another limitation is related to the dynamic nature of the content and information of the websites, which can influence the problems detected according to the period in which the analysis is performed.

Based on these limitations, in future work, we intend to complement this evaluation with the perceptions of the people that experience these conditions (i.e. domain experts), understanding the interactions that occur between the users and the web applications in a real context.

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Journal of Accessibility and Design for All

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INTEGRATING BEHAVIORAL RESEARCH IN UNDERGRADUATE DESIGN STUDIO IN ARCHITECTURE FOR DESIGNING INCLUSIVE ENVIRONMENTS

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***Abstract*:** Behavioral research as a part of a design process in an undergraduate design studio in architecture can help bridge the gap between the user needs and design decisions and sensitise the students to the concept of accessibility and social inclusion. This paper presents the process and outcome of three academic design projects in which the students employed behavioural research. The design researches at undergraduate level occurred at different times and with diverse groups of students. The study for the design for the park for the blind used quasi-experimental research while the research for the other two design projects viz.; The project design for the Home for Elderly and the project of designing an Orphanage used case study research employing qualitative strategies of behaviour mapping and in-depth interviews with key informants. The findings which emerged certainly provide the evidence for the overarching hypothesis that behavioural research sensitised the students to the concerns of accessibility and social inclusion and accessibility has to be looked at from both physical and social angles to facilitate inclusion. Hence the model of incorporating design research as part of the design studio proves to be a useful one. Developing empathy in the students towards the disabled and towards those who need social inclusion, can facilitate social inclusion through design. The contribution of the paper

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lies in the development of a framework for design research for undergraduate students of architecture for inclusive design.

Keywords: empathetic, accessibility, social concerns, built environment, design

Introduction

Designers are typically criticised for designing without the knowledge of human behaviour in public realms (Chakravarti, 1993) or assuming a doctrinal stand (Rutledge, 1985). Architects designing in their own image often centralise their own experiences of space and marginalise and negate the experiences of others (Morrow, 2002). Architects many times tend to make decisions about function or aesthetics based upon their own intuition or preconceived ideas. Berleant (1988) noted that designers can encourage or inhibit participation by the design of environments. The gap between demands on the person and the individuals' capabilities can be closed or at least decreased through suitable control over the environment (Kroemner, 2006). It is the responsibility of the designers to create settings which offer "all" the opportunity to realise their different potentials (Lindel, 1991). The mainstream practices of education and standards limit themselves to the conventional spectrum of "normal" excluding numerous user groups and victims of social circumstances (Mostafa, 2013). Hence, designers need to be empathetic to the needs of the users and various user groups.

Behavioural Research For Inclusive Design

Environment behaviour studies are about the interrelationships between behaviour and properties of the manmade environment (Teklenburg, Zacharias, John, & Teresa, 1996) and there is a need for placing more emphasis on "environment-behaviour" studies in architecture schools (Boyer & Mitgang, 1996). Integrating behavioural research in the architectural design

process can help the students to understand the user requirements and after that, prepare a more user sensitive spatial program.

One of the objectives of Architectural Education spelt out by UIA UNESCO Charter [2011] is training in research techniques as an inherent part of architectural learning, for both students and teachers.

Roberts (2007) extends the Healey's model of teaching research nexus to design project stating four paradigms which are as follows:

- *"Research-tutored paradigm" - students apply research findings of their tutors in their project work,*
- *"Research-based paradigm"- students use the design process as a means to advance knowledge,*
- *"Research led paradigm" - students learn about the findings of their tutors' research though not linked to their project work and*
- *"Research-oriented paradigm" - students are encouraged to develop research skills and design enquiry and related information gathering skills through focussed teaching.*

Episodic research (Groat & Wang, 2002) at various stages of the design process helps in design program evolution. In the integrated design paradigm, exploratory as well confirmatory research can be carried out in the rational phase of design and knowledge gained from this research can be applied in the creative phase (Bashier, 2014). The pedagogic model for the design studios described in this paper uses a "research-oriented paradigm" which employs the "exploratory as well as confirmatory research" for understanding the concerns of various users and generating design brief.

Case study is the most commonly employed research method in architecture schools. It is a research method, which can be qualitative, quantitative or can combine both (Groat & Wang, 2002). The researcher embeds oneself in the field, and various methods of data collection can be used, such as talking to users, observation, mapping etc. It enables the students to observe the

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

phenomenon on the setting and learn about the interactions of the users with the setting as well as within them. Case studies are useful to gain insight into past projects to successfully design new ones (Francis, 2001).

Salama (2009) calls for utilising the built environment as an open textbook wherein students can learn about the supportive environment for human behaviour and recommends techniques such as socio-behavioural mapping. Observation is an important and easy tool for the students. Systematically observing behaviour can give an idea about how the environment is used or misused and the way in which design and arrangement of elements result in particular behavioural patterns (Laurie, 1975).

Inclusive design aims to meet the needs of people who have been unable to use mainstream products because of age or disability (Morrow, 2002). Inclusive design education must provide students with knowledge and skills in brief making, participatory methods and environmental auditing (Morrow, 2002). Thus the students must be sensitised about the diverse types of users and their needs and the need for an inclusive design approach. The duty of education is to cultivate and support the human abilities of imagination and empathy (Pallasmaa, 2009). Empathic Modelling enables an individual using of various props and scenarios, to simulate the deterioration of physical and perceptual abilities in everyday scenarios (Nicolle & Maguire, 2003). Consulting experiences of persons with impairment can help gain insights into the gap in the designers' intention and visitors' expectations (Heylighen, Doren, & Vermeersch, 2013).

Behavioural Research In Design Studio: A Study Of Three Cases

The curriculum of the undergraduate course in Architecture emphasises upon accessibility and addressing the social concerns as one of its objectives. Accordingly, the design projects in the studio are planned to focus on some

concern or user group, so that the students are trained to address its specific needs through design. This paper takes a pedagogic review of learning outcome of three research studies [listed in table 1] undertaken by the students of Architecture of the BKPS College of Architecture, Pune [India] and presents findings of each study and its applicability addressing the social concern of inclusivity in the respective settings.

Table 1. List of Case studies

Sr. No.	Design Program	Number of student(s)	Level
01	Park for the visually impaired	36	Third Year B.Arch. Landscape studio
02	Home for the Elderly	40	Third Year B.Arch. Landscape and Architectural design studio
03	Orphanage	01	Final Year Architectural Project

All three researches were primarily undertaken to identify the design issues/challenges in designing settings for the different user groups.

The third-year students underwent an exploratory research to design a park for the visually impaired persons, which employed quasi-experimental method. The other two studies used case study method as a precursor to the design of "Home for the Elderly" and "Orphanage" in which unobtrusive observation and interviews of the gatekeepers and managers of the settings were the tools used for data collection. Following sections describe the three studies separately and then present the pedagogic outcome, and design applicability of the findings.

Case 1: Design of Park for the Blind

Landscape architecture is a compulsory course in the third year of the architecture curriculum in which, along with theory, students are also given design assignments as part of their studio work. The intention of asking the students to design a park for the blind was twofold. Firstly and importantly,

to understand the needs and design considerations for the visually impaired persons to evolve barrier-free public parks. The second objective was to sensitise the students to the non-visual characteristics of the landscapes such as the olfactory, the tactile, the auditory for a holistic understanding of landscape space and its attributes.

The Procedure of the Study

Without briefing the students about the intent of the project they were taken to Saras Baug, an important public park in the city of Pune, Maharashtra State, India [refer figure 1]. The park is characterised by its sunken setting, which is about 5 meters below the surroundings. There is a temple in the centre of the park, surrounded by a shallow pool of water. The park has a peripheral loop of pathway and four cardinal pathways dividing the park into four quadrants. Each quadrant has lawn as a dominant ground plane element and sparse planting. The edges of the park are characterised by stone retaining walls with vegetation.

There were 36 students who were divided randomly into twelve groups of three each. One person from each group was blindfolded and was asked to be barefoot. Blindfolding is one technique to simulate the experience of visual impairment (Nicolle & Maguire, 2003). This student was then asked to take a walk in the park with the help of a group member guiding him/her. The blindfolded student continuously described his/her spatial experience of moving through the park with details like surfaces, sounds, smells, enclosure, openness etc. The third person in the group took down these descriptions in the form of transcripts and logs. A blindfolded walk in the park took around 30 minutes which otherwise would take 10 minutes [refer figure 2].

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

Figure 1. View of Saras Baug – The Research Setting

Figure 2. Blindfolding -Part of the Quasi Experiment

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After this exercise, the students were taken to the classroom and the logs written by them were collected and cross-compared. In all total, twelve logs (one per group) were studied and analysed to find out if there were patterns of perceptions across the twelve logs. Following were the findings based upon the commonality of experiences observed across the twelve logs.

The findings

- It was found to be scary to walk over the grass mounds and one could not gauge the path ahead.
- Curbing of the pathways was creating problems for walking.
- Walking in sun gave the “feeling of expanse”.
- Cobbled stone paving had directional/guiding quality but it was not so with the interlocking blocks.
- Sounds helped in understanding one's location in the park. E.g., sound of vehicles indicated proximity to a road, the sound of birds indicated proximity to trees.

The findings brought forth the “non-visual” perception of space experienced through tactile, auditory stimuli. The students also mentioned that with the eyes blindfolded, they were more alert with respect to the other senses to understand their spatial locations and navigation through the space. This little research, which was a precursor for the design assignment, enabled the students to undertake the park for the visually impaired persons in a compassionate manner.

Case 2: Home for the Elderly

India has always cherished its joint family system wherein almost three generations have been staying together in one house. However, owing to changes in socio-economic realms, a nuclear family system has become common. Hence, elderly persons in the family either have to stay alone with the younger generation moving out to a different house or the elderly move into the homes for elderly – the need for which is growing. In order to

understand the physical and psychological aspects of ageing and design considerations for designing a home for the elderly, a project of Home for the Elderly was assigned to the third-year students.

The students were asked to undertake case study research of five homes for the elderly in the city of Pune. The cases were purposely selected to have diversity in terms of architectural form, type of management (private/public) and funding (admission by payment or charitable). Grant of permissions from the gatekeepers was also a criterion, which governed the selection of the cases.

The Protocols, Ethical considerations and Procedure of Case study.

The managers of the homes were approached for permission with a request letter from the Principal of the college, asking the informed consent and undertaking for non-disclosure of names of the respondents. In all the cases, the students were granted permissions but during specific timings. The students were allowed only to do observations. They were not permitted to talk to the residents.

As manager of one of the home for the elderly mentioned as follows:

"Frequent visits of various study groups disturb the residents and also sometimes they probe into their lives which open up their wounds. As many times staying in these homes is not by choice but due to negligent behaviour of the family members / younger generation".

Accordingly, the students refrained from talking to the residents. Each case was studied for a period of two days. Architectural drawings were procured wherever available and were used for mapping behavioural observations indicating the use of space and user behaviour. Photographs were also taken wherever permissions were granted. Unstructured interviews were conducted with the managers and the supporting staff. Critical understanding of the homes from the perspectives of the residents was not possible due to the restraint, and hence it was one of the limitations of this research.

The findings

Following are the findings derived from the study of the Old Age Homes.

The room typology in the homes varied from dormitories (8-bed capacity) to triple seated rooms (in some cases a double room converted to triple room) to single/double rooms for single persons or couples. It was noted that the rooms had institutional furniture units mostly in steel, which was very not comfortable given the physical needs of the elderly persons who had age-related disabilities such as arthritis, knee joint problems etc.

The verandas/corridors tended to get used more for sitting and interacting by the residents. Of the three cases studied, two homes were ground and the first floor having wheelchair access while the third one was ground and two floors high without any lift or ramp. In the former two cases, residents were using the ground/site freely for various passive as well as active recreational pursuits due to easy access. The case which lacked accessibility inhibited the use of the ground level courtyard by the residents staying on upper floors.

Provision and availability of facilities for recreation, medical clinic etc. depended upon the funding. Open spaces contributed substantially in serving the recreational and health pursuits of the residents. Working in the garden, participating in daily chores etc. helped the residents in developing a feeling of contribution and maintaining mobility and fitness. This further developed feeling of community amongst the residents.

During the discussions with the managers of the home for the elderly, it was noted that living in an old age home was not definitely by choice of the elderly persons. There appeared to be an air of pathos in all the homes. Interestingly one of the old age homes had a crèche for small children where some of the inmate women worked. The presence of small children was a big fillip for adding joy in the otherwise monotonous environment, and the crèche created the opportunity for elderly persons to interact with the outside world.

Having undertaken the study of old age homes, the students were able to develop empathy towards the needs of the elderly persons and were sensitised to the social issue of exclusion of the elderly. Developing connections with the society through the introduction of shared facilities, kids play areas; crèche etc. can create opportunitiesof interaction. An example of one such design is presented in figure no. 3.

Figure 3. Facilities and Spaces in a Home for elderly.Source: courtesy of Ms Karishma Joshi

Case 3: an Orphanage: a Children's Village

A home for the orphan children was final year Architectural Project / Thesis project of a student. The student undertook literature studies, meetings with the experts in the field of child psychology, sociology before embarking upon the case studies. This background research brought forth the difference between an orphanage and a children s village. In an Orphanage, children live together and are looked after by caretakers. They usually have a dormitory with a few common facilities. On the contrary, the unique feature of the

Balgram (*Bal*- children *gram*- village thus - Children's village) concept is a home-like environment. Each house is a self-contained unit. Every child who comes "home" steps into a family which has a caretaker referred as mother and the children are referred as brothers and sisters. Each house has a mother looking after her 8-10 children. Within the family, each child is protected and independent. S/he enjoys a sense of belonging and forms lifelong bonding with the inmates. Having realised this difference, the student decided of designing a children's village and accordingly selected cases three for her research.

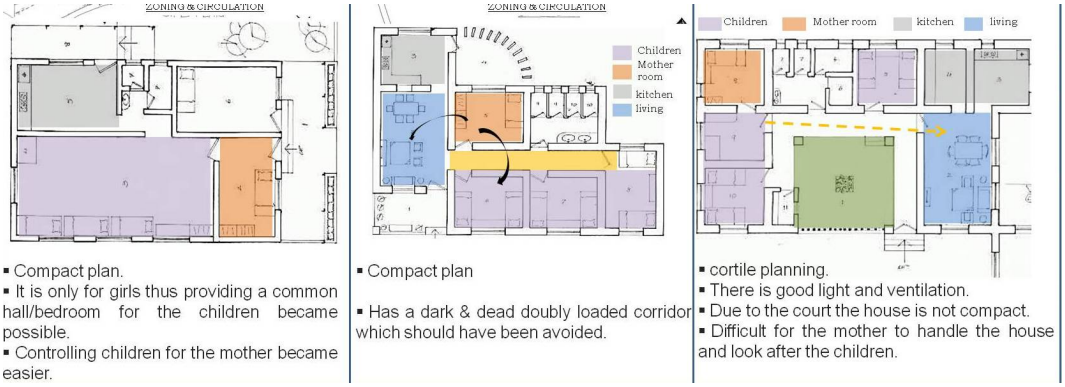
The Protocols, Ethical considerations and Procedure of Case study

Prior permissions were sought from the administration of the children's villages. Since this was a research study of a single student (unlike the group study of the home for elderly mentioned case 2) seeking permission was much easier and at none of the three cases, entry was denied. However, as a research ethic, it was decided to not to ask any personal questions to the children but limit the items only to the activities they do and the spaces they use. Observations were recorded in the form of field notes and sketches. Roughly, two days were spent in studying each case. Unstructured interviews were conducted with the mother, the administrative heads and the managers.

The findings

All the three cases studied had sprawling layouts of family cottages connected by a path. This kind of spatial arrangement afforded open spaces between the cottages and at campus level. The open spaces in the proximity of the cottages were used by the children for studying, playing, etc. The campus-level open space was a common ground for various activities ranging from community prayers, informal play, sports, cultural activities etc. Field observations revealed that the spaces between the cottages and at the campus level were settings for interactions between the children and informal learning.

Figure 4. Comparative study of Homes for Orphan Children. Source: courtesy of Ms Sarvari Harpale



In the analysis of an individual cottage, it was found that proximity of the mother's room to the children's room was necessary to have visual as well as physical control of the mother over the children. Case 1 had a large hall with a mother staying in the same hall [on the extreme left in Figure 4]. Case 2 had a compact plan with rooms of mother and children close to one another along a double-loaded corridor [in the centre in figure 4]. Case 3 had a cortile plan with rooms around it [on the extreme right in figure 4]. In the former two cases, it was easier for the mother to look after the children while in the third it was difficult due to the courtyard in the centre. The double-loaded corridor in the second case was ill-lit and ill-ventilated. The courtyard in the third case was a pleasant open space for various activities.

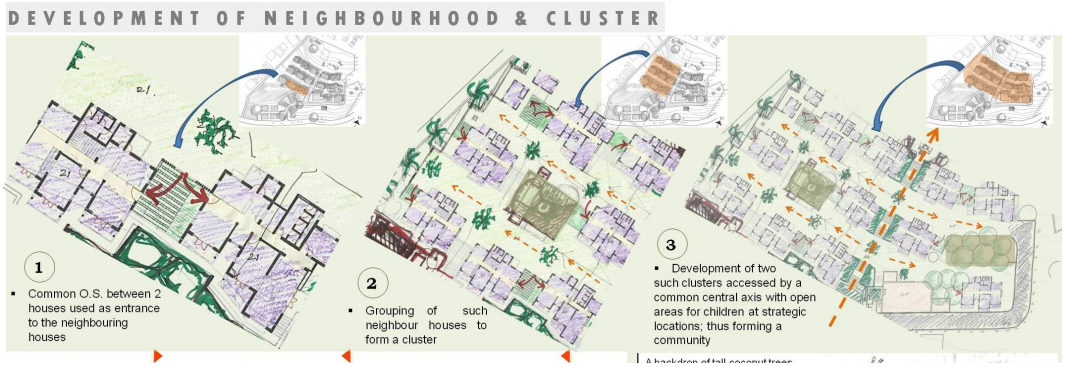
All the three cases had recreational facilities, studying facilities, health centre within the campus. As a rule, these children's villages are generally located in closer proximity of a neighbourhood so that they can be provided schooling in that neighbourhood. Apart from this consideration, it was understood from the managers of these campuses that the proximity provided them the opportunity to mix with society and participate in the community festivals and programs.

One crucial aspect came up from the discussions in all the three centres that these children have a desire to personalise their own space. In the rooms, the children drew pictures on walls, put pictures, and wanted to have pets and so

on. In one of the case, rabbits, dogs, cats were kept on the campus that the children really loved.

Though the student started her topic as an orphanage, her study guided her to revise and redefine her project as “Children’s village”. She realised that the architects could facilitate bonding between the otherwise “lone strangers” through unit design and creating opportunities for interaction. In addition, foster a sense of belonging in the children. To promote social interactions between the children at the cluster level as well as the neighbourhood level, the student planned hierarchy of open spaces in the project proposal [Refer figure 5]

Figure 5. Hierarchy of open spaces to promote social interaction on the campus in the proposal of the Children's' Village. Source: courtesy of Ms Sarvari Harpale



Findings From The Three Studies

The author being one of the studio teachers in case of all the three design projects could very closely interact with the students and engage with them in the process of research and design. The author could categorise the learnings from these researches broadly in the following heads. These categories are inductive and based upon the discussions with the students in the research process, assessment of the design outcomes and the feedback given by the students and other teachers involved in the studio.

- Evolving the Design Program and Intent

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

- Design development
- Learning Process and Outcome

Evolving the Design Program and Intent

The research studies in all the three cases were “episodic” as Groat and Wang (2002) refer to it, and they were undertaken with the aim of program formulation and evolving the design intent. In the case of the park for the blind persons, students were initiated to understand the non-visual characteristics of the landscapes. They were in a better position to employ landscape elements for other than visual qualities for better appreciation and perception of the landscapes by the persons with visual impairment.

In the project of designing old age homes, apart from the understanding of physical accessibility needs of the elderly, the students came up with the finding that the elderly need social contact. A crèche and community hall was incorporated in the design program so that the elderly would get an opportunity to meet children and society which otherwise in an exclusive elderly housing they would not get. Similarly, in the case of the children’s village, the student identified the need of contact of the orphan children with the society, and hence the student selected a site, which was closer to a neighbourhood and allowed sharing of facilities like playground, an art centre that the children in the adjoining communities could use. The design brief for the children’s village was evolved to create a family cottage wherein a mother with around six girl children of ages 4 to 9 could stay together like a family.

In all the three cases, the students realised that sheer provision of areas in square meter is not enough for the development of an architectural program. Sensitively identifying the psycho-social dimensions of user needs is required for developing the program. During the informal feedback sessions after the academic project was over, students mentioned that the programs helped them to develop empathetic understanding of the social issues and concerns

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

and thus developed design program and intent in response to the issues identified.

Design Development

Though design tends to be an iterative and subjective process (Groat & Wang, 2002) the research study informed the design program formulation and also the design itself. Owing to these, the decisions regarding the development of design were based upon empirical observations and findings.

In the design for the blind, the students used a palette of landscape elements that afforded multi-sensory stimuli. They came up with designs, which allowed ease of movement, offered tactile legibility and avoided elements such as sharp corners, thorny plants, abrupt changes in levels etc. In “The home for elderly”, the students developed schemes which incorporated accessibility features. They also made open spaces accessible from the rooms or corridors so that the open spaces could be accessed effortlessly and elderly could engage with the landscape. Both the Park for the Blind and the Home for the Elderly were projects given to a class of 35 students. However, not all the students succeeded well on design quality but, at least, they were sensitised to the issues of universal design and inclusive environments, as was revealed from the informal feedback session after the completion of the academic projects.

In the thesis project of Children’ s village, the student developed hierarchy of open spaces ranging from cottage level space, to cluster level to campus-level space which became multi-functional spaces needed for various activities and interaction between the residents. At cottage level, the student designed the rooms to give individual alcoves to the children at the same time, allowing visual access of the caretaker mother.

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

Learning Process and Outcome

As discussed, the research could sensitise the students to the needs of different types of users. Apart from physical needs and physical meaning of accessibility, the students could understand psycho-social needs of various users and means to generate inclusive environments by architectural interventions.

Apart from the findings for architectural programming and design, the students were exposed to behavioural research and its importance, which is extremely important, particularly in the discipline of architecture, which tends to be intuitive. The ethical protocols followed in case study research, notes taking in qualitative interviews, behavioural mapping were important aspects the students learnt in the process of the research. Furthermore, being embedded in the settings allowed students to become more sensitive to the concerns of the users.

The feedback from the students about their learnings from the behavioural research studies and their application in the design was not formally collected and analysed in the present research. This is a limitation of the study. However, informal discussions with the students, during the research and design phase brought forth their understanding about the needs of various user groups. Inclusive design strategies incorporated by the students in their designs also evinced their learnings. Research can be carried out by collecting data on the use of the research studies in design development and issue identification, using structured survey instrument.

Conclusion

Sensitising the designers about the concepts of accessible and inclusive environments can be best done at the schools of design. A rationale approach of research to understand the needs of various user groups is required, rather than to presume the requirements of the users. Small but significant research

studies can contribute meaningfully in the process of design of the built environments. The research-oriented paradigm of teaching (Roberts, 2007) used in the three cases helped the students to learn research skills, use them in the design process and apply the findings. For example, as illustrated in figure 3, the student planned facilities and spaces in a home for the elderly. The discovery in this paper supports the finding by Hitch, Dell and Larkin (2016) that education around universal design may promote more positive attitudes towards people with a disability for architecture students.

Inclusive environments enable participation of people with different disabilities or various social groups. A limited view of the idea of accessible design as providing physical accessibility features like ramps or railings can be apathetic to the visually disabled persons. The psycho-social outlook for creating design intent and a program is essential, and it is only possible using the empathetic model (Nicolle & Maguire, 2003) of teaching.

Acknowledgement

The author is thankful to Ms Sarvari Harpale who shared drawings and findings from her design thesis on Orphanage [Figure 4,5] and Ms Karishma Joshi who shared drawings from her architectural design project on Home for Elderly [figure 3], and allowing them to be part of the illustrations for this paper.

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STUDY OF INTERIORITY APPLICATION IN DEAF SPACE BASED LECTURE SPACE

CASE STUDY: THE CENTER OF ART, DESIGN & LANGUAGE IN ITB BUILDING

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Abstract: Many lecture space facilities today are included in audism category because they do not yet have space design regulations for hearing disabilities. As a result, students with hearing disabilities, who are not identified from the start, require more time to sustain their education. This study aims to apply related theories including DeafSpace principles and interiority to find lecture space settings that can support the behavior of SHD's. Lecture spaces in the CADL-BIT building are not currently designed specifically for users with disabilities in application of interiority. This research used a qualitative method with a case study approach. Data is collected through observation, simulation, and interviews to explore the experience of space users. The research results showed that spatial experience was influenced by behavior, activities and space. The behavior of students with hearing disabilities in lecture space settings is influenced by interiority. There are lecture classrooms found to form of interiority, which are u-shaped furniture settings, easy visibility to read facial expressions and lips movements, and can interact with each other, bright lighting (not dim), wall colors according to pastel colors, plain wall material, and acoustics are

Harahap, R. M., Santosa, I., Wahjudi, D., Martokusumo, W., (2020). Study of interiority application in deaf space based lecture space. Journal of Accessibility and Design for All, 10(2), 229-261. https://doi.org/10.17411/jacces.v10i2.245

used sound absorbers. This research is expected to be beneficial for scholarship about the DeafSpace design, community, and building based on social culture.

Keywords: hearing disability, audism, *Deaf Space*, interiority, lecture classroom.

Introduction

Audism, which is discriminatory behavior towards people with hearing disabilities, stays an issue in managing public space (Humphries, 1977). Audism in public spaces drives people with hearing disabilities (deaf) to adapt to normal people's preferences (without hearing abilities) (Harrington, 2002; Jacobi, 2009; Berke, 2018). In the education context, audism has built a hurdle for people with hearing disabilities to accept the full features from the learning and teaching activities. An increasing number of people with hearing disabilities has resulted in an increasing demand for supporting teaching and learning facilities for them. An inclusive learning system needs to consider people with disabilities to access equally all features in education (Bauman, 2005; Murray et.al., 2014), and end audism in the inclusive education system.

Applying inclusive education system can be done by, for example, adjusting the lecturing space layout in such a way to facilitate people with hearing disabilities to interact with one another. This layout enables people with hearing disabilities to read other person's lips and gestures. Visibility, lighting, colour, and acoustics setting of the classroom are also essential for people with hearing disabilities to take part more actively in learning and teaching activities. (Bauman, 2005; Guardino, 2016).

People with hearing disabilities rely heavily on the visual sense, in which they are overly sensitive to things related to visual (Bauman, 2005: Guardino, 2016). A study by De Parny (1984); Worrel, (2011); Martins &

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

Gaudiot, (2015); Guradino, (2016) said that the role of visual senses is vital for people with hearing disabilities. Based on this, the lecture space layout should be arranged to facilitate people with hearing disabilities to optimise their sense of sight to concentrate on learning, easy to read the expression or teacher's lips. Other settings also include how easy for the students with hearing disabilities to see the blackboard, the lighting settings (bright and not glare), the use of non-textured wall material, applying soft colours and supportive space acoustics.

Interiority is a potential eye sense experience that can be sharpened through space experience in communication and orientation (Harahap, 2019). The proper lecture space interior is needed by students with hearing disabilities (SHD's) to support their physical, psychological, and social independence. Harahap (2019) states the purpose of interiority is to identify the spatial design concepts following the behavior characteristics of hearing aid users (HA), without hearing aid (WHA), and cochlear implant (CI). Interior settings in lecture space must be applied in a way so that both students with hearing (SH) and students with hearing disabilities (SHD's) can carry out learning and teaching activities independently.

Architectural obstacles in the education sector, especially in the inclusive higher education system, prevent SHD's from being able to learn and experience teaching process optimally, thus unable to access equal features compared to SH.

The DeafSpace concept arises as one of the interior design strategies that apply the needs of people with hearing disabilities in public spaces (Harahap, 2019). DeafSpace application can be done by the lecture space interior layout setting to support SHDs. The case study in this study is a lecture space at the Centre of Art, Design and Language Building at Bandung Institute of Technology (ITB) because this building has not met its accessibility aspects. The lecture space in the CADL building is one of the main lecture space used by all students, including students with hearing disabilities (SHD's).

This study aimed at application related theories to seek lecture space settings that could facilitate and accommodate the needs of SHD's in the learning process. Understanding interiority and its elements can benefit the field of interior design to meet the needs of people with hearing disabilities. This research did not aim to generalization, but it is idiographic, by taking a case study at the CADL-ITB building. The lecture space's current setting is not specifically designed to shape interiority, which is the most basic thing in creating a space experience.

Literatur Review

The Deaf Space Conception

Communication activity on people with hearing disabilities focuses on the visual space. The DeafSpace conception in interior design accommodates the needs of people with hearing disabilities in public spaces. DeafSpace focuses on increasing visual space quality for people with hearing disabilities. DeafSpace conception has 5 principles (figure 1), i.e., 1) space and proximity, 2) sensory reach, 3) mobility and proximity, 4) light and color, and 5) acoustics (Bauman, 2005; Worrel, 2011, Chiambretto & Triilingsgaard, 2016).

Figure 1. DeafSpace design guidelines (Bauman, 2005; Chiambretto & Triilingsgaard, 2016)

Figure 1.1. Space and Proximity

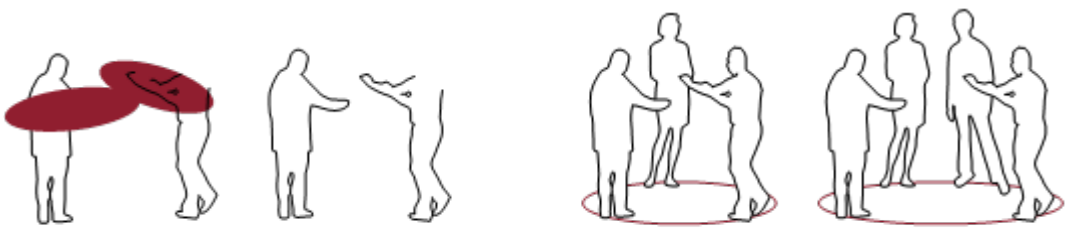


Figure 1.2. Sensory Reach

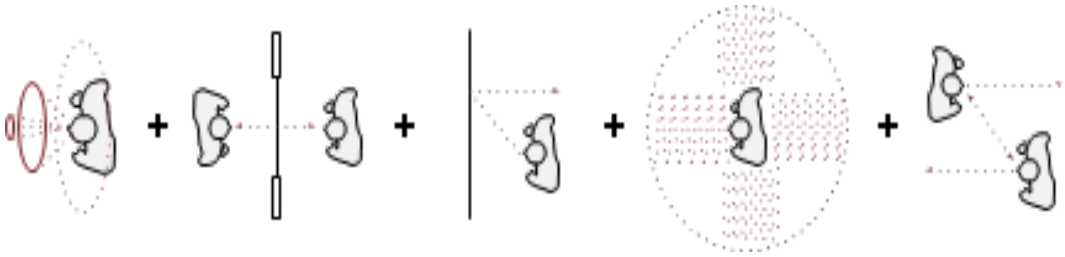


Figure 1.3. Mobility and Proximity

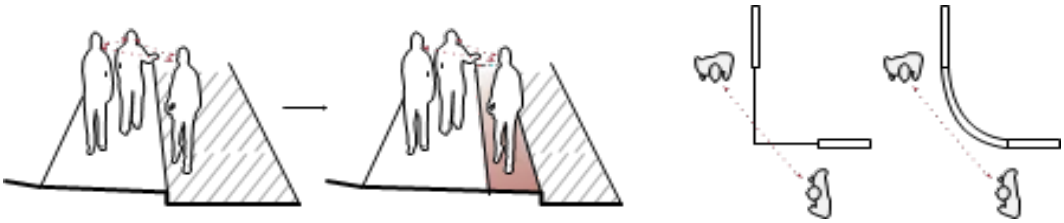


Figure 1.4. Light and Color

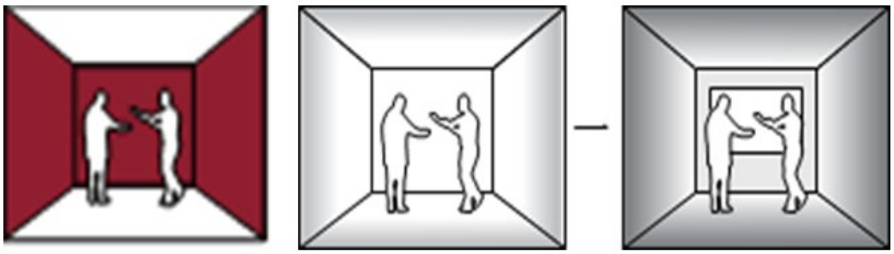
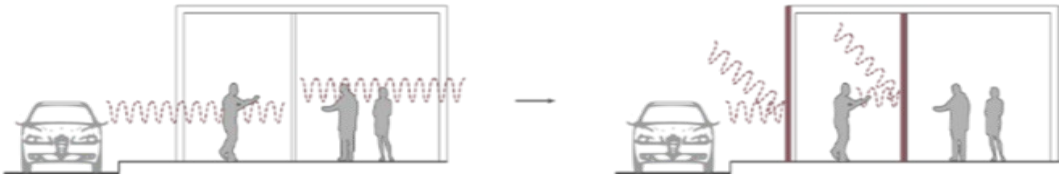


Figure 1.5. Acoustic



Interiority of Hearing Disability

Interiority is a combination of non-physical images in the realm of his mind with the experience of a physical or interior place that contributes to the emotional relationship between humans and places (Kole 2017, Harahap, 2019). Space experience cannot be separated from human experience itself. According to Leslie (1998; in Kole, 2017), the processing and rebuilding of human experience are reflected in the activities of telling stories about the

time that has passed. The experience of a place can be assumed as a place personalization, that is, giving a space a personality or identity. The identity of space can be achieved by connecting the outer skin of buildings with interior elements, such as furniture, colour, light, movement, finishing, and so on (Rice, 2006; Maharani, 2014).

Interiority in people with hearing disabilities is defined as an element that has measurement criteria for body movements and communication modes (visualization cues) that affect the quality of accessibility in a space. The elements are visibility, lighting, space layout, acoustics, colours, and materials. If the element criteria are not met, the quality of the interior elements in the space will be affected. This likely to cause problems for hearing disabilities, such as communication difficulties or difficulties in understanding certain spatial conditions (Kloese and Ramadani, 2012 in Harahap, 2019).

Figure 2. Phenomenon of hearing disabilities

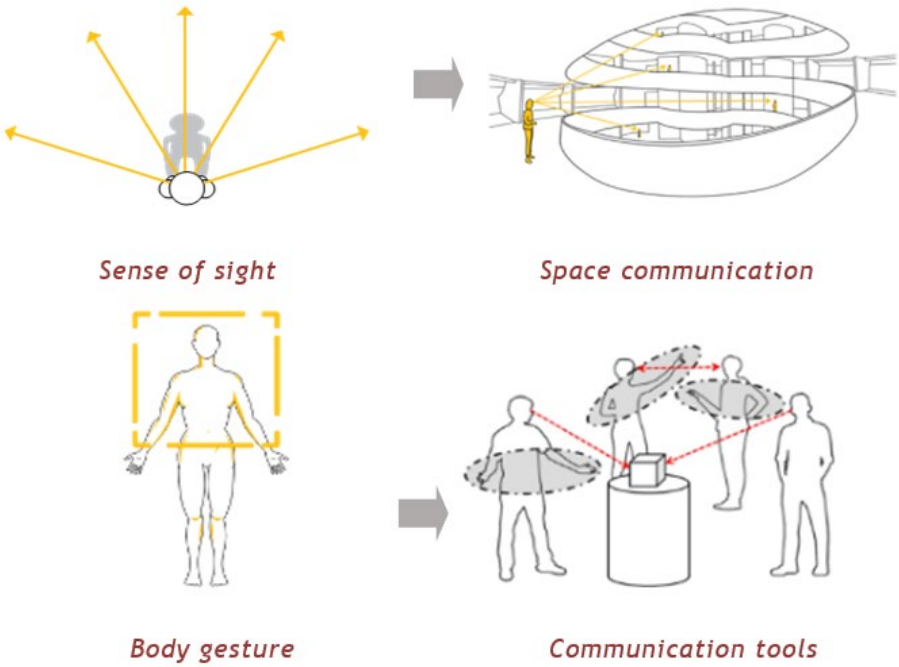


Figure 2 shows the phenomena of hearing disabilities behavior that requires dimensions of gesture (body) and visual senses to help communication in a

space. An example of planning that accommodates DeafSpace concept of hearing disabilities behavior to ease communication.

Methods

This research used a qualitative method. This qualitative research is specifically directed towards the use of case study methods (Creswell, 2013). A strategic case study is suitable if the main question of study centres on the "how" and "why" aspects (Yin, 2015). The qualitative method was chosen upon consideration that the characteristics of auditory disability behavior could be seen through the induction process, with empirical observation through observation, interviews, compiling questionnaires, simulation and documentation (Miles and Huberman, 1994). The research location was chosen in the ITB CADL building, considering that ITB is a university that accepts students with disabilities in high-level countries, and later has an inclusive campus that centred in one area.

Research Sample

Samples were selected with particular criteria based on certain theories following the research objectives. This was under the consideration that sample would really serve as the representative of the phenomenon being studied. (Starus & Corbin, 1990). The theory observed in this research is the behavior of people with hearing disabilities categorised based on their types of deafness, the use of assistive devices, and the phenomenon of the spatial experience felt by students with hearing disabilities (SHD's) to lecture space setting which is related with the DeafSpace conception.

Determining the sample size is based on the principle of information saturation. If the sample taken holds information that is still needed, a sample that is estimated to contain information that has not been obtained is pursued again. Conversely, if you add the same sample to obtain the same information, it means that the number of samples is sufficient because the

Volume 10, Issue 2. (CC) JACCES, 2020. ISSN: 2013-7087

information has become saturated. Based on this method, the sample taken stopped at 72 peoples. As many as 60 respondents are SHD's active/alumni/dropouts (DO) regarding of space experience of lecture space at 12 local universities (Table 3) and 12 respondents of SHD's active/alumni/DO participating in a simulation regarding the user connection with lecture space setting at CADL-ITB building (Table 4).

Instrument

This research was conducted in several stages of data collection and data analysis (Creswell, 2013). The observation stage was carried out at the lecture space on the 7th floor of CADL-ITB building. An Observation collected data in the form of interview data and photo documentation on interior elements in the lecture space, e.g. the setting pattern of furniture, visibility, lighting, colour, materials, and acoustic. Data were then analysed according to the DeafSpace concept as proposed by Bauman (2010). The three main components that had been observed were: a) space settings, b) activities, refers to what is done by SHD's in a lecture, and c) interiority that arises from the relationship between lecture space setting and SHD's behavior.

Research Procedure

Following the research problem and research objectives, the outline of the research can best described as follows:

a. Preparation stage consists of:

1) general observation stage, 2) collecting secondary data collection, and 3) making / composing two question instruments for respondents, namely, i.e., the questionnaire instrument lecture space experience questions, and questionnaire and simulation instruments. 4) the stage of sketching the physical space and phenomena of activities that occur, as well as taking photographs for the validity of data validity, and 5) the general interview

stage to take responses from respondents and to determine samples to represent respondents for further interviews. 6) the tryout stage, is a testa test conducted before the main interview is conducted. This stage is to determine the level of validity and reliability.

b. Implementation stage:

1) Mapping SHD's behavior by questionnaire field observation stage. 2) Visiting respondents to interview them. As many as 60 respondents in 12 cities and another 12 respondents taking part in the simulation in the lecture space at CADL- ITB building. This unstructured interview stage is for certain respondents who are representative of the phenomena taken. 3) Completing and classifying data according to respective operational variable groups. 4) Analysing and interpreting data. 5) Drawing conclusions based on the data analysis result. 6) Conducting a discussion. 7) Drawing research conclusions and make suggestions. 8) Making a research report.

Data Collection Methods

The initial stage of this research is to explore things that can influence the characteristics of SHD's behavior during the learning process in the lecture space. Unequal learning services in higher education often occur when lecturers do not pay attention to the presence of disabled students in lecture space. Lecturers will be able to provide a problem-based learning process (Fauziah, et al., 2017) if students with hearing disabilities do not understand the problem of the prepared space element. With literature that focuses on learning space experiences that can serve students to learn (Zollinger, Guerin, Hadjiyanni & Martin, 2009), lecturers can teach how to deliver learning process including to SHD's with lecture space setting. Applying the lecture space setting based on DeafSpace concept requires adjusting to the SHD's behavior.

The next research stage was conducting a simulated al survey with 12 respondents of SHD's active/alumni/DO in the lecture space on the 7th floor

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CADL-ITB building (table 3). Simulation is part of access socialization of theory lecture space conducted to find out how to work the use of al results. At this stage, a simulation was conducted with 12 participants/respondents. Researcher asked respondents to carry out activities that were normally done in theoretical lecture space while learning takes place. Activities were evaluated from a connection with the respondent's different seating positions: position F1, F2, and F3 (Table 4). Activities undertaken by respondents in theory lecture space related to the layout design of seating position are 1) taking notes or writing, 2) looking at the lecturers' lips and lips movements, 3) seeing sign interpreters or note taker /android, and 4) looking at the blackboard or projector screen/TV text.

The researcher asked respondents to fill in an instrument which rates the lecture space setting from the most optimum to the least optimum. The scores were 4 (optimum), 3 (optimum enough), 2 (sub optimum), and 1 (no access at all). This instrument produced data scoring. An assessment of interior element settings in the theoretical lecture space(classroom for theoretical lessons) were furniture layout patterns (traditional lines, circles, u-shapes, clusters, hollow squares, and chevrons), lighting, colour, material, noise (acoustic), and circulation dimensions.

The researcher then instructed respondents to do a simulation on six different furniture layout patterns; A modification (traditional line), B modification (hollow square), C modification (circle), D modification (u-shape), E modification (cluster), and F modification (chevron). The researcher would then ask the lecturer to teach while circling in the lecture space (the ones for theoretical purposes) and observe whether SHD’s found some difficulties or not during the learning process. The simulation stage of each modification duration was 30 minutes making a total 180 minutes for six pattern modifications.

Research Variable

The variables used in this study are SHD's interaction as the independent variable (Table 1) and the lecture space setting as the dependent variable (Table 2). This study did not test the hypothesis to describe information with the observed variables.

Tabla 1. The independent variable (SHD's)

Indicator	Element observed	Resources	Research tool
Type of activity	Learning and teaching	- Respondents - Field observations	- List of questions - Photography
Behavior characteristics	- Deaf – dumb with hearing aid (HA) - Deaf with HA/without HA - Hard of hearing with HA/without HA - Deaf with cochlear implant (CI)	- Respondents - Field observations	- List of questions - Photography

Tabla 2. The dependent variable (lecture space setting theory)

Indicator	Element observed	Resources	Research tool
Physical	- Setting types - Setting conditions	- Sketches / notes - Photography	- Stationary - Camera
Spatial (DeafSpace concept)	- *Space and proximity* - *Sensory reach* - *Mobility and proximity* - *Light and colour, and acoustic*	- Sketches / notes - Photography	- Stationary - Camera
Independence	- Accessibility - Visibility - Convenience - Element availability	- Interview - Observation	- List of questions

Data Analysis

Due to the exploratory and qualitative nature of this study, the author used content analysis to analyse the data generated (I.e., written notes were taken during the interview sessions) (Dickinson et al., 2016). Data obtained from observations were analysed through categorization. According to Moleong (1989), categorization implies the compilation of data which is considered to have similarities in a particular category.

Data categorization used in this study includes the conditions of setting, activities, and behavior. Data obtained through interviews, both verbally and using sign language (Sign Language of Indonesia /BISINDO). Data were then analysed using content similarity analysis method. Content analysis is a scientific analysis of content and communication messages. The process of extracting data was done one by one from each respondent. Trends and similarities acquired from the content analysis include the settings which were chosen as places of activity. Data compilation was added with description and explanation techniques.

Result and Discussion

Analysis of Research Location Data

The location of the research object in the CADL (Centre of Art, Design and Language) building is located in Bandung Institute of Technology (ITB) campus complex, a total of 7 floors and an area of 7,866, 28 or approximately 7.8 hectares (Figure 2 & Figure 3), data of Directorate of Facilities and Infrastructure-BIT, 2017). CADL is arts and language Centre intended to develop the support of creative industries and linguistics that have been recognized as important supports in the international research competition. This building has been equipped with various facilities that can support the needs of further research on art and design in Indonesia.

Figure 3 shows that the CADL – ITB building has not provided available signs, both visual signs or information clues, on the exterior and interior. This situation makes SHD's difficult to access. Figure 4 shows the path setting from the ground floor lobby entrance to the 7th floor where the lecture space is situated. The parking area that serves parking and circulation holds the need for access to see the presence of vehicles passing in front or behind.

Figure 6 shows the furniture setting (seating position). It turned out that it was not easy for users to see the expression and lip movements, thus, reducing users' ability to hear & comprehend the discussion. The setting of entrance element at CADL building is quite optimum enabling users to have uninterrupted conversations and visual connections without disruption. Glassdoor materials helped to identify activities in the space according to DeafSpace guidelines.

Figure 3. Case location of lecture space in CADL building- BIT (blue). (Source: Site Plan, Directorate of Facilities and Infrastructure/DFI- BIT, 2018)

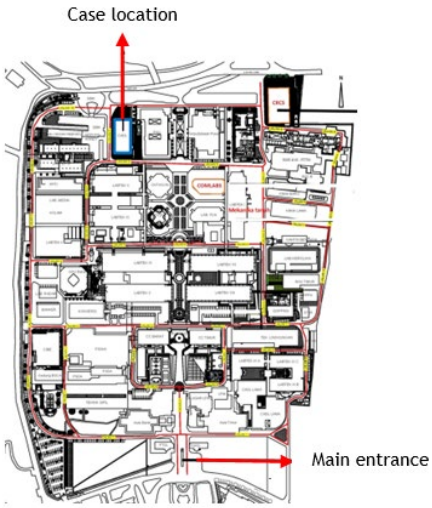


Figure 4. Floor plan 1 of the CADL building at BIT and entrance (red arrow). (Source: DFI-BIT, 2018)

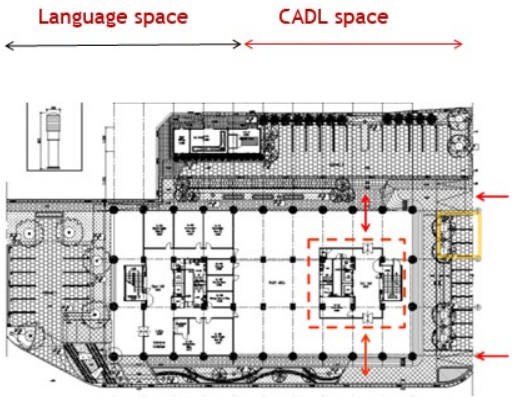
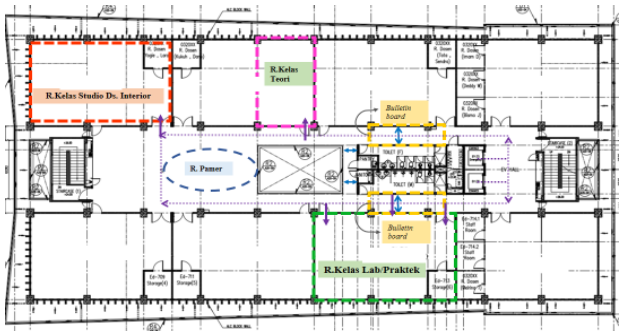


Figure 5. Circulation flow from lobby (elevator) to 7th floor lecture space.Source : (DFI-BIT, 2018) and pyshical appearance of a CADL building at BIT.



Circulation line; : Entrance/exit; Corridor width :

Research result

1. Phase 1 Results

This stage used a questionnaire to selected respondents based on differences in characteristics or physical functions, i.e. hearing aid (HA) users, without HA, and cochlear implants (CI), totalling of 66 SHD's active/alumni/DO respondents regarding user experience towards access to lecture spaces in 12 city universities in Indonesia (Table 3).

The results of data calculation are categorised based on gender and age. Most of the respondents were male (65%) and within the 19-25 years old category (55%). Only 1.67% aged 45 years and above. In the category of deafness and the use of assistive devices, as many as 56.7% of the respondents were deaf. Ear models hearing aid occupied the top category with (61%) and the lowest hearing aid models used were cochlear implant users (3.3%). In terms of education and employment, most of the respondents were undergraduate (75%) and only 2.1% was in doctoral programs (2.1%). The majority of respondents worked as active students (48.3%), and only 3.5% worked as civil servants.

Tabla 3. Number of respondents of student with hearing disabilities

No	University area	Number of respondents		Total (person)
		Face to face	via Email	
1	Jakarta	13	3	16
2	Depok	1	2	3
3	Banten	1	2	3
4	Bandung	7	2	9
5	Semarang	2	1	3
6	Solo/Surakarta	-	5	5
7	Yogyakarta	1	2	3
8	Malang	9	-	9
9	Surabaya	1	1	2
10	Denpasar	6	1	7
11	Banda Aceh	-	1	1
12	Tangerang	5	-	5

Based on the results regarding the space experience perceived by users on physical access, the lecture space is not designed for people with hearing disability in university (answered by 61.67% respondents). While 46.73% of respondents on non-physical access issue stated that lecture space in universities do not facilitate proper accommodation (sign language interpreter, and special assistance). As many as 63.3%. Respondents claim that assistive technology facilities (a feature of speech recognition via speech to text from smartphones that have been applied from play store, live transcribe, notetaker / CART-specific projectors) were not yet facilitated by universities.

2. The result study of phase 2

This stage was conducted by questionnaire of 12 respondents/participants in the lecture space of the CADL-ITB building (Table 4).

Tabla 4. For 12 respondents of SHD's (active/alumni)

Respondent's name	University origin	Majors	Semester
R1	University of Mercu Buana in Jakarta	Interior design	6
R2	University of Esa Unggul in Jakarta	Interior design	2
R3	Unikom Bandung	DKV	10
R4	University of Pembangunan Jaya in Banten	Product design	Graduated
R5	National Institute of Technology in Bandung	Graphics design	Graduated
R6	Widyatama Bandung	Graphics design	6
R7	University of Islam Bandung	Management of hospital	3
R8	University of Mercu Buana in Jakarta	Interior design	Graduated
R9	Bandung Institute of Technology	Business	Graduated
R10	Sekolah Tinggi Hukum Bandung	Law	DO
R11	Sekolah Tinggi Ilmu Teknologi in Bandung	Islamic Education	5
R12	Widyatama Bandung	Graphics design	6

This stage aimed at identifying things that are expected to influence the characteristics of SHD's behavior during the learning process in the theoretical lecture space. Based on the results, factors that affect SHD's behaviors are: 1) The Cause of deafness: most respondents have deafness since birth (75%), caused by accidents (8.3%), and caused by a disease (16.7%). 2) The use of assistive devices: most respondents were Hearing Aids users (58.3%), followed by users without Hearing Aids (25%), and Cochlear Implant Users (16.7%). 3) Communication methods: the largest percentage of communication methods used are both sign language and verbal communication at 41.66% each, while the combination of sign language and verbal/aural is 16.73%.

Setting lecture space, which is used by SHD's space experience in conducting their learning and teaching activities, has shaped the interiority. Several elements of interiority that are captured in behavior of students with hearing disabilities are as follows: a) Capturing the alteration on their surroundings by maximising their visual sense. b) Requiring movement space to accommodate two-way communication or more using sign-languages. c) Requiring a wide visibility range to facilitate visually capturing object from a

far distance or the opposite direction. d) The tendencies of imperfect body posture, because an impaired hearing system could cause issues in the human spinal nerve system.

The above behavior and need specification that arises from the research findings can explain several applications on element characteristics on a space design based on deaf space conception. This space design allows accessibility for Students with Hearing Disabilities to communicate, reduce visual hurdles, and gain independence in learning and teaching activities.

3. The results study of phase 3

The results of the final stage of the study carried out a simulation of furniture setting (seating position) in lecture space of the CADL-BIT building (Table 6). The result of furniture setting data calculation shows that the highest value (optimal category) is the U-shape pattern (66.7%). The optimal category is Circle-shape pattern (16.7%), the suboptimal category is on the Hollow square shape and Cluster shape (8.3%). The inaccessible categories are Traditional line and Chevron (0%) pattern settings.

As seen in table 5 above, the majority of F1, F2 and F3 furniture layouts stating that u-shape expresses independence, ease (visibility) and comfort. This includes one required character from the DeafSpace conception on the principle of sensory reach, mobility and proximity. Also, it connects with the aspect of interiority, to know the location of places or to reach that place without the help of others, to be able to learn on their own, to feel safe in their activities, and to be able to see each other between lecturers and students. Comfort becomes the factors that influence the SHD's behavior on the U-shaped furniture layout pattern.

An analysis on the comparison of the characteristics and the respondents' behavior and the layout of lecture space, conducted on each type of deafness category and the use of assistive devices, shows that an effective furniture setting pattern is also a U-shaped layout. Reasons for selecting

respondents from the lecture space with the u-shape pattern on aspects of interiority, namely :

a. Accessibility and visibility, related to the proximity of the distance, easy to see the expression and lip movements of lecturers and proper accommodation (whiteboard, LCD projector and so on).

b. Convenience, related to being able to focus learning without interrupting visualization movements, for example lighting, colour, material, and noise

c. Independence related to being able to interact with each other between lecturers and students.

Tabla 5. Summary analysis of comparison result on the four types of deafness categories and the use of tools to seating arrangements is chosen in u-shape patterns

Types of deafness category & use of assistive devices	Accessibility, independence, and comfort needs	Interiority factors
F1: Deaf -dumb (hearing aids/without hearing aids)	- Choose seating arrangements in U-shape patterns - Easy to interact - Easy to see the lecturer's 'lips' movements - No need to turn back	- Through visual sign - Gestures/cues
F2: Deaf (hearing aids/without hearing aids)	- Choose seating arrangements in U-shape patterns - Easy to interact - Easy to see the lecturer's 'lips' movements - No need to turn back	- Through of visual sign - Gestures/cues
F2: Hard of hearing (hearing aids/without hearing aids)	- Choose seating arrangements in U-shape patterns - Easy to interact - Easy to see the lecturer's 'lips' movements - No need to turn back	- Through of visual sign - Written / verbal - Gestures/cues
F3: Deaf (CI)	Whether or not to choose seating arrangement of U-shape patterns - Easily capture information - It's easy to see the lecturer's 'lips' movements - No need to turn back	- Through sense of hearing and visual sign - Gestures - Written

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Research Findings

Some research findings in field contained two data, namely physical data and non-physical data. Physical data findings are findings obtained by interiority in lecture space setting in accordance with the purpose of study, while non-physical data findings are findings that are based on problems that arise in physical data.

1. Physical data findings, as follows: a) The condition of formation of lecture space is influenced by behavior of persons with disabilities, activities and spaces. b) Lecture space setting that are found to form interiority; interior in classroom setting based on DeafSpace. c) The role of interiority in lecture classroom setting can support the behavior of students with hearing disabilities. This research is expected to provide benefits for science about interior design.

2. Non-physical data findings, as follows: a) Classrooms are perceived by students as classrooms for learning and teaching activities. b) In the use of lecture space for students with hearing disabilities towards interiority.

Physical Data Findings

A. Finding 1: The condition of the formation of the lecture space is influenced by the behavior of persons with disabilities, activities and spaces.

Based on research conducted on classrooms that are considered as cases, it can be seen that the condition of the classroom setting can encourage the tendency for space activities to occur, where both are affected by hearing disability student behavior. The following will describe the behavior conditions (physical) of each lecture space setting.

The condition of the classroom theory is as follows: a) Traditional line-shaped furniture layout; difficult to interact with each other. b) Visibility (visibility) can not read the expression and lecturer lip movements. c)

Lighting is quite bright and not glare from the sun. d) The color matches the pastel color. e) Plain or non-textured wall materials, partially transparent doors, easy to see the conditions outside the space. f) Acoustic; no silencer.

The condition of the above theory classrooms encourages a tendency towards activities undertaken by students with hearing disabilities: 1) learning and teaching, 2) Group discussion, and 3) Coursework

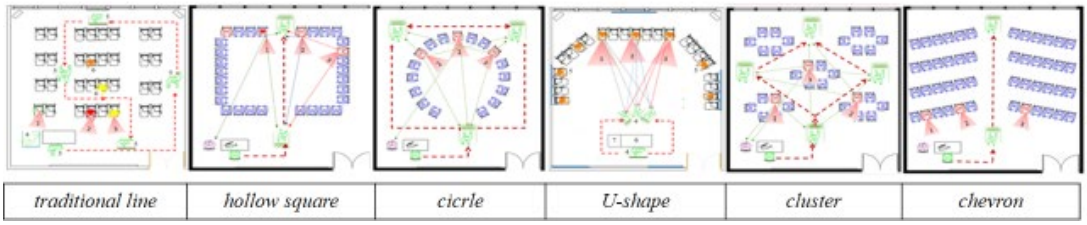
The settings of these elements that affect the formation of interiority are:

- Physical accessibility of space (convenience)
- Visibility (comfort of the eyes / visual senses
- Independence (interaction between spaces and lecturers).

B. Finding 2: Setting lecture space found to form interiority; interior in classroom setting based on deaf space.

Analysis of lecture space settings found to form interiority that fits the criteria of DeafSpace character, namely furniture layout sitting position 6 types of patterns (traditional line, hollow square, circle, U-shape, cluster, and chevron), visibility, lighting, color, material and acoustics. Shows the formulation of analysis of results of simulation of 6 different types of classroom setting patterns that are appropriate are u-shape patterns. The U-shape pattern in the sitting position of students with hearing disabilities facilitates communication and interaction with one another clearly compared to the other 5 patterns. In addition, lecturers can pay attention to which senses are functioning better, to determine the direction of lecturer position more effectively. Can be seen in figure 7.

Figure 7 Furniture layout 6 types of patterns and reactions of sitting position of students with hearing impairments



Seen in table 6, it shows that the setting pattern of the lecture space on aspects of interiority, namely the layout of furniture (sitting position), visibility, lighting, color, material and acoustics are u-shape shapes including one of the character needs in the theory of deaf space on the principle of sensory reach and mobility and proximity, in addition to aspects of interiority, among others, can find out the lecture classroom settings to reach the space without the help of others, can learn on their own, feel comfortable and secure their activities, and can see each other. In the visibility (ease) and independence of students with hearing disabilities make more use of the senses of the eye, namely seeing or reading communication in the space while comfort is not a priority for students with hearing disabilities. Comfort is seen more as a consequence due to the application of deaf space on the principle of space and proximity and light and color. It is known that light and color can cause a feeling of comfort other than security. That is why hearing disability students feel comfortable in the lecture space. Comfort is also a factor influencing the behavior characteristics of students with hearing disabilities to the u-shape lecture classroom setting.

.Tabla 6. Summary Analysis of comparison of six types of furniture layout patterns in lecture space.

Type of furniture layout pattern	Furniture layout (seating position) SHD's users			Aspect of Interiority
	Furniture 1 (F1)	Furniture 2 (F2)	Furniture 3 (F3)	
Traditional line	senses of eye	senses of eye	senses of hearing + eye	Not independent, visibility and comfort are disturbed
	difficult to capture information (reading the lecturer lips / whiteboard / projector's)	difficult to capture information (reading the lecturer lips / whiteboard / projector's)	rather difficult to capture information (reading the lecturer lips / whiteboard / projector's)	
	interact less	interact less	interact less	
	reaction looks back	reaction looks back	reaction sometimes or not looking back	
Hollow square	senses of eye	senses of eye	senses of hearing + eye	visibility and comfort quite disturbed, not independent except seating position 3 (F3)
	rather difficult to capture information (reading the lecturer lips / whiteboard / projector's)	rather difficult to capture information (reading the lecturer lips / whiteboard / projector's)	capture enough information (lecturer / whiteboard / projector)	
	interact enough	interact enough	interact enough	
	reaction looks back	reaction looks back	reaction sometimes or not looking back	
Circle	senses of eye	senses of eye	senses of hearing + eye	Visibility is lacking, comfort is quite disturbed, quite
	rather difficult to capture information (reading the	rather difficult to capture information (reading the	capture enough information (lecturer / whiteboard /	

Type of furniture layout pattern	Furniture layout (seating position) SHD's users			Aspect of Interiority
	Furniture 1 (F1)	Furniture 2 (F2)	Furniture 3 (F3)	
	lecturer lips / whiteboard / projector's)	lecturer lips / whiteboard / projector's)	projector)	independent
	interact enough	interact enough	interact enough	
	reaction does not need to look back	reaction does not need to look back	reaction does not need to look back	
U-shape	senses of eye	senses of eye	senses of hearing + eye	Very visibility, comfortable, independent,
	easily capture information (read the lecturer lips / whiteboard / projector's)	easily capture information (read the lecturer lips / whiteboard / projector's)	easily capture information (read the lecturer lips / whiteboard / projector's)	
	very interacting	very interacting	very interacting	
	reaction does not need to look back	reaction does not need to look back	reaction does not need to look back	
Cluster	senses of eye	senses of eye	senses of hearing + eye	impaired visibility and comfort, not independent,
	difficult to capture information (read the lecturer lips / blackboard / projector)	difficult to capture information (read the lecturer lips/ blackboard / projector)	just capture information (read the lecturer lips / blackboard / projector)	
	interact less	interact less	interact less	
	Looking back	Looking back	Looking back	
Chevron	senses of eye	senses of eye	senses of hearing + eye	impaired visibility and comfort, not independent,
	difficult to capture information (read the lecturer lips / blackboard / projector)	difficult to capture information (read the lecturer lips/ blackboard / projector)	difficult to capture information (read the lecturer lips/ blackboard / projector)	
	interact less	interact less	interact less	
	reaction looks back	reaction looks back	reaction sometimes or not looking back	

You can see table 4 of F1 seat code. F2 and F3. Can be seen Table 6 Seated seat number of students with hearing disabilities.

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Setting lecture space, which is used by SHD's space experience in conducting their learning and teaching activities, has shaped the interiority. Several elements of interiority that are captured in the behavior of students with hearing disabilities are as follows: a) Capturing the alteration on their surroundings by maximising their visual sense. b) Requiring movement space to accommodate two-way communication or more using sign-languages. c) Requiring a wide visibility range to facilitate visually capturing object from a far distance or the opposite direction. d) The tendencies of imperfect body posture, because an impaired hearing system could cause issues in the human spinal nerve system.

The above behavior and need specification that arises from the research findings can explain several applications on element characteristics on a space design based on deaf space conception. This space design allows accessibility for Students with Hearing Disabilities to communicate, reduce visual hurdles, and gain independence in learning and teaching activities.

C. Finding 3: The role of interiority in lecture classroom can support the behavior of students with hearing disabilities during productive learning and teaching processes.

In essence, self-awareness of students with hearing disabilities who can identify themselves in lecture classroom is called interiority. Implicitly, the inner self of students with full hearing disabilities that identifies with behavior characteristics of lecture classroom setting. It can be proven that the behavior is seen in students with hearing disabilities to reactions to furniture settings in sitting position, visibility, lighting, color, material and acoustics. This is explained by the findings of the process of independence, visibility, and comfort of the interiority or indicators of hearing disability behavior. Interiority can occur when students with hearing disabilities consider themselves to be subjects of space users and can distinguish themselves from objects of physical space.

The interiority that is present in persons with hearing disabilities is the configuration of behavior aspects (physical and spatial) related to the process of self-formation. The process of self-formation in this study can be seen from the learning and teaching process that starts from the intuition to end on meaning. Interiority is created when the six aspects are integrated and productive.

Conclusion

It was found in study, how the interiority in lecture classroom setting can support the behavior of students with hearing disability during productive learning and teaching processes. Based on results of analysis conducted previously with consideration of creating interiority in lecture classroom DeafSpace-based it can be concluded, as follows:

Principle 1: Space and proximity

- The interiority of characteristics of hearing disability in space and proximity forms a comfortable space for users with hearing disability to move. Often hearing disability users need their ability to communicate. Facial and gestures are very important for users, so users need landscape space to communicate or sign language. In communicating, the space needed by users with hearing disability is different from hearing people.

- The principle of space and proximity is applied in several aspects of space, namely the furniture layout, and physical appearance of elements. The problem of shape or pattern of space that is tailored to characteristics of hearing disability. For example, furniture layout patterns that are deemed appropriate for characteristics of hearing disability are shaped like a semicircle or u-shape because they are flexible, effective, broad, and dynamic. This form or pattern is chosen based on the user's habit of hearing disability in their

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activities. Unconsciously a group of users with hearing disability will form a semicircle or curve in order to be able to see everyone or interact with each other. They will avoid squares or elongated shapes that can block the view.

Principle 2: Sensory reach

- The interiority o characteristics hearing disability in sensory reach that is applied to help or enhance the sensory stimulation they have. By using other senses, users of hearing disability are expected to be able to read situations that occur in class lectures. For example, the u-shaped sitting position in the middle part easily sees the lecturers' lips or movements, also blackboard or projector screen, and addition of transparent glass on lecture classroom door so that they can find out activities outside if there are people who are interested to enter.

- The use of signage for lecture classroom is also needed as a marker. Examples of the use of signage exit signs or evacuation routes, visual bell lights provide information of fire or danger signs installed in each lecture classroom. With this signage, users with hearing disability can recognize the danger without having to be warned in the form of audio.

Principle 3: Mobility and proximity

- The interiority of characteristics of hearing disability requires a large amount of wiggle space compared to the needs for mobility of hearing persons. The need for space for hearing disability users is influenced by distance and area of vision or closeness. This principle is based on characteristics of hearing disability regarding how to communicate. In communicating, users with hearing disability rely on their visuality. If users are too focused on the conversation, they become less concerned about the surrounding conditions. But they can still pay attention to conditions around, so it requires a large space to move to

allow them to continue to pay attention to elements of circulation path (corridor) and the interlocutor.

- The space to be discussed in this principle is the extent of corridor road and the use of stairs or ramps. Calculation of road and the use of stairs or ramp need to be considered in the comfort of hearing disability users.

- The width of the road in this lecture classroom is designed wider than the width of the road, so that users with hearing disabilities can freely pay attention to the surrounding conditions. The width of the corridor path (or pedestrian) in the lecture space is about ± 3.00 m^2.

- Ramp elements in space for all users including physical and sensory disabilities to make it easier for users to move to different heights. Meanwhile, the use of stairs in this lecture classroom has some special attention in order to be able to make it easier for users with hearing disabilities to access from different floors. The stairs used in this lecture classroom have a width and a length that is wider than the usual stairs. The steps in the lecture classroom are also sloping so users can easily access the room.

Principle 4: Lighting, Color and Material

- The interior of the characteristics of persons with hearing disabilities in the elements of light and color, namely the selection of color and processing of light in the room Color and light affect the hearing impaired psychology. In order for them to see and read the situation comfortably, the color chosen must contrast with the color of the skin. That way, students are deaf when watching someone speak or sign language.

- The color choices in this lecture room tend to be pastel colors. However, because the lecture class space is adapted because of the

points of hearing impaired persons, but also some selected public and private space areas are fresh colors and can increase their knowledge of colors.

- Ideal light processing required by DeafSpace design is light that is gentle on the eyes, not blinding, and avoids dark or dim spaces.
- In this lecture space, hearing impaired users typically make more use of natural lighting. The use of large openings allows natural light to enter the room so that there are no dim or gloomy (dark) corners. This lecture space uses skylights in several large spaces. In another room, a large window is provided so that natural light can enter freely and reduce the cost of using artificial light.

Principle 5: Acoustic and vibration

- The processing of acoustic and vibration elements in the lecture room for hearing impaired users is something that needs to be considered so that users can feel comfortable. Even though users have a hearing deficiency, those who use hearing aids (ABD) and cochlear implants (CI), loud sounds and even the sound of cutting machines practicing in the practical classroom can interfere with their hearing. Therefore, the ideal acoustics in a quiet and quiet room. However, quiet acoustic processing does not have to be applied in every room.
- Acoustic processing can be given to a room that requires calm. For example, in a practicum room that requires pure sound and vibration produced by the sound source, the room can be given soundproof material so that it is not disturbed by outside noise.

Interiority in the classroom setting is based on DeafSpace which is applied to five principles as physical elements that have communication (language) and orientation or visual signs that are implemented in each room. In interiority based on the concept of DeafSpace aims to facilitate users who have hearing impairment to recognize space in the built environment. The spatial design

supports the provision of information through the senses of the eye and the ability to capture vibrations.

The results of the study, physical space (architectural) is not enough to increase independence, so the need for an adaptation process, commonly called interiority. The adaptation process is meant to support interiority in space. Therefore, it can add to the previous theory of the deaf space theory which explains that architectural environment influences the behavior of persons with hearing disabilities (Bauman, 2005; Byrd, 2007; Sirvage, 2011).

This research applies the interiority process in the conception of a good DeafSpace that can improve the independence of students with hearing disabilities in lecture space. Therefore, it can be done to enrich and develop the DeafSpace theory in context of behavior characteristics of persons with hearing disabilities in Indonesia.

The spatial design process does not only reach the problem of problem solving in the space through the configuration of interior elements, so as to reach a certain quality stage. A person with a hearing disability as a user of space will achieve a level of ease (visibility), comfort and independence. When it reaches the level of unification of the space which is then referred to as interiority. The intended self-unification between space and behavior (physical and spatial) becomes important in the midst of various accelerations and developments in virtual technology.

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