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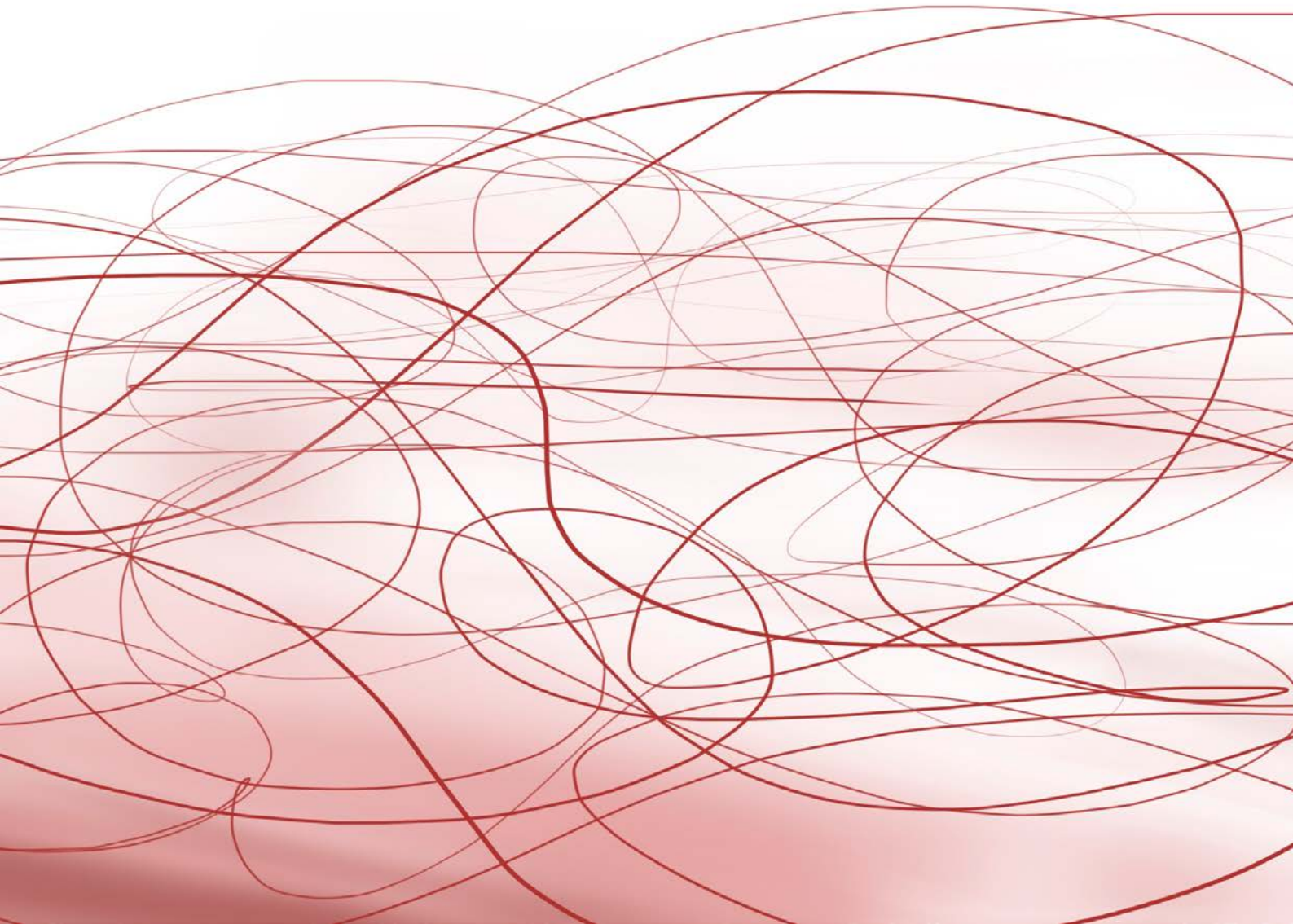

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SEMI-AUTOMATIC RETRACTABLE HANDRAIL UTILIZING OPENING/CLOSING MOVEMENT OF SLIDING DOOR SUPPORTING ELDERLY PEOPLE TO WALK INDEPENDENTLY

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***Abstract*:** The purpose of this research is to install a handrail on the sliding doors used in hospitals and nursing facilities to support senior and people with disabilities to walk by themselves. The semi-automatic lifting equipment is utilized for the retractable handrail to make sure people in bad health are able to open the door using a weak force. To design the handrail for this purpose, the theoretical formula for opening force is derived. Then the simulation is performed with varying geometry conditions confirming the results are in good agreement with the experiment results. The opening force is designed to be less than the target value previously reported. The sliding door developed in this study is useful for elderly people walking by themselves safely.

Keywords: sliding door; handrail; opening force; simulation; people with disabilities.

Nomenclature

The following notations will be used in this paper.

$F_{Ax}(x_A)$: Opening force applied at point A in Figure 6. Target value $F_{Ax}(x_A)$ = 19.6 N

$F_{Ay}(x_A)$: Reaction force applied to handrail at point A (x_A, 0) in y-direction in Figure 6

$(x_A, y_A) = (x_A, 0)$: Coordinates of supporting point A in Figure 5, x_A = Opening distance of sliding door

(x_{B0}, y_{B0}) : Coordinates of point B in Figure 5, Point B = Center of guide roller

(x_D, y_D) : Coordinates of point D in Figure 5, Point D = Center of arc portion of guide rail

Q : $Q = \mu_t P$, Running resistance (see Figure 6)

P : Reaction force to handrail from guide rail at point B in Figure 6

R : Rolling surface radius of guide rail stand in Figure 5 (R = 478 mm, for prototype)

θ : Angle between retractable handrail and horizontal line (see Figure 5)

φ : Handrail angle between tangential direction of guiderail at B and handrail (see Figure 5)

ε : Guide rail angle between tangential direction of guiderail and vertical direction (see Figure 5)

W : Weight of handrail including guide roller in Figure 6 (W = 13.7 N, for prototype steel handrail)

M : Moment due to torsion spring in Figure 6 ($M = k(0.5\pi - \theta)$)

k : Spring constant (k = 2395 N mm/rad)

μ_t : Friction coefficient of bearing 0.03 + friction coefficient of rotating roller 0.05 in Figure 6 (μ_t = 0.03 + 0.005 = 0.035) (Ando, 1968)

a : $a = y_A - y_{B0}$, AB in y-direction in Figure 6 (a = 22.6 mm, for prototype)

b : Horizontal difference, $b = x_A - x_{B0}$, between point A and point B in Figure 5 (b = 910.3 mm, for prototype)

c : Distance from guide roller contact point to rail vertical point in Figure 5 (c = 58.2 mm, for prototype)

r : Radius of guide roller B in Figure 5 (r =17.5 mm for prototype)

e : Distance in x-direction between center point of guide roller B and contact point of roller and rail in Figure 5

l : Length of retractable handrail rod in Figure 5 (l = 910.3 mm for prototype)

C : Contact point of roller in Figure 5

E : End point of curved portion of guide rail in Figure 5

F : Guide rail end in Figure 5

Introduction

Sliding doors have many advantages compared to hinged doors popularly used in the world. No space is necessary during the opening, people can feel a sense of freedom due to the door fitting inside the wall, and the smaller movement of the body is suitable for elderly people opening/closing. In Japan, therefore,

a lot of sliding doors are conventionally used as interior doors in private houses, hospitals, and welfare facilities. Figure 1 shows examples of sliding doors used in Japanese welfare facilities.

As shown in Figure 1, to support elderly people to walk independently, many residential buildings, nursing homes and hospitals have installed handrails along all over the corridor walls. However, if there is a sliding door in the middle of the corridor, a handrail cannot be installed on the sliding door surface because the sliding door cannot be opened and closed. Because of no handrail on the sliding door, it would be difficult for elderly people to go to the bathroom alone. It is, therefore, necessary to install handrails continuously without interruption for elderly people. When elderly and people with disabilities can walk by themselves, it is known that such decline prevention measures are useful for maintaining and restoring their walking function (Gault & Willems, 2013; Porter, Vandervoort, & Lexell, 1995; World Health Organization, 2007).

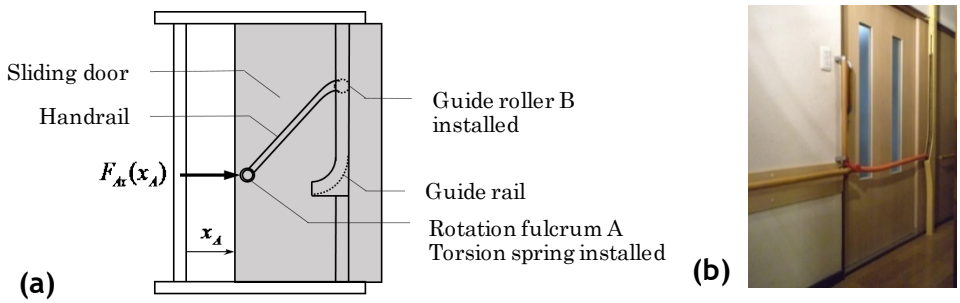
Figure 1. Examples of sliding doors used in Japanese welfare facilities.

In addition, installing handrails over the entire length of the corridors eliminates risks of falling during walking and increases their motivation to walk (Arfken, Lach, Birge, & Miller, 1994; Chu et al., 1999; Cumming, Salkeld, Thomas, & Szonyi, 2000; Gunter, White, Hayes, & Snow, 2000; Howland et al., 1998; Kim, Yoshida, & Suzuki, 2001; Lachman et al., 1998). From this viewpoint, in this study, the final goal is to develop a retractable handrail fixed on the surface of the sliding door (Kubo, 2011; Kubo, 2017) to support elderly people walking by themselves. This product is useful for maintaining

and restoring the walking function of elderly people by providing a self-support environment, which can contribute to a healthy life expectancy. Dozens of studies on handrails are found including handrail shapes intended to prevent falling over on stairs and handrail position designs for a movement from a seated to a standing position (Chihara & Seo, 2014; Dusenberry, Simoson, DelloRusso, & Rao, 2009; Ishihara et al., 2002; Min, Kim, & Parnianpour, 2012). However, research and development of handrails that can be attached to the sliding doors along corridors have not been well conducted. Additionally, several conventional products on sliding doors are currently available, which have a risk of falling off or falling down and cannot be used without the possibility of fear.

Figure 2 illustrates the retractable handrail on the sliding door considered in this study. This paper deals with how to design the handrail device to enable the safe use of elderly and people with disabilities. Specifically, experiments and numerical simulations were performed to clarify the effect of the retractable rail geometry on the opening force to enhance the operability of the sliding door with the retractable handrail during the opening.

Figure 2. Illustration of sliding door with retractable handrail: (a) Opening state of sliding door; (b) Sliding door with handrail.

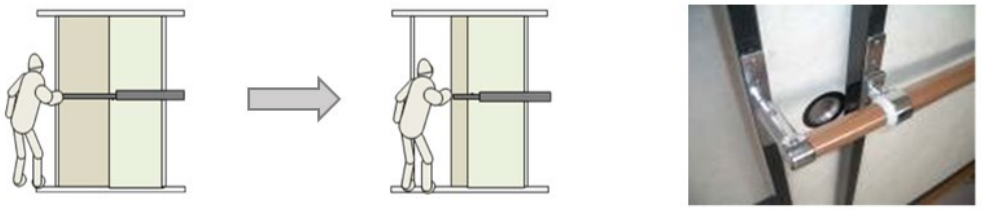


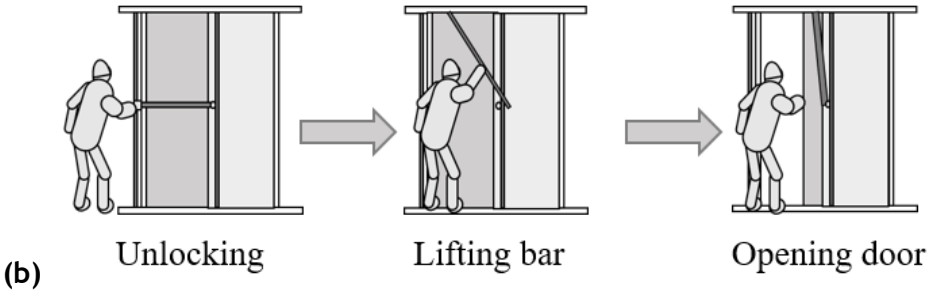
Conventional handrails on sliding doors and their problems

Figure 3 illustrates three kinds of conventional handrails closely related to the proposed retractable handrail in Figure 2. Figure 3(a) shows the telescopic type whose door may fall out from the threshold when the human weight is fully applied to the handrail (Itoh, 2007). Figure 3(b) shows the flip-up type

handrail (Mazroc Co., Ltd., 2019). Although the door may have enough strength, the flip-up operation of the handrail is difficult for elderly people. Figure 3(c) shows the stand type handrail (Kitamura, 2007), which can be installed easily in Japanese rooms. However, the structure is unstable because the vertical supporting force from tatami mats varies.

Figure 3. Conventional handrails closely related to Figure 1: (a) Telescopic type handrail attached on sliding door; (b) Flip-up type handrail attached on sliding door; (c) Stand type handrail installed in a Japanese room.



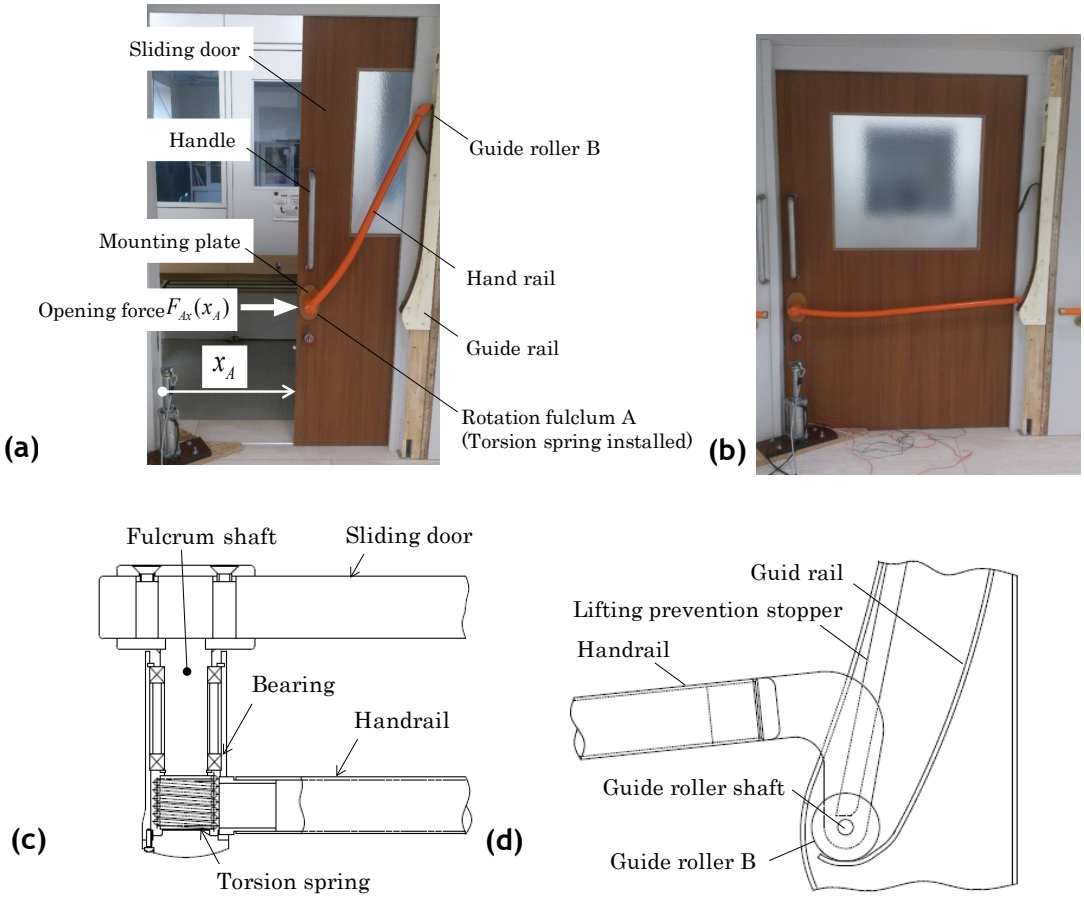


It is harsh for elderly people to stand with their trembling limbs, support their weight with one hand so as not to fall, operate the handrail with the remaining hand, and open the sliding door. In addition, there remains a concern about the door strength and safety. In this way, the conventional technology seems to have been designed mainly from the viewpoint of a healthy person.

Structure of sliding door with semi-automatic retractable handrail utilizing open/closing movement considered in this paper

Figure 4(a) shows the sliding door with the retractable handrail, which is composed of a sliding door, retractable handrail, rotation fulcrum, rotary roller of the retractable handrail and guide rail. Under the closed state of the sliding door, the retractable handrail becomes horizontal and functions as a handrail. Figure 4(b) shows the closed state of the sliding door. With the movement of opening the sliding door, the retractable handrail moves around the rotation fulcrum A, and the rotating roller B at the end of the handrail moves upward along the rolling surface inside the guide rail stand. In this way, the handrail is retracted by utilizing the opening movement. Due to the weight of the handrail, the sliding door can be closed automatically. Figure 4(d) shows the guide roller B and the guide rail. When the sliding door is closed, the retractable handrail moves downward along the rolling surface inside of the guide rail. Figure 4(c) shows the structure of the rotation fulcrum A with the built-in torsion spring. The torsion spring whose spring constant k = 2395 N mm/rad is equipped on the rotation fulcrum A (Sasuga, 2003). When the door is opened, the torsion spring supports the movement and the rotation of the handrail and reduces the opening force. In this way, the handrail is designed to be raised and lowered semi-automatically by utilizing the sliding door opening/closing movement. Therefore, even elderly people can easily open and close the door by their weak force, 2 kgf = 19.6 N or less (Tanaka et al., 2004). This sliding door can be opened with one hand, and it can be used by wheelchair users pushing and pulling the handrail with a small force. If the opening force of the sliding door can be design in a suitable way, it will be stable and easy for the users to use.

Figure 4. Retractable handrail on sliding door: (a) Opening state of sliding door; (b) Closed state of sliding door; (c) Structure of rotation fulcrum A; (d) Guide roller B and guide rail.



Simulation of sliding force

Equilibrium of handrail to obtain opening force

The numerical simulation is conducted to investigate the opening force. To simplify the simulation, the guide rail is assumed to consist of a curve and a straight line sections, as shown in Figure 7(b). Figure 5 illustrates the handrail model considered when the torsion spring M (in Figure 6) is not installed. Figure 6 shows the free body diagram of the handrail when the torsion spring is installed on the rotation support of the shaft. Equations (1) to (3) are derived from the equilibrium in Figure 6.

$$F_{Ax}(x_A) = Q\cos(\theta+\varphi) + P\sin(\theta+\varphi) \quad (1)$$

$$F_{Ay}(x_A) + P\cos(\theta+\varphi) = W + Q\sin(\theta+\varphi) \quad (2)$$

$$M + lP\cos\varphi = \frac{1}{2}lW\cos\theta + lQ\sin\varphi \quad (3)$$

From equations (1) to (3), the following expressions are obtained.

$$F_{Ax}(x_A) = \mu_t P\cos(\theta+\varphi) + P\sin(\theta+\varphi) \quad (4)$$

$$F_{Ay}(x_A) = W + \mu_t P\sin(\theta+\varphi) - P\cos(\theta+\varphi) \quad (5)$$

Figure 5. Schematic illustration of retractable handrail and guide rail.

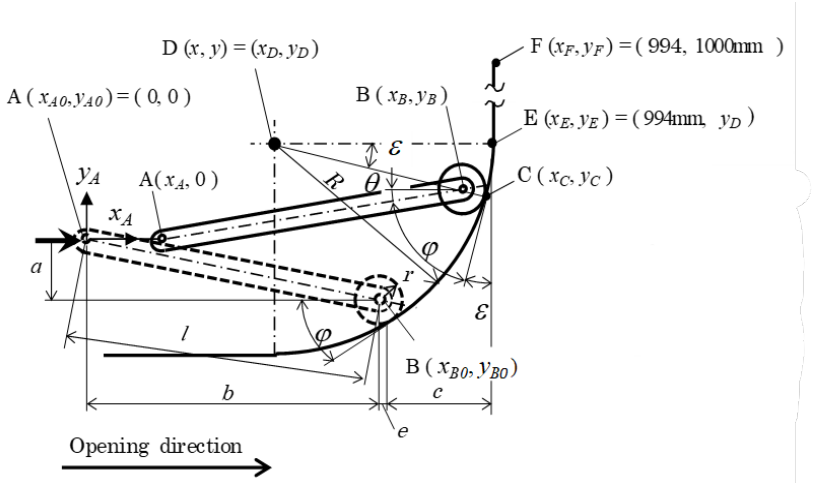
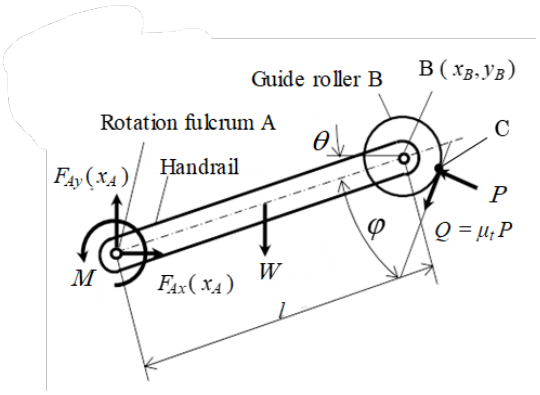


Figure 6. Equilibrium of external forces with torsion spring.



As shown in Figure 5, a Cartesian coordinate system (x, y) is used to describe the handrail position during the opening of the sliding door. When the sliding door is fully closed, the origin (x, y) = (0, 0) is defined as the coordinates (x_A, y_A) of the rotation fulcrum A. Then, the door's position can be expressed by the position of point A as $x = x_A$. To describe the coordinates (x_{B0}, y_{B0}) at the

rotation fulcrum B, the angles θ and φ in Figure 5 will be used in relation to the coordinates of the centre point D at $(x, y) = (x_D, y_D)$ with the curvature radius R. The following equations can be used during the sliding door opening at $x = x_A$.

$$\theta = tan^{-1}\frac{(y_B - y_{B0}) - a}{\sqrt{l^2 - ((y_B - y_{B0}) - a)^2}} \quad (6)$$

$$\varphi = 90^\circ - (\theta + \varepsilon) \quad (7)$$

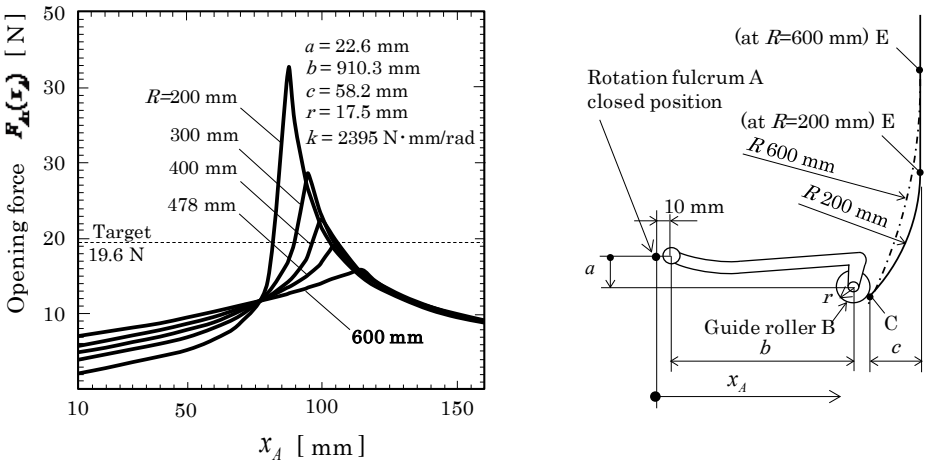
$$\varepsilon = sin^{-1}\frac{y_D - (y_B - y_{B0})}{R - r} \quad (8)$$

As shown in equations (4) and (5), the opening force $F_{Ax}(x_A)$ includes equations (6) to (8). Note that the effect of the inertia force on the opening force $F_{Ax}(x_A)$ is small enough to be negligible.

Guiderail geometry and opening force

In this section, simple geometry of the guide rail is assumed. Then, the opening force is discussed. Figure 7(a) shows the simulation results of the opening force $F_{Ax}(x_A)$ obtained from equation (4) when R = 200, 300, 400, 478, and 600 mm. Figure 7(b) illustrates the simulation model where the guide rail consists of a curve and a straight line sections.

Figure 7. Sliding force $F_{Ax}(x_A)$ in Figure 5 obtained from equation (4) by varying R: (a) Simulation value; (b) Simulation model.



In this modelling, the opening force is obtained when x >> 10 mm since the guide rail geometry 0 ≤ x ≤ 10 mm will be considered later. When the door is

at x = 10 mm, the guide roller B starts contacting the point C at the end of the circular arc in Figure 7(b). As shown in Figure 7(a), the opening force $F_{Ax}(x_A)$ increases gradually while the distance x_A is increasing and takes the maximum value in the vicinity of xA = 79 to 105 mm, then decreases gradually. In Figure 7(a), the maximum opening force increases with decreasing R.

Discussion on maximum opening force

As shown in Figure 7(a), the opening force takes the maximum value at a certain distance around x_A = 79 to 105 mm. In this section, the distance x_A showing the maximum opening force is discussed. First, let us focus on the angle φ in Figure 5 between the handrail bar direction of the line AB and the tangential direction of the guide rail. Figure 8 illustrates three models having a different angle φ. When the angle $\varphi = 90^\circ$ in Figure 8(a), the force F_A acting perpendicularly to the guide rail cannot raise the point B in the upward direction. Instead, when $\varphi < 90^\circ$ as shown in Figure 8(b), the roller can be raised. When the angle φ is smaller as shown in Figure 8(c), the roller can be moved by a smaller force. Thus, when the angle φ approaches 90°, the opening force becomes greater.

Figure 8. Schematic illustration $F_{AX}(x_A)$ depending on φ : (a) $\varphi = 90^\circ$; (b) φ = Middle < 90°; φ = Small << 90°.

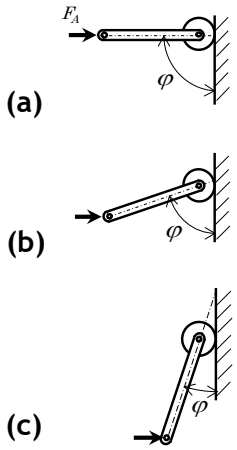
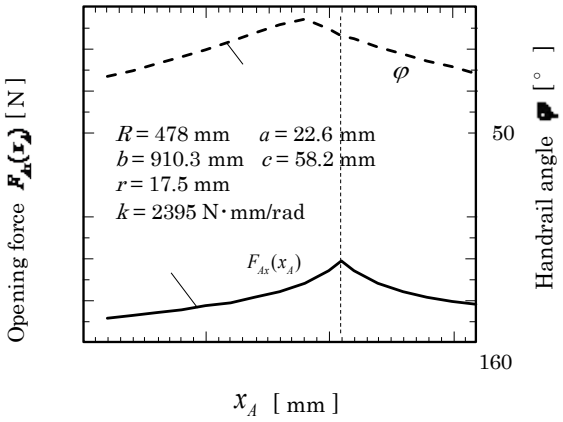


Figure 9 compares the sliding force $F_{Ax}(x_A)$ and the angle $\varphi(x_A)$ with respect to the opening distance x_A. The angle φ increases while the distance x_A is increasing and takes a peak value around the point E in Figure 5, then decreases. A similar behaviour can be seen for the sliding force $F_{Ax}(x_A)$. The peak value position of φ is slightly different from the peak value position of

$F_{Ax}(x_A)$ because the roller diameter affects the results. The maximum opening force $F_{Ax}(x_A)$ appearing in a convex form can be explained with the angle φ variation. The maximum opening force appears when the point B locates at the circular arc end point E in Figure 5 where the straight portion starts. Tanaka et al. (Tanaka et al., 2004) reported that the opening force of 20 N or less is suitable for elderly people. Therefore, in this study, based on the target opening force $F_{Ax}(x_A)$ = 2 kgf = 19.6 N, the radius of curvature of the prototype guide rail is designed as R = 478 mm.

Figure 9. Opening force $F_{AX}(x_A)$ closely related to angle $\varphi(x_A)$.



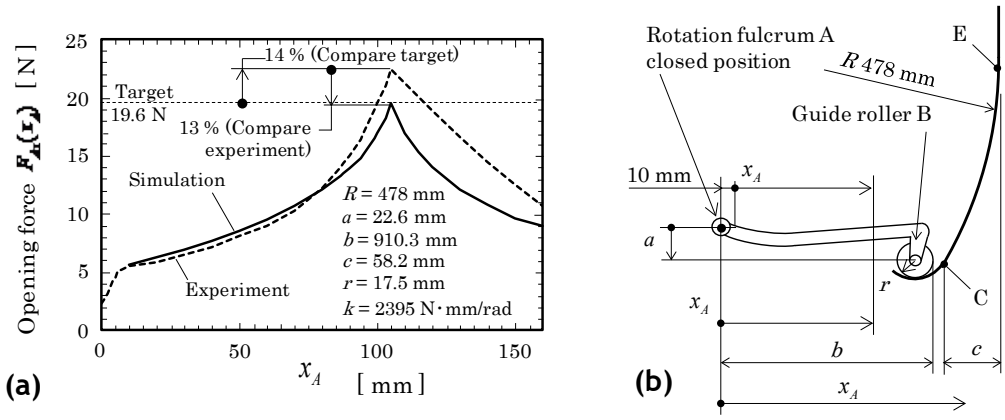
Prototype handrail geometry and opening force

Opening force of prototype sliding door

Figure 10(a) compares the analytical and experimental results of the opening force of the prototype handrail shown in Figure 10(b), whose R = 478 mm. The experimental value is obtained using a spring scale in the range $0 \le x_A \le 160$ mm, which is from the fully closed position to x_A = 160 mm. The experimental opening force $F_{Ax}(x_A)$ increases sharply from $F_{Ax}(x_A)$ = 2.3 to 5 N because the radius R is small (17.5 mm) at the lower end of the guide-rail, as shown in Figure 11(b). To start opening the door, 2.3 N is necessary. After that, both of the opening forces $F_{Ax}(x_A)$ analytically and experimentally obtained gradually increase and reach the maximum at the point S, then decreases. The analytical maximum value equation (4) F_{Axmax} = 19.5 N and the experimental maximum value F_{Axmax}^{Exp} = 22.4 N coincide with each other

within 13%. The difference is mainly caused by the guide rail fabrication and assembly errors. Equation (4) does not include the inertia force effect, but the error can be estimated within several percentage points.

Figure 10. Opening force $F_{AX}(x_A)$ of prototype sliding door: (a) Sliding force $F_{AX}(x_A)$ value; (b) Handrail model.



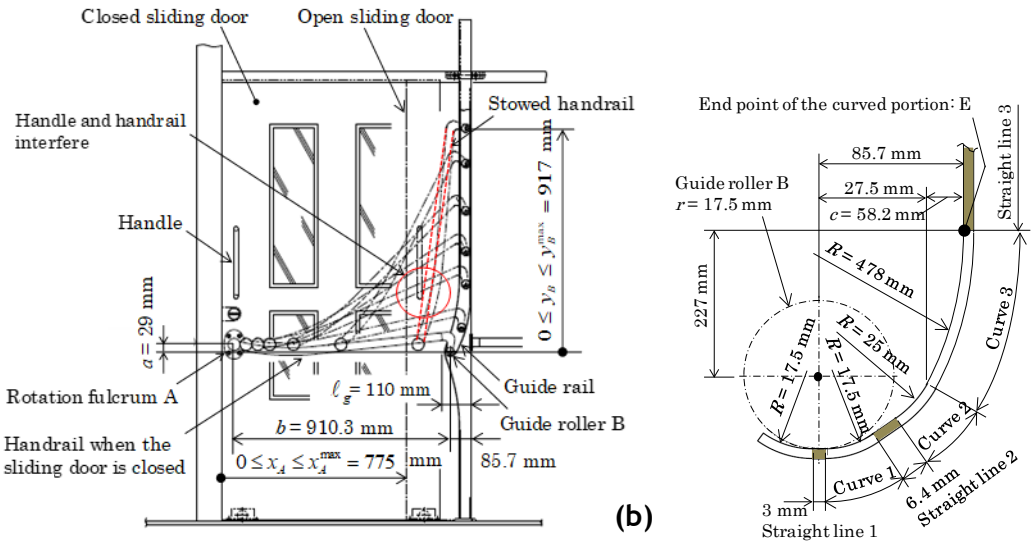
Although the simulation result when R = 478 mm in Figure 10(a) satisfies the target value $F_{Amax} \leq 19.6$ N, the experimental result F_{Amax}^{Exp} = 22.4 N is slightly greater than the target value by 2.8 N (14%). This difference of 2.8 N can be eliminated by adjusting the torsion spring attached to the rotation fulcrum A. It is concluded that the target opening force can be realized without changing the design specifications.

Details of prototype guide rail geometry

Figure 11(a) illustrates the movement of the retractable handrail. The feature is that the handrail on the sliding door in the horizontal state can be retracted vertically by the rotation around the rotation fulcrum A utilizing the movement of the sliding door opening. In addition to the small opening force 19.6 N shown in Figure 7(a), enough space is also required during the opening for wheelchairs to go through. Therefore, the dimension for storage shown as the notation l_g in Figure 11(a) should be designed as small as possible so that the retracted handrail as well as the guide-rail does not interfere with daily life during the opening. The following design specifications are set to satisfy those requirements. First, in Figure 11(a), the sliding door opening distance is set as x_A^{max} = 775 mm based on the wheelchair width of 700 mm.The horizontal dimension of the storage space l_g in Figure 11(a) is set as l_g =

110 mm to increase the opening distance. The relative positions between the rotation fulcrum A and the guide roller B are determined to realize the smooth movement of the handrail when the guide rail geometry is determined. In addition, as shown in Figure 11(a), the handrail is gently bent to avoid interference between the handle and the handrail when the sliding door is fully opened (see the red circle in Figure 11(a)).

Figure 11. Prototype retractable handrail trajectory and guide rail details: (a) Outline of sliding door device; (b) Detail of guide rail.



Next, the detailed geometry of the prototype guide rail will be explained. The smooth handrail movement totally depends on the guide rail. Figure 11(b) illustrates the guide rail geometry of the prototype determined after several trials. The guide rail geometry consists of three straight line and three circular arc sections. The straight line 1 and the circular arc 1 may allow the door's installation position error to close the door completely. The circular arc 2 and the straight line 2 are set to produce the initial opening force $F_{Ax}(x_A) = 5$ N in Figure 10(a). This is because a small initial opening force $F_{Ax}(x_A) < 5$ N is dangerous for elderly people. As shown in Figure 10(a) , the opening force suddenly increases from $F_{Ax}(x_A) = 0$ at $x_A = 0$ to $F_{Ax}(x_A) \approx 5$ N at $x_A \approx 5$ mm. The circular arc 3 with $R = 478$ mm is set to obtain the maximum opening force within 19.6 N. In this way, the prototype guide rail is suitable for opening the sliding door. It was also confirmed that the door is closed automatically due to the weight of the handrail. It should be noted that the closing speed

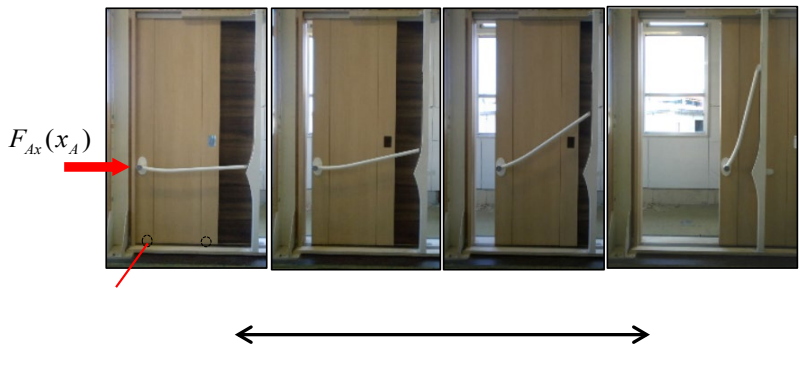
becomes slower at the end of the closing due to the smaller radiuses of the circular arcs 1 and 2.

Repeated opening/closing test for sliding door

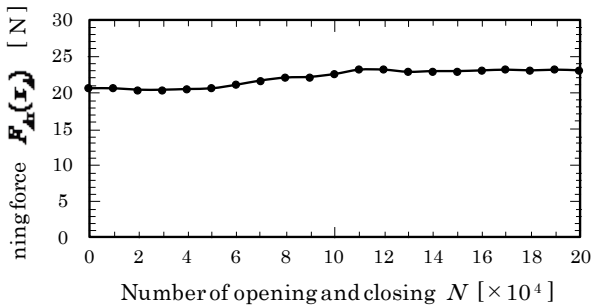
Figure 12(a) illustrates a repeated opening/closing test condition for the sliding door. The second prototype equivalent to the first one, which was used for the measurement of the opening force $F_{Ax}(x_A)$, was used for this test. In this experiment, the door is opened and closed manually until the number of cycles reaches 200,000. The following procedure is repeated; grabbing the handrail handle, opening the sliding door until the position where the handrail is fully raised, and then fully closing the sliding door. The average speed is 12.5 cycles/min with a 775 mm sliding stroke. The opening force was measured with a spring meter every 10,000 cycles. When the door is opened, the maximum value was visually read. Figure 12(b) is the plot of the measured opening force values in the repeated opening/closing test. The opening force $F_{Ax}(x_A)$ gradually increases from 20.5 N at the beginning of the test, reaches the maximum value of 23.1 N at 110,000 times, then becomes almost constant until 200,000 times. The amount of increase in opening force is about 10%. This is because wear occurs on resin wheels supporting the door and on the rail surface due to the repeated opening/closing operations. The wear increases running resistance. After the test, the wear marks were found on the wheels and rail surface though they were new at the beginning of use.

Figure 12(c) shows the wear condition of the rail and wheel surfaces after the test. The main cause of this wear is considered to be jammed minute particles including dust as well as the rollers becoming overheated by the frequent and repeated operation of the sliding door. In the experimental condition of this case, the opening/closing speed of the sliding door is the same as that in normal use though the number of operation is high. This level of the change in the opening force is acceptable in function. The above-mentioned experiment confirms that the sliding door is capable of withstanding 200,000 times of repeated opening/closing use at the maximum without significant change.

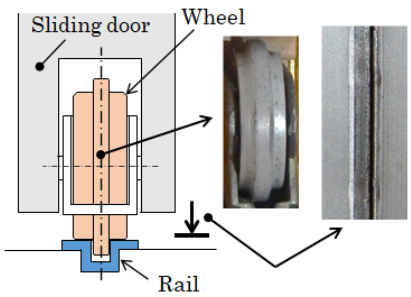
Figure 12. Repeated opening/closing test for sliding door: (a) Repeated opening/closing test for sliding door; (b) Opening force vs number of cycles; (c) Rail and wheel wear.



(a)



(b)



(c)

Conclusions

In this study, to support the senior and people with disabilities to walk independently, a semi-automatic retractable handrail was developed utilizing opening/closing movement of the sliding door. The sliding door with the retractable handrail can be installed in hospitals and nursing facilities. A theoretical formula was derived from the equilibrium of the handrail to reduce the opening force. The conclusions can be summarized in the following way.

(1) The opening force variation was numerically evaluated by using the derived formula including the maximum value. The experimental measurement shows that the error is within 13%.

(2) The effect of the rail curvature on the opening force was clarified as well as the effect of the height of the rotation fulcrum at the end of the guide rail. By using a torsion spring in the rotation fulcrum A, the opening force can be less than the target value of 19.6 N.

(3) To obtain the enough passage width for wheelchairs, the horizontal dimension of the storage space was set as small as possible (see Figure 11(a)). The guide rail with the circular arc radius R = 478 mm is set to reduce the maximum opening force. The relative positions between the rotation fulcrum A and the guide roller B are determined to realize the smooth movement of the handrail when the guide rail geometry was determined.

(4) The guide rail geometry consists of three straight line and three circular arc sections. The straight line 1 and the circular arc 1 may allow the position error when the door is installed to close the door completely. The circular arc 2 and the straight line 2 are set to produce the initial opening force $F_{Ax}(x_A)$ = 5 N in Figure 10(a). This is because a small initial opening force $F_{Ax}(x_A)$ < 5 N is dangerous for elderly people. The handrail is gently bent to avoid interference between the handle and the handrail when the sliding door is fully opened (see the red circle in Figure 11(a)).

(5) To secure the safety of the sliding door, a repeated opening/closing test was conducted. The results show that the retractable handrail and the sliding door may withstand 200,000 cycles within an increase of the running resistance by about 10% due to wear appearing on the built-in wheels and the sliding door rail surface.

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PEOPLE WITH INTELLECTUAL DISABILITIES AND THEIR HEALTH CARE UTILIZATION IN KOREA: A STUDY USING THE KOREA WELFARE PANEL STUDY (KOWEPS)

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***Abstract*:** Empirical studies on health care utilization by people with disabilities are rare in South Korea. There exist even fewer studies that examine health care utilization by people with intellectual disabilities and that compare the health care utilization pattern by this population vs by population with other types of disabilities. This study investigates the characteristics of people with intellectual disabilities (vs those with non-intellectual disabilities) and evaluates the relationship between the presence/absence of intellectual disabilities and health care utilization. The present study analyzed the 2005 and 2016 Korea Welfare Panel Study data. The final sample included observations from these two years that span over the ten-year period. Health care utilization was operationalized by whether the people with disabilities (intellectual and non-intellectual) participated in health screening, how often they received outpatient physician visits, and how long they received inpatients service. To examine the effect of the types of disabilities on health care utilization, random-effects logistic regression and negative binomial regression models were employed. The present study found that people with intellectual disability showed a much lower attendance rate than both people with non-intellectual disabilities and people without disabilities. The percentage of those who received outpatient service experience was higher for people with non-intellectual disabilities than for people with intellectual disabilities. The mean annual number of outpatient visits was greater for people with non-intellectual disabilities than for people

with intellectual disabilities. People with intellectual disabilities also showed a lower rate of inpatient experience compared to those with non-intellectual disabilities. Based on these results, it is suggested that policy-makers should promote fuller access to the use of health care services for people with intellectual disability. In addition, more efforts should be made for people with intellectual disabilities to participate in medical research so that they can express their demands on health-related issues.

Keywords: Intellectual disabilities, Health care, Korea welfare panel study.

Introduction

Are persons with disabilities living a happy life in Korea? The answer to these questions might be to see if they are leading a life free from restrictions in terms of socio-economic, health, housing, and time use characteristics(Campen & Iedema, 2007). The Korean Welfare Law for the Disabled, which was put in effect in 1982, following the United Nations' declaration of 1981 as the International Year of Disabled Persons, defines a person with intellectual disabilities as someone with a permanent delay in mental development or incomplete intellectual development, and who is in considerable difficulty in dealing with his or her work and adjusting to everyday life. These delays in mental development limit them to taking care of their own health.

Though the overall economic income level of the Republic of Korea has increased (e.g., South Korea gnp for 2019 was $1,743.71B, a 3.62% increase from 2018) and the average life expectancy has also increased (e.g., The current life expectancy for South Korea in 2020 is 83.06 years, a 0.18% increase from 2019. The life expectancy for South Korea in 2019 was 82.92 years, a 0.18% increase from 2018), Jung (2018) reported that people with disabilities face worse health problems than non-disabled people. That weak health conditions tend to develop early chronic diseases and secondary dysfunction compared to non-disabled people. According to Kim et al. (2017), disabled people have lower rates of health care than non-disabled people. This is in contrast to higher rates of health care for non-disabled people, the highly

educated, and high-income people. As such, the gap between underprivileged and privileged people experienced by the disabled regarding access to health care services is constantly recognized as a social problem (Kim et al., 2017).

Existing studies covering the medical status of people with disabilities are mostly focused on access to medical services by people with retardation and brain lesions and those with vision and hearing impairment (Kim et al., 1998; Lee, Kim, & Kang, 2003; Choi & Kim, 2015; Lee & Hong, 2017). After all, people with intellectual disabilities are faced with the fact that access to medical services is weaker compared to people with other types of disabilities as well as non-disabled people. This dual alienation phenomenon is in line with studies of quality of life by disability type (Kim, 2008; Kim, 2002) and with the results of a study in which intellectually disabled and non-disabled people were compared with respect to the quality of life (Oseran, 2006), which claimed that the quality of life is lower for intellectually disabled people than for those with other types of disabilities.

Outside Korea, studies on the intellectually disabled have been conducted (Lee & Hong, 2017; Shogren, Wehmeier, Ress, & O'Hara, 2006). These have studied developing programs and curriculums to promote self-determination of the health, decision-making and medical services for the intellectually disabled. Compared to these overseas studies, the study using KoWeps 2016(which will be presented in the next section) that focused on access to and use of medical services by people with intellectual disabilities is relatively insufficient in Korea. Therefore it is significant to investigate the utilization rate of health care services for people with intellectual disabilities in Korea.

Methodology

Description of Data

This study analyzed the Korea Welfare Panel Study (KoWePS) for two years, i.e., 2005 and 2016 (KoWePS, 2016). I selected these two specific years since the two are the ones where the first and the most recent survey data were gathered. The data come from a nationwide survey containing a range of detailed welfare information of the respondents, including the use of welfare services, economic activity status, financial status, household conditions, and other general characteristics of the participants. This panel survey was conducted jointly by the Korea Institute for Health and Social Affairs (KIHASA) and the Social Welfare Research Center of Seoul National University (KIHASA & SNU, 2016). To better represent the sample of the population that is socio-economically disadvantaged, the survey made use of a stratified double sampling model to ensure that low-income families (who are less than 60% of median income) are over-sampled.

Participants

When pooled across the 2005 and 2016 data, the KoWePS dataset contains a balanced panel of a total of 19,820 individuals. Included in this study are selected sample of adults whose age range from 20 to 64(N=14,098). Individuals that belong to this specific age range were chosen since those who are outside of this age range differ in terms of health care benefits they receive from the Korean government and other related factors from the target sample in this study (Jeon, Kwon, Lee, & Kim, 2015).

Dependent Variables

The focus of this study is to investigate how individuals with intellectual disabilities compared with those with other types of disabilities concerning their health care utilization in a given year. In this study, health care utilizations were operationalized in terms of three key variables, i.e., whether they attended the annual national health screening, how often they used outpatient services, and how long they stayed in hospitals for health-related

problems. Attending health screening is important in that it reflects how early diseases can be detected so that the individuals can be properly treated in a timely manner, ensuring prevention of further mental/physical losses, and, if necessary, intervention with diseases (Ko, Lee, Lee, et al., 2011). The number of outpatient visits (i.e., the sum of outpatients uses) and that of inpatient days (i.e., the sum of inpatient days) are selected as key dependent variables since they are considered as important indicators of the level of one's access to health care system (United Nations, 2006). It needs to be noted here that for the days of outpatient visits, KoWePS counts as one whether a person was treated at the same hospital two or more times for different illnesses. However, when the person visited two separate hospitals, the visits were counted as two. Also, health screening participation, the number of outpatient visits, and the number of hospitalization days were examined.

Independent Variables

The key independent variable in this study was the types of disabilities (i.e., intellectual vs non-intellectual) that individuals have. To begin with, it is necessary to define whether a person has any disabilities. Based on previous studies (Ministry of Health and Welfare Institute for Health and Social Affairs, 2012; Korea Ministry of Health and Welfare Homepage, 2019), in South Korea, a person qualifies as having a disability when they have one or more disabilities defined by the Korea disability registration system. In the case of multiple disabilities, KoWePS recorded the most severe handicap. If the level of severity is identical, respondents were requested to enter the one that poses more difficulty for their life. In addition to disability status, characteristics of individuals, including gender, age, marital status, place of residence, education level, employment status, annual equalized disposable household income, public health insurance type, self-rated health status, and chronic disease status were examined.

Statistical Analyses

Descriptive analyses were conducted for the general characteristics of individuals. I compared the health status and health care utilization of people with vs. without intellectual disabilities. Wald Chi-squared tests were performed to compare categorical variables, such as the percentage of good or excellent ratings for self-rated health, having chronic diseases, and whether the respondents experienced health screenings and received outpatient or inpatient care services. To compare the means for health care utilization days according to whether people had an intellectual disability or not, an unequal variances Welch's t-test was performed.

In estimating the relationship between the presence of intellectual disabilities and health screening participation, I first applied bivariate (unadjusted) random-effects logistic regression analyses. Subsequently, I performed multivariate (adjusted) random-effects logistic regression analyses, including all the covariates. For the relationship between the presence of intellectual disabilities and the number of outpatient visits or the number of hospitalization days, I also performed bivariate random-effects negative binomial regressions and applied multivariate random-effects negative binomial regressions with covariates to adjust for these factors. Sensitivity analyses were conducted to estimate the relationship between the extent of disability and the three dependent variables: health screening participation, the number of outpatient visits, and the number of hospitalization days. I selected the random-effects model to address heteroscedasticity and the time-series correlation in the longitudinal dataset. All analyses were conducted using proper weights to report nationally representative estimates.

Results

Table 1 shows the general properties of the target population. Among the 14,098 observations, the number of people with intellectual disabilities was 70(0.5%) (vs with non-intellectual disabilities 1,380(9.8%)). Among the people with intellectual disabilities, more than 57% were men, and the mean age was approximately 38 (SD:±11.1). The percentage of intellectually disabled people with an education level of high school or higher was 20%. The proportion of

intellectually disabled people whose employment status is unemployed or unpaid family workers was 71.8%. The mean annual equalized household disposable income of this population was 12.5 million KRW (approximately 11,109 USD), and as much as 50% of these people were assisted by the Medical Aid program. To be able to receive this program, the household to which the intellectually disabled people belong must have income that is less than the minimum cost of living per household. Like those with intellectual disabilities, there were more men with non-intellectual disabilities (55.9%). However, compared to those with intellectual disabilities, those with non-intellectual disabilities were more educated (high school or higher: 35.5%), with a lesser proportion being unemployed or unpaid family workers (65%). The household income of those with non-intellectual disabilities was higher (16.2 million KRW) than that of those with intellectual disabilities. The proportion of beneficiaries of the Medical Aid program among the people with non-intellectual disabilities was 22.6%, which was relatively low in proportion compared to people with intellectual disabilities.

*Table 1. General characteristics of the study population (wt % = weighted %, *p < 0.05).*

		Total wt %	People with intellectual disabilities (n = 70) wt %	People with non-intellectual disabilities (n = 1380) wt %	People without disabilities (n = 12,648) wt %	*p* values
Gender	**Female**	55.8	42.9	44.1	57.2	*
	Male	44.2	57.1	55.9	42.8	
Age group (year)	**20-29 years**	13.3	24.3	3.7	14.3	*
	30-39 years	21.4	28.6	12.0	22.3	
	40-49 years	20.4	28.6	18.8	20.5	
	50-59 years	19.6	14.3	28.4	18.6	
	60-64 years	25.4	4.3	37.0	24.2	
	Age (mean ± SD)	46.7 ± 13.9	38.6 ± 11.1	53.1 ± 11.6	46.1 ± 14.0	*
Place of residence	**Seoul**	16.7	10.0	14.1	17.1	
	Big 5 metropolitan cities	26.5	27.1	26.7	26.4	

		Total wt %	People with intellectual disabilities (n = 70) wt %	People with non-intellectual disabilities (n = 1380) wt %	People without disabilities (n = 12,648) wt %	*p* values
	City	34.2	37.1	32.4	34.4	
	County	19.2	21.4	23.7	18.7	
	City-Rural mixture	3.3	4.3	3.2	3.3	
Marital status	**Married**	73.5	37.1	67.0	74.4	*
	Other	26.5	62.9	33.0	25.6	
Education	**Middle school or lower**	43.4	80.0	64.5	40.9	*
	High school	31.7	17.1	25.4	32.5	
	College or higher	24.9	2.9	10.1	26.6	
Employment status	**Employer, self-employed**	16.5	2.6	16.3	16.5	*
	Permanent employee	37.3	25.6	18.7	39.7	

		Total wt %	People with intellectual disabilities (n = 70) wt %	People with non-intellectual disabilities (n = 1380) wt %	People without disabilities (n = 12,648) wt %	*p* values
	Unpaid family worker	6.9	7.7	4.5	7.1	
	Unemployed	38.9	64.1	60.5	36.7	
Annual equalized household disposable income (mean ± SD)	**Annual equalized household disposable income (mean ± SD)**	34.5 ± 41.5	20.6 ± 12.6	24.4 ± 30.3	35.6 ± 42.4	*
Public health insurance	**National Health Insurance**	76.0	50.0	77.4		*
	Medical Aid	24.0	50.0	22.6		

The self-reported health status, length of having chronic diseases, and the types of main diseases of the study population are shown in Table 2. First, 20.0% and 32.9% of people with intellectual disabilities reported that their health status was very poor and poor, respectively. The proportions of those with non-intellectual disabilities reporting their health being very poor and poor were 12.1% and 42.3%, respectively. Therefore, among those with disabilities, those with intellectual disabilities (vs those with non-intellectual disabilities) reported a higher percentage of their health being very poor. The proportion of people with intellectual disability having chronic diseases for more than 6 months was 55.7%. This was lower compared to that of the people with non-intellectual disability (76.8%) but was higher compared to that of the people without disabilities (41.2%). Overall, the proportion of having the five most frequently occurring diseases was relatively lower for people with intellectual disabilities. However, the relative prevalence of stroke and cerebrovascular disease, as well as that of diabetes, was almost the same for people with intellectual (vs non-intellectual) disabilities.

*Table 2. Perceived health status and main diseases of the target population (wt % = weighted %, *p < 0.05).*

		Total wt %	People with intellectual disabilities (n = 70) wt %	People with non-intellectual disabilities (n = 1380) wt %	People without disabilities (n = 12,648) wt %	*p* values
Self-rated health	**Very poor**	3.5	20.0	12.1	2.5	*
	Poor	20.5	32.9	42.3	18.1	
	Fair	20.4	21.4	23.2	20.0	
	Good	42.8	22.9	20.5	45.3	
	Very good	12.8	2.9	1.9	14.1	
Chronic disease	**None**	51.3	40.0	21.0	54.7	*
	Less than 3 months	2.2	2.9	1.3	2.3	
	3-6 months	1.7	0.0	0.1	1.6	
	More than 6 months	44.8	55.7	76.8	41.2	

Main diseases	**Arthritis, back pain, sciatic ache, herniated lumbar disc**	10.4	7.1	16.0	9.9	*
	Stroke, cerebrovascular disease	1.6	5.7	7.0	1.0	
	Hypertension	13.8	1.4	18.3	13.4	
	Diabetes	6.3	7.1	9.6	6.0	
	Fracture, dislocation, and/or after-effects of an injury	0.6	0.0	1.6	0.5	

The patterns of annual health care utilization are presented in Table 3. There was a difference in health screenings attendance rate between people with intellectual disability and people with non-intellectual disabilities. People with intellectual disability showed a much lower attendance rate (27.1%) than both people with non-intellectual disabilities (41.7%) and people without disabilities (42.6%). The percentage of those who received outpatient service experience was higher for people with non-intellectual disabilities (92.8%) than for people with intellectual disabilities (78.6%). The mean annual number of outpatient visits was greater for people with non-intellectual disabilities (30.3 visits) than for people with intellectual disabilities (16.1 visits). The latter rate is almost identical to that of people with no disabilities (15.0 visits). People with intellectual disabilities also showed a lower rate of inpatient experience (11.4%) compared to those with non-intellectual disabilities (22.6%). However, when it comes to the number of inpatient days, people with intellectual disabilities (8.4 days) and people with non-intellectual disabilities (9.4 days) were not different. Notwithstanding, people with disabilities stayed for longer periods in hospitals compared to people without disabilities (2.0 days).

*Table 3. Patterns of annual health care utilization by the target population (wt % = weighted %, *p < 0.05).*

		Total wt %	People with intellectual disabilities (n = 70) wt %	People with non-intellectual disabilities (n = 1380) wt %	People without disabilities (n = 12,648) wt %	*p* values
Health screening experience	Yes	42.5	27.1	41.7	42.6	*
Outpatient service experience	Yes	82.0	78.6	92.8	80.9	*
Number of outpatient visits	Mean ± SD	16.5 ± 29.0	16.1 ± 25.8	30.3 ± 43.9	15.0 ± 26.5	*
Inpatient experience	Yes	11.4	11.4	22.6	10.2	*
Number of inpatient days	Mean ± SD	2.8 ± 16.2	8.4 ± 38.6	9.4 ± 34.3	2.0 ± 12.3	*

Table 4 reports the result of statistical analyses exploring the relationship between the presence of disabilities and health care utilization. In the adjusted logistic regression model, compared to people with no disabilities, people with intellectual disabilities has significantly lower odds of receiving a health screening (OR = 0.50, 95% CI = 0.29–0.85). However, there was no significant difference in health screening attendance between people with non-intellectual disabilities and without disabilities.

The association between having a disability and the number of outpatient care days varied depending on the types of disabilities. Having an intellectual disability was negatively associated with the number of outpatient care days in the binomial regression model, although this association was not statistically significant. On the contrary, having a non-intellectual disability was significantly positively associated with the same variable ($p < .001$).

Having a disability was negatively related to the number of inpatient days, in both people with intellectual disabilities and non-intellectual disabilities.

*Table 4. Estimation results of the association between disabilities and health care utilization (ref = reference, *p < 0.05).*

		Whether respondents received health screenings	Number of outpatient visits	Number of inpatient visits
	Independent variable	OR(95% CI)/Adj OR (95% CI)	*β* (SE)/Adj *β* (SE)	*β* (SE)/Adj *β* (SE)
Key variable (ref = people with no disabilities)	**Intellectual disability**	0.501* (0.29, 0.85)/0.884*(.782, .998)	-.019(.170)	-1.711(.992)
	Non-intellectual disability	0.961 (0.85, 1.07)/0.846(0.435, 1.647)	.691*(.039)	-.015(.638)
Gender (ref = female)	**Male**	1.25* (1.17, 1.34)/1.25* (1.17, 1.34)	/-.279*(.021)	/.185(.106)
Age	**(Continuous)**	1.008(1.006, 1.010)/1.001*(1.006, 1.010)	/.021*(.003)	/-.087*(.048)
Marital status (ref = other)	**Married**	1.52* (1.41, 1.64)/1.52* (1.41, 1.64)	/.430*(.027)	/.176(.116)
Place of residence (ref = City-Rural mixture)	**Seoul**	1.13 (0.92, 1.38)/1.13 (0.92, 1.38)	/.029(.068)	/-.289(.295)
	Big 5 metropolitan cities	0.92 (0.75, 1.11)/0.92 (0.75, 1.11)	/.178*(.065)	/.067(.285)
	City	1.05 (0.86, 1.27)/1.05 (0.86, 1.27)	/.053(.065)	/-.164(.280)

		Whether respondents received health screenings	Number of outpatient visits	Number of inpatient visits
	County	1.10 (0.90, 1.35)/1.10 (0.90, 1.35)	/.252* (.066)	/-.033(.287)
Education (ref = middle school or lower)	**High school**	0.91* (0.84, 0.99)/0.91* (0.84, 0.99)	/–.089*(.027)	/-.194(.135)
	College or higher	1.21* (1.12, 1.32)/1.21* (1.12, 1.32)	/–.129*(.0006)	/-.579*(.158)
Employment status (ref = unemployed)	**Employer, self-employed**	1.12* (1.01, 1.24)/1.12* (1.01, 1.24)	/–.060*(.0005)	/– 1.464*(0.0019)
	Permanent employee	1.94* (1.79, 2.10)/1.94* (1.79, 2.10)	/–.186*(.0009)	/– .483*(.0026)
	Unpaid family worker	1.25* (1.08, 1.44)/1.25* (1.08, 1.44)	/–.036*(.0004)	/– 2.178*(.0069)
Public health insurance type (ref = National Health Insurance)	**Medical Aid**	0.65* (0.47, 0.90)/0.65* (0.47, 0.90)	/.021*(.003)	/0.224*(0.008)
Self-rated health (ref = very good)	**Good**	1.31* (1.18, 1.46)/1.31* (1.18, 1.46)	/.228(.0005)	/-.079 (.162)

		Whether respondents received health screenings	Number of outpatient visits	Number of inpatient visits
	Fair	1.44* (1.27, 1.62)/1.44* (1.27, 1.62)	/.522(.0006)	/.702*(.191)
	Poor	1.28* (1.14, 1.45)/1.28* (1.14, 1.45)	/.974(.0007)	/1.955*(.208)
	Very poor	0.98 (0.80, 1.21)/0.98 (0.80, 1.21)	/1.183(.0013)	/2.999*(.332)
Chronic diseases (ref = none)	**Less than 3 months**	2.21* (1.75, 2.78)/2.21* (1.75, 2.78)	/.674(.0009)	/1.012*(.337)
	3-6 months	1.78* (1.38, 2.30)/1.78* (1.38, 2.30)	/.934(.0012)	/1.754*(.377)
	More than 6 months	1.49* (1.39, 1.60)/1.49* (1.39, 1.60)	/1.145(.0004)	/1.509*(.102)
Year dummy (ref = 2005)	**Year 2016**	2.46* (2.30, 2.64)/2.44* (2.30, 2.64)	/.141*(.0004)	/.502*(.112)
	Constant	0.472(,)	/2.58*(.014)	

Discussion

This study explored the health-related characteristics of people with intellectual disabilities in Korea and compared the relationship between the types of disabilities and health care utilization. The present study found that people with intellectual disability showed a much lower attendance rate than both people with non-intellectual disabilities and people without disabilities. The percentage of those who received outpatient service experience was higher for people with non-intellectual disabilities than for people with intellectual disabilities. The mean annual number of outpatient visits was greater for people with non-intellectual disabilities than for people with intellectual disabilities. People with intellectual disabilities also showed a lower rate of inpatient experiences compared to those with non-intellectual disabilities.

By definition, people with intellectual disabilities have a harder time acquiring the ability to care for and protect their health than non-intellectually disabled or non-impaired people. In other words, people with intellectual disabilities lack the possibility to use healthcare-related information. If there are gaps in health promotion activities, access and utilization of the medical health system for those who already have a large gap with the non-intellectually disabled in their health conditions, the intellectually disabled group's health problems are in a serious situation (Lee, 2013). This is in line with the findings that people with intellectual disabilities are less likely to use medical services, generally less satisfied with the quality of medical care and more unsatisfactory than other disability types (Coughlin, et al., 2002; Yoon et al., 2007; Lee, 2013).

Although the health of the intellectually disabled is poor and they have limited ability to take care of their own health, prior research on the medical approach of the disabled is mostly focused on access to medical services for the non-intellectually disabled, including brain lesions, vision and hearing impaired (Kim et al., 1998; Lee, Kim, & Kang, 2003; Choi & Kim, 2015, Lee & Hong, 2017). Fieldman et al. (2014) argued that only 2% of the studies involved people with intellectual disabilities after analyzing 300 medical studies using

RCTs between 2007 and 2011. This shows that people with intellectual disabilities are in poor health overall, and they are also suffering from double difficulties being sidelined in studies dealing with access to medical services, and therefore efforts are required to improve this situation.

Second, people with intellectual disabilities had a shallow attendance rate for health examination compared to those with non-intellectual disabilities and those with disabilities. In the case of non-disabled people, regular medical checkups are used to check their health conditions and prevent future illnesses. As such, medical checkups are important enough to be necessary in modern times. Such medical examinations have a participation rate of less than 30 per cent for people with intellectual disabilities. The Korea National fourth Health Plan (Health Plan, 2020) conducted in 2016 shows that the use of health and medical services by people with intellectual disabilities is not sufficient, compared with the plan to raise the medical checkup rate for the disabled to 67.7 per cent in 2020. The results are also consistent with Lee's (2013) study that people with intellectual disabilities have a great desire for health care and promotion activities but suffer gaps in access to and utilization of health promotion activities or health care systems despite frequent contact with the health care system.

There could exist a number of reasons for the low attendance rate for the checkup by intellectually disabled people. The Korean Ministry of Health and Welfare (MoHW, 2020) reported problems regarding the inconvenience of transportation, lack of convenience facilities, lack of awareness about the financial burden of health checkup, hospital reservation, communication, and lack of facilities because of the slight symptoms due to the lack of awareness of the hospital's health examination. The hospital, a service agency, has been found to have problems such as restrictions on medical examination time and inadequate compensation for medical institutions, budget for setting up facilities for the disabled and lack of manpower. Examination items are suitable for the non-disabled, and examination items based on disability type and characteristics are found to be limited by disabled types. In the U.K., the Health Examination Program in the NHS is promoting cancer screening, and the medical institution operates separate tests for breast, cervical, and colon cancers(). There is no separate examination program for prostate cancer, but

services are provided for selective examination. Among the programs designed for the Australian public, the government is applying a method to increase the test rate by considering the characteristics of each type of disability so that disabled people can benefit from the program().

People with intellectual disabilities may need to be provided with information that can increase the utilization of medical and health services and that can educate or train them. Both 'unavoidable' innate physiological limitations and 'unreasonable' social barriers contribute to this group's health gap, so an integrated and comprehensive approach to a healthy life is needed (Lee, 2013). Here, social barriers include several possibilities in Korea. A shortage of proper public transportation(25), access barriers related to health care institutions(41), and even a lack of qualified health care providers(45) can all contribute to the unreasonable social barriers. The policy direction for enhancing health inequality suggests the level of education as a determinant of social health. The higher the level of education, the better and the more complex techniques for accepting health behaviours. One may argue that if adequate income and adequate medical services are well implemented, the threat of health resulting from low levels of education can be greatly reduced. We can see that state-level policy-making is more important than anything else in order to approach the diseases of the intellectually disabled at a preventive level.

The current results suggest that national policy-making will require, among other things, a status analysis of the disabled health promotion program and the facilities that operate it. We believe that there are limitations to the activities of the intellectually disabled people due to the lack of information related to how many institutions are currently carrying out health promotion programs for intellectually disabled people in Korea and how long it will take to wait for them to participate in (Kim & Jung, 2018).

The European Commission conducted an indicator development study to identify the health status of people with intellectual disabilities in Europe through the PONOMA Project, which was co-hosted by 14 countries. The report cited poor health conditions for people with intellectual disabilities (Horwitz et al., 2000; US Public HealthService, 2001; Fisher, 2004; Oullette-Kuntz,

2005; Krachn, Hammond, & Turner,2006) and indicated that proper research must be conducted before health can be measured effectively.

Overseas, health-related information provision and communication-related information support further studies for people with intellectual disabilities (Chinn & Homeeyard, 2016; Mastbroek et al., 2014), as well as research on the experience and role of medical staff in health education and medical support for people with intellectual disabilities (Focht-New, 2012). Programs for improving health care and self-help for people with intellectual disabilities are actively being developed. In Korea, there is a pressing need to develop specialized programs to promote the use of health and medical services for people with intellectual disabilities and provide them with proper education(WHO, 2006). Related to this is the report described in WHO(2006), suggesting that even though Korea has a significant number of healthcare experts in the area of mental health, few mental health services are instantiated in the country's primary health care system. This relative lack of instantiation contributes to separating mental health from the general health care system of the country, and in consequence, contributes to the social stigma against mental illness.

Third, it may be argued that the experience of outpatient service should be higher in the case of people with intellectual disabilities than those with non-intellectual or non-impaired and that the number of days of hospitalization should be longer than those with non-disabled people. In the U.K., the government has been pushing for a project to pay a personal health budget related to the disabled since 2012(). In Germany, "medical rehabilitation benefits" are provided to prevent, eliminate, alleviate, compensate, and aggravate chronic diseases and disorders, limit their ability to live and prevent the need to take care of them(MHH, 2016). In the case of Japan, the medical institution provides disability-related inspection tools for the medical examination of the disabled and implements the disabled-related health and medical care project to allow disabled people to receive medical expenses from their residence (National Rehabilitation Center, 2017). Korean government needs to consult these cases in an effort better to meet the needs of intellectually disabled people.

Conclusions

Based on these results, I would like to make the following suggestions. First, to promote access to and use of health care services for the intellectually disabled people, a paradigm shift is required such that intellectually disabled people are recognized as an individual with rights given to the other types of disabled people, away from a defect-centred view of the intellectually disabled as a minority, and to ensure that these values are the basis for policy proposals and support. In addition, various efforts should be made to participate in medical research by people with intellectual disabilities so that they can express their demands on health-related issues related to health services. Second, it is necessary to reflect their characteristics and closely analyze the experience of medical care processes in order to promote the use of health care services by people with intellectual disabilities. Based on this, specialized programs should be developed and distributed so that the intellectually challenged can self-help to self-manage the choice related to their health. In addition, attention should be paid to ensure that continuous education is provided through multidisciplinary collaboration in the field of education and health and medical policy, which allows these programs to be taught during school years. Third, activities are required for people with intellectual disabilities to periodically monitor health inequality and current status and trends for intellectually disabled people. It is time to pay attention to institutional improvements at the national level so that more time and effort can be invested in a healthy life for people with intellectual disabilities who have a high level of deficiency in health care and have difficulty accessing health care information.

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BIRDWATCHING AND BIRDING BY EAR: AN ACCESSIBLE AND INCLUSIVE TOURISM PROPOSAL FOR THE CITY OF LAGOS

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***Abstract*:** Accessible tourism goes beyond the physical dimension, associating services with sensory experiences, considering the specificities of people with disabilities. Birdwatching and birding by ear can be a good example of an activity that links visiting new places with outdoor activities. It can bring positive outcomes to the visitors through the benefits of being outside and connecting with nature, consequently, with ecosystem services; moreover, it can be an inclusive and accessible activity. Urban areas are increasing all over the world. In a sustainable context, green and blue infrastructures have received increasing attention in urban strategies. They create new habitats, contributing to urban biodiversity and, at the same time, providing many ecosystem services that guaranty well-being for the communities. The main goal of this study was to inventory and characterize the bird community in the urban area of Lagos, a touristic city in the South of Portugal. Birdwatching and birding by ear in the city could have the potential for an inclusive and accessible touristic activity. Three different sites along the city were sampled

and a total of 35 species were sighted and identified. Some of these species could be identified through specific web sites which describe the bird and give the respective bird singing sound. Most species identified were migratory, which increases the potential to sight different species through the year. The three sites' location has high potential to be integrated into accessible walking routes or tours, which increases the relevance of this study.

Keywords: Birdwatching; Birding by ear; urban environment; avifauna; well-being; accessible tourism; inclusive tourism.

Introduction

Tourism among green and blue spaces can positively impact on their visitors, not only concerning their physical and mental health but also in providing a sensorial experience regarding the surrounding environment.

Various types of habitats, which we will designate as green and blue spaces, such as forest, grasslands, woodlands, gardens, wetlands, riverbanks, lakes, sea, among others, can provide ecosystem services (Maidstone Borough Council, 2016; Barbie et al., 2011); Nowak, Crane & Stevens, 2006) that can be defined as "components of nature, directly enjoyed, or used to yield human well-being" (Boyd & Banzhaf, 2007). More specifically, different types of ecosystems can contribute with a variety of services such as provisions (food, fresh water, soil, biomass fuels, natural medicines), regulating (regulation of climate, air and water purification, noise mitigation, natural hazard mitigation), supporting (formation of soil and biomass, recycling and renewal of nutrients, oxygen production through photosynthesis, nursery habitat) and cultural services (nature' aesthetic value and appreciation, recreation opportunities and spiritual/religious enrichment) (Elmqvist, 2013; de Groot, Alkemade, Braat, Hein, & Willemen, 2010; Millennium Ecosystem Assessment, 2005; Turner & Chapin, 2005).

Visiting urban green and blue spaces can benefit human's well-being in a variety of forms. More specifically, in terms of health, these places can function as a motivational localization to increase physical exercise in a

natural environment by the local population; which in turn, is associated with an increase of self-reported health, from a physical and mental point of view (Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; de Vries, Verheii, Groenewegen, & Spreeuwenberg, 2003). Regarding physical health, some studies reported that being in contact with natural environments can improve the function of the immune system due to exposure to a variety of beneficial microorganism (Kuo, 2015; Rook, 2013). Recreational walking in green spaces or near blue spaces enhances people's physical activity, contributing to a reduction in sedentary time. As a result, it helps to reduced obesity, to improve cardiovascular health and osteoporosis disorder, among other benefits (Dadvand et al. 2015; Owen, Healy, Matthews, & Dunstan, 2010; Edensor, 2012). As for mental health, being in contact with natural places can help in the reduction of stress and negative emotions and improve general personal satisfaction (Bowler, Buyung-Ali, Knight, & Pullin, 2010; White, Alcock, Wheeler, & Depledge, 2013). Walking in green spaces or near blue spaces can enhance the feeling of relaxation and mental restoration, can help to reduce mental fatigue and to improve the performance in cognitively demanding tasks (Kaplan, 2001; Kaplan & Kaplan, 2011). Moreover, green and blue spaces can enhance social interactions and cohesion by facilitating social networking and social inclusion, promoting an improved sense of community (Kim & Kaplan, 2004; Seeland, Dübendorfer, & Hansmann, 2009).

In addition to the benefits previously exposed, tourism among natural locations can provide visitors with a sensorial experience regarding the surrounding environment. These multi-sensory experiences can generate a greater link between the visitor and the surrounding environment and can lead to a memorable physical reminder of that place, which in turn, can lead to "long term changes in conservation behaviour" by the visitors (Ballantyne, Packer, & Falk, 2011). The sensory elements that can be experienced by the visitors in a natural environment are visual, smell, sounds, taste, texture, personal feelings, mobility and, together, the individual's perception of the surrounding habitat results in their conscious sensory experience (Goldstein, 2010). All these multi-sensory stimuli can enhance visitors experience and knowledge concerning their surrounding natural habitats and provide a memorable visit for them (Zainol, 2014; van Hoven, 2005). These aspects are

important in nowadays tourism to allow a full and meaningful experience in the final destination. For example, the sound of birds singing can be heard by the visitors and, later, this sensorial stimulus can remind the visitors and give them an image of that specific destination (Gibson & Connell, 2007).

As mentioned above, natural environments can benefit mental health by reducing stress and inducing positive emotion. However, few studies are demonstrated a direct link between human's well-being when exposing to biodiversity. Nevertheless, Fuller et al. (2007) showed that physical and psychological benefits of contact with natural environments increased with habitat diversity and species richness, being bird richness positively correlated with psychological well-being perceive by the population. Dallimer et al. (2012) observed that the perceived biodiversity of plants, butterflies and birds by the population can increase their sense of psychological well-being. Carrus et al. (2015) observed that both the greenspaces' location and the biodiversity it contains are important factors contributing to the sensation of restorative benefits of their visitors. Another study showed that watching marine coastal wildlife was associated with the improvement of visitors' mood and happiness (Wyles, Pahl, & Thompson, 2014).

Taking into account the benefits mentioned of being in contact with nature and its biodiversity, from the tourism point of view, birdwatching is a good example that links visiting new places with outdoor activities that bring positive outcomes to the visitors. In this way, birdwatching can be seen as niche tourism which is designated as "special interest, culture and/or activity-based tourism, involving smaller numbers of tourist in more authentic settings, and could be more sustainable and less damaging tourism" (Novelli, 2004). In this sense, niche tourists are the ones that have specific motivations and interests and, therefore, will visit destinations to meet their specific interest. Hereupon, birdwatching has the potential to diversify the product in tourism, reduce seasonality and disperse tourist to less-visited places (Acorn Consultants, 2008). Concerning the Algarve region, it has a great potential for birdwatching due to its bird diversity, around 360 regularly occurring species, as well as good climate conditions (Machado, 2011; Costa, 2015). However, birdwatching is usually designed for people who have good sight and hearing. Besides, as a tourist activity, it tends not to consider the human diversity, the

need for universal design of the built environment and the associated accessibility for all.

According to the European Concept for Accessibility, accessibility "is the characteristic of an environment or object which enables everybody to enter into a relationship with, and make use of, that object or environment in a friendly, respectful and safe way" (Aragall et al., 2003). It is associated with Universal Design, which aims to make the design and composition of different environments and products accessible and understandable, as well, as usable by everyone, to the greatest extent, most independently and naturally possible, without the need to adapt design solutions (Center for Universal Design, 1997). According to these authors, there are seven principles associated with the universal design: 1) equitable use; 2) flexibility in use; 3) simple and intuitive use; 4) perceptible information; 5) tolerance for error; 6) low physical effort; 7) size and space for approach and use. These principles must always be incorporated in the conception of products and physical environments to create a fair built-up environment, where all have the right to use it in the same way, any part of the built-up environment, independently and naturally. Thus, Universal Design is a key attribute of accessible and inclusive tourism. Since providing access and opportunities to people with disabilities, it is not only an ethical issue and a legal obligation but also a business opportunity in the tourism sector (Asia-Pacific Economic Cooperation, 2013).

Accessible tourism can be designated as a "process of enabling people with disabilities – mobility, vision, hearing and cognitive - and seniors to function independently and with equity and dignity through the delivery of universal tourism products, services and environments" (Darcy, 2006). So, accessible tourism for everyone is transversal to many kinds of tourism, which develops leisure and spare time activities in such a way that every type of people may enjoy it, regardless of their physical, social or cultural conditions.

Studies have shown that people with disabilities feel satisfied after visiting natural environments and participate in wilderness activities (Jaquette, 2005; Zeller, 2008). According to a few studies, people with disabilities want to visit natured-based tourism as an escape from the urban/mundane space, to

experience the natural habitat beauty, for relaxation purpose, for boosting family interactions, to increase self-confidence and social adjustments and to experience personal challenges (Saayman, Slabbert, & van der Merwe, 2010; Slabbert & du Plessis, 2013; McAvoy, Holman, Goldenberg, & Klenosky, 2006). Activities such as sightseeing and birdwatching are known to be enjoyed by people with disabilities regarding tourism in natural areas (McAvoy et al., 2006; McCormick, 2004; Chikuta, du Plessis, & Saavman, 2019). However, the configuration of natural environments, generally accessible by pedestrian trails with irregular surfaces or steep slopes, does not guarantee universal accessibility conditions in its physical dimension. So, the focus of the present paper is naturalized urban environments since sustainable and resilient cities have provided green and blue infrastructure in their area, which holds diverse ecosystem services on an urban scale.

Although the visitors' sensations are unique and can vary from person to person, urban planners and tourism operators can facilitate the development of the right environment to enhance a positive and memorable visiting experience (Tung & Ritchie, 2011). Visiting green and blue spaces, near or within the urban context, can offer a specific aesthetical and multi-sensorial experience and appreciation of the surrounding habitat, which, in turn, can lead to an engagement with nature (Todd 2019; Berleant, 2011; Barbier et al., 2008). This is the case of Lagos, a historic city located in the Algarve region in the south of Portugal, a coastal city known for its importance on the Portuguese Discoveries in the 15th century and wonderful landscapes. Moreover, Portugal has more than 400 bird species, residential and migratory, (SPEA, 2008) and around 360 different species in the Algarve region (ERTA, 2009), which is a key region where it is possible to observe rare migratory birds that came from Africa, North America and North Europe. Moreover, in Portugal, the majority of studies regarding species characterization are performed in natural habitats, being the studies about bird community on an urban scale still scarce (Santos et al., 2012; Mexia et al., 2018).

Taking this into consideration, this study aims to inventory and characterize the existing avifauna in the urban area of Lagos. It studies the potential for birdwatching and birding by ear in three different points of the city, assuming an inclusive approach promoting sensorial experiences for all tourists related

to urban green and blue spaces located in the city of Lagos. Additionally, it proposes accessible birdwatching stations that permit their use for all interested people, promote access to ecosystem services through watching and earing wildlife, and improve residents' and visitors' well-being and happiness. To the best of our knowledge, is the first study regarding Lagos city to propose possible inclusive and accessible birdwatching routes at an urban scale.

Methods

Case study: Bird-fauna in the urban area of Lagos

Study area

The city of Lagos is in the Algarve region, south of Portugal (Figure 1). It is a coastal city, part of Faro district, known as the city of Discoveries. It has a markedly Mediterranean climate and an average temperature of 15.9°C (INE, 2018). It is crossed by a small river (Ribeira de Bensafrim) connected to the sea by a Marina, a prominent place in the city. Along the river, wetland regions and salt marshes can be found. As a coastal city, the rock surrounded beaches are an attraction point, making this city a reference point in the region for Tourism. The municipality has a total area of 212.99 km2 (Instituto Geográfico Português, 2013) with a resident population of 30 442 (INE, 2018). Besides the historic centre, along the periphery, the city has grown through the years, receiving every year thousands of tourists (INE, 2018). Although there is no forest area inside the city, there are approximately 20 green spaces, mostly with small dimensions and characterized by green elements and urban furniture. In Lagos, there are some routes and walking tours around the city, namely: a) guided audio tour "Lagos dos Descobrimentos" – which is a 4,1 km tour around the urban area, going through the most emblematic cultural monuments and touristic places in the city. It is a circular tour, with the start and ending point in Avenida dos Descobrimentos, going through the historic centre, city park, and rock surrounded beach. b) Fishermen route (Trilho dos Pescadores) – located along the sea, follows the routes used by locals to access beaches and fishing spots. c) Lagos Bensafrim pedestrian and cycling route,

connected to Via Algarviana. Via Algarviana is a big pedestrian route in the Algarve region that connects Alcoutim to cape São Vicente, covering around 300 km, and allowing pedestrians to know the mountain areas and the Southwest Alentejo and Vicentine Coast natural park.

For this study were selected three different sites with potential for birdwatching (Figure 2). The first site Avenida dos Descobrimentos (Figure 3) was chosen considering it is the biggest avenue in the city. It has a large sidewalk being a reference point for tourists.

Additionally, its association with Marina, a blue space, make this site a potential candidate for birdwatching. It has a high urbanization degree, and the two sides of the Marina are connected by a moveable bridge. This allows the passage of pedestrians and big vessels. Especially in the morning, the maritime traffic can be very intense.

Figure 1. Portugal map and the location of Lagos city (orange circle). Source: Map data copyrighted by OpenStreetMap contributors. Available from: https://www.openstreetmap.org.

Figure 2. Location of the study area in the city of Lagos. Source: Orthophotomaps. Source: downloaded from Direção Geral do Território. Available from https://www.dgterritorio.gov.pt

Figure 3. View of Avenida dos Descobrimentos. Source: Photograph taken by the authors.

Along the avenue, many small kiosks are found selling souvenirs and clothes as well as promoting private maritime-touristic activities. The second site – Ribeira de Bensafrim – located between two bridges of Lagos (Ponte da Ribeira de Bensafrim and Ponte Dona Maria) is an area with lower levels of urbanization (Figure 4). This site is located near the municipal swimming pool and sports centre. It has a view of a natural area with saltmarshes crossed by a small river (Ribeira de Bensafrim). The proximity to the city centre (around 1500 m) makes this site potentially interesting for birdwatching. Urban furniture elements can be found in the local. However, it is not widely used by tourists or residents. The last site chosen was the "City Park" (Figure 5). Built between 2003 and 2009, it is the biggest green space in the city with a total area of 4.2 hectares. The trees' community is mainly composed of native tree species, as is the case of the Almond Tree (Prunus dulcis), Carob Tree (Ceratonia siliqua), Olive Tree (Olea Europea) and Strawberry Tree (Arbutus unedo). People can touch these Mediterranean trees, and different smell are associated with this type of landscape. Located in the city centre and surrounded on one side by the city walls it is an inviting area, used for recreation and leisure activities. Bellow the park an underground car park with capacity for approximately 400 cars can be found. There are some touristic places nearby as historical monuments and a mini-golf centre. These characteristics have the potential to attract several people to the area.

Survey methodology

The avifauna survey was conducted from September to October 2020. A total of 30 visits were randomly done to the three sites. Many factors may have an effect on bird activity and behaviour which consequently may affect surveys. Therefore choosing the right time and conditions for surveying is crucial (Bibby, Jones, & Marsden, 1998). Considering the aims of this study, the sites were visited during working days in the morning (8:30-11:00) and in the late afternoon before sunset (16:30-19:00). Birds tend to display morning and evening peaks of activity, reducing their activity during the middle of the day(Bibby et al., 1998; Sutherland et al., 2007).

Figure 4. View of Ribeira de Bensafrim in the urban area of Lagos. Source: Photograph taken by the authors.

Figure 5. View of Lagos City Park. Source: Photograph taken by the authors.

Surveying these periods may increase the probability of detecting individuals in an area. Each visit – morning or afternoon - was considered a sampling period. Weather can influence the occurrence of certain species (Service et al., 1996), as result, surveys during bad weather (e.g. rain; strong wind) conditions were not conducted. Two different survey methodologies (Carbó-Ramírez & Zuria, 2011), comparable to each other, were used for counting birds and were chosen considering the characteristics of each study site. The first method, 500 m line transects (Carbó-Ramírez & Zuria, 2011), was used in the study site Avenida dos Descobrimentos. In total, 3 transects per visit were performed. The transects were walked slowly in a straight line for 10 minutes each. All birds seen using the area were recorded and incorporated in the calculations. This method was preferred for this site, considering the linear nature and narrow width of the site. The second method used was 10 minutes unlimited radius point counts (Nichols, Thomas, & Conn, 2009). This method consisted of selecting random points and during the 10 minutes periods, all the birds seen were counted. It was used in the other two study sites (Ribeira de Bensafrim and City Park). In each site, three-point counts were conducted, totalizing 30 minutes of observation per sampling period. The points were at least 100 m apart to assure independence and avoid double count (Bălescu & Gache, 2017).

For data collection was used a DSLR camera (Canon-EOS 2000D with Lens 75-300 mm) to photograph all individuals seen during the sampling period. This ensured a photo-documentation of all individuals detected. Posterior analysis of the images was performed to accurately identify the species observed. The identification was performed using online tools such as Birds of Portugal (Aves de Portugal info, n.d.) as well as a taxonomic book (Svensson, 2017). For each specie, the ICNF conservation status (Cabral et al., 2005) and residence status (Aves de Portugal info, n.d.) in Portugal was accessed.

Data analysis

To describe the avifauna community of Avenida dos Descobrimentos and Ribeira de Bensafrim, species richness and species diversity were calculated (Table 1). Species richness accounts for the number of species in a sample

(Supriatna, 2018), while species diversity - Shannon index (H) - considers not only the number of species but also the dominance of each species (Colby, 2018). Due to the natural landscape and logistic constraints, the number of individuals per species for the study site City Park was not obtained. The presence of trees made it difficult to detect and capture photographically all individuals. This conjugated with the fact that acoustic recordings were not being made, accurate estimates would not be obtained. Therefore, it was not possible to calculate species richness and species diversity for this place. Instead, for the "City Park", only the characterization of the avifauna species identified was performed. It was observed a high number of individuals of synanthropic species (Columba livia, Larus michahellis, Passer domesticus and Turdus merula) simultaneously during the sampling period. This made it impossible to count all of them. Due to this constraint, the number of individuals of these species were not obtained for any of the study sites and, therefore, were not used in the diversity index calculations.

To assess if the survey effort was enough, accumulation curves of the cumulated number of species for each site were constructed. This allowed ensuring that most species present in the study sites were detected and that a representative sample of the avifauna was obtained. To obtain the accumulation curves the cumulative number of species in each site as a function of the number of the sampling period (effort) was used.

To investigate whether there is a potential for birdwatching in each study site the frequency of occurrence (Table 1) during the study period was obtained. This allowed to compare the three study sites and to determine which species were more frequently sighted and have some insights on their occurrence in the study area and possible differences between sites.

Accessible Pedestrian Trails and Birdwatching Stations

To guaranty the universal accessibility of the Birdwatching and Birding by ear Stations, its surrounding must have specific attributes of an accessible pedestrian network. It is necessary to act upon the different constituent elements of these, namely: a) accessible pedestrian sidewalks (including infrastructures, urban furniture, traffic signals); b) pedestrian crossings; c)

modal interface areas, considering bus stops, terminals, reserved parking places for people with disability.

Table 1: Equations used to obtain ecological index and frequency of occurrence. Source: Authors´elaboration

Name	Equation
Species Richness (Supriatna, 2018)	D = $\frac{s}{\sqrt{N}}$; s – number of species; N – total number of individuals
Species Diversity (Colby, 2018)	H = $\sum(p_i) * \ln p_i$; p_i – the proportion of the total number of individuals in the population that are in species "*i*"
Frequency of occurrence (Martos-Martins & Donatelli, 2020)	F (%) = $\frac{t_i}{t} * 100$; t_i – number of days specie "i" was observed; t – total sampling days

The universal accessibility of the stations is dependent on the accessibility according to the universal design of the built environment. Sidewalks are urban infrastructures that support pedestrian walking and the use thereof by people with disabilities, including citizens that use wheelchairs. They must be dimensioned as a channel of slow circulation and be continuous, safe and free from obstacles. The dimensioning of trails requires a minimum width free from obstacles. When people are continually meeting and passing each other a useful width above 1.80 m is recommended (Aragall & EuCAN members, 2003), which permits the crossing of two people in wheelchairs. Another aspect to take into consideration is the quality of the surface/pavement of a pedestrian walkway, which must-have materials that provide a stable, durable, firm, continuous, non-slip, anti-skidding and regular surface (but not too smooth). The longitudinal and cross slopes of pedestrian areas is another important factor for the movement of people, mainly for those with reduced mobility. The choice of levelled pathways and suitable gradients of the ramps contribute to the creation of accessible pedestrian networks for all users, influencing

their speed and safety. Pedestrian crossings must be accessible, too. It must be clear of obstacles, well illuminated and the access to the carriageway must be ramped through a dropped kerb and small gradient. This slope is essential to cater to the mobility of people with motor disabilities, especially wheelchair users. On this ramp, there should be a surface with contrast colour and tactile marking strip to guide the pedestrian with impaired vision.

The Birdwatching and Birding by Ear Stations must be accessible for all. Usually, there are only stairs to access a high platform. The access to this floor must be made through stairs that must have specific dimensions, as well as adequate width of the stairs, these must-have strips with chromatic differentiation, guardrails, and handrails. The layout must consider a ground floor too (example can be seen in Figure 6). The ground floor must guaranty access to people in wheelchairs, senior people and children. The floors must have a levelled and paved waiting area. An adequate barrier-free space provides a safe, secure, non-slip, smooth surface for people. On the ground floor, there must be room for manoeuvring a wheelchair with no obstacles. The doors must have adequate width and contrast colour to guarantee orientation for people with low sight. The small windows must be positioned at a height that allows birdwatching by people in wheelchairs or by children. This type of station for birdwatching should provide some benches and seats. The benches should be installed at an adequate height from the platform. Signage of timetables, route maps and line services must be clear, simple, easily visible and understandable. Braille information should also be provided.

In the context of smart cities, this type of stations should have QR codes (Quick Response) or technology NFC (Near Field Communication) that increase the access to information for those who have smart mobile phones.

To verify the web accessibility of a set of sites with bird sounds, which could be a useful tool for birding by ear, AccessMonitor was used. It is an automatic validation tool that verifies a set of accessibility guidelines of HTML contents in a website. AccessMonitor performs tests based on WCAG 2.1 (Web Content Accessibility Guidelines). The output is a qualitative report as well as quantitative indexes.

Figure 6: Example of a birdwatching accessible station. Source: photograph taken by the authors.

Results

A total of 35 species from 22 families were sighted and identified from the three study sites (Table 2). From the identified species, 15 are considered resident in Portugal, while 10 species are migratory, and 10 species have a small resident population with most individuals being migratory. The majority of species do not have threatened conservation status and are classified as Least Concern (LC). However, there are a few species that are in the red list of ICNF (n.d), namely the Eurasian Whimbrel (Numenius phaeopus) (Figure 7) that has a vulnerable status, which is considered the level below an

endangered status; the resident population in Portugal of the Common redshank (Tringa tutanos) has a critically endangered status (Figure 8). As for the migratory species, the Sandwich tern (Thalasseus sandvicensis) has a near-threatened conservation status and the Black-tailed godwit (Limosa limosa), has a near-threatened status in the world by International Union for Conservation of Nature (IUCN), even though it has the least concern status in Portugal.

Figure 7. Example of a vulnerable bird watched in the city of Lagos - Eurasian whimbrel (Numenius phaeopus). Source: Photograph taken by the authors.

Table 2: Birds species sighted and identified in the study area considered. Source: Authors´ elaboration

Conservation status: *LC = least concern, NT= Nearly Threatened,Vu = Vulnerable, CR = Critically endangered.*

Residence Status: *Res = Resident, Mig = Migratory.*

Family	Species	English common name	Conservation Status	Residence Status
Alcedinidae	*Alcedo atthis*	Common kingfisher	LC	Res
Anatidae	*Anas platyrhynchos*	Mallard	LC	Res
Ardeidae	*Egretta garzetta*	Snowy egret	LC	Res

Family	Species	English common name	Conservation Status	Residence Status
	Ardea cinerea	Grey heron	LC	Res
Charadriidae	*Charadrius hiaticula*	Common ringed plover	LC	Mig
Ciconiidae	*Ciconia Ciconia*	White stork	LC	Res/Mig
Columbidae	*Streptopelia decaocto*	Euroasian collared dove	LC	Res
	Columba livia	Rock dove	LC	Res
Corvidae	*Cyanopica cooki*	Azure-winged magpie	LC	Res
Emberizidae	*Emberiza calandra*	Corn bunting	LC	Res
Falconidae	*Falco tinnunculus*	Common kestrel	LC	Res
Fringillidae	*Carduelis cannabina*	Common linnet	LC	Res/Mig
	Carduelis carduelis	European goldfinch	LC	Res
	Serinus serinus	European serin	LC	Res
Hirundinidae	*Cecropis daurica*	Red-rumped swallow	LC	Mig
Laridae	*Chroicocephalus ribibundus*	Black-headed gull	LC	Res/Mig
	Larus michahellis	Yellow-legged Gull	LC	Res
Motacilidae	*Motacilla alba*	White wagtail	LC	Res/Mig
	Motacilla cinerea	Grey wagtail	LC	Res/Mig
Muscicapidae	*Erithacus rubecula*	European robin	LC	Res/Mig

Family	Species	English common name	Conservation Status	Residence Status
	Oenanthe Oenanthe	Northern wheatear	LC	Mig
	Ficedula hypoleuca	European pied flycatcher	LC	Mig
Passeridae	Passer domesticus	House sparrow	LC	Res
Phalacrocoracidae	Phalacrocorax carbo	Great cormorant	LC	Mig
Phylloscopidae	Phylloscopus trochilus	Willow warbler	LC	Mig
Recurvirostridae	Himantopus Himantopus	Black-winged stilt	LC	Res/Mig
Scolopacidae	Numenius phaeopus	Eurasian whimbrel	Vu	Res/Mig
	Actitis hypoleucos	Common sandpiper	Vu	Res
	Calidris alba	Sanderling	LC	Mig
	Tringa tetanus	Common redshank	CR/LC[1]	Res/Mig
	Limosa limosa	Black-tailed godwit	LC[2]	Mig
	Arenaria interpres	Ruddy turnstone	LC	Mig
Sternidae	Thalasseus sandvicensis	Sandwich tern	NT	Mig
Turdidae	Turdus merula	Common blackbird	LC	Res

[1] Tringa tetanus – conservation status: CR for the resident population; LC for Wintering population.
[2] Limosa limosa – conservation status in IUCN: NT.

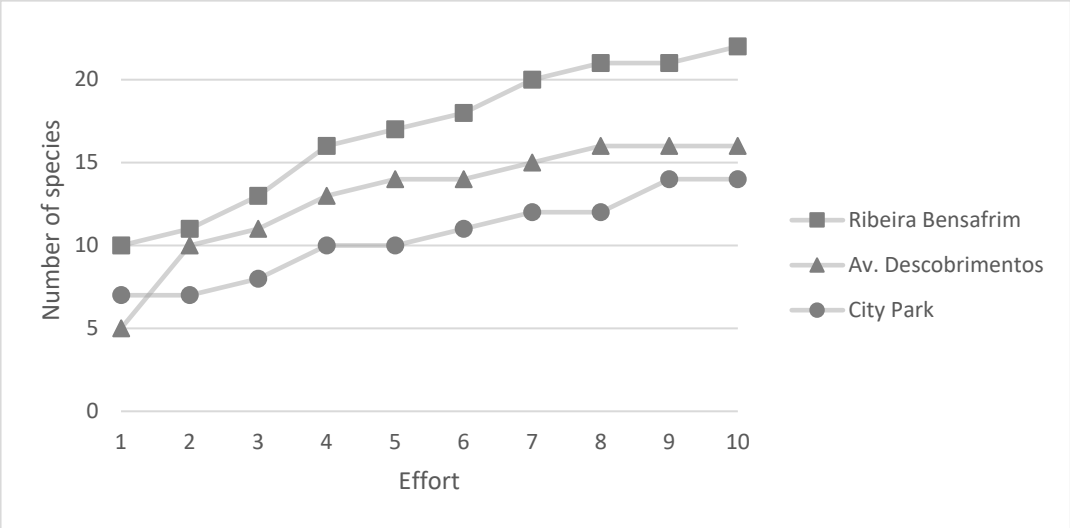
Family	Species	English common name	Conservation Status	Residence Status
Upupidae	Upupa epops	Hoopoe	LC	Res/Mig

Figure 8. Example of a critically endangered bird watched in the city of Lagos - Common redshank (Tringa tetanus). Source: Photograph taken by the authors.

As for the accumulation curves (Figure 9), that is the cumulative number of species in each site as a function of the sampling period (effort), they did not completely flatten out, which can be an indicator that the inventory might have not been completed.

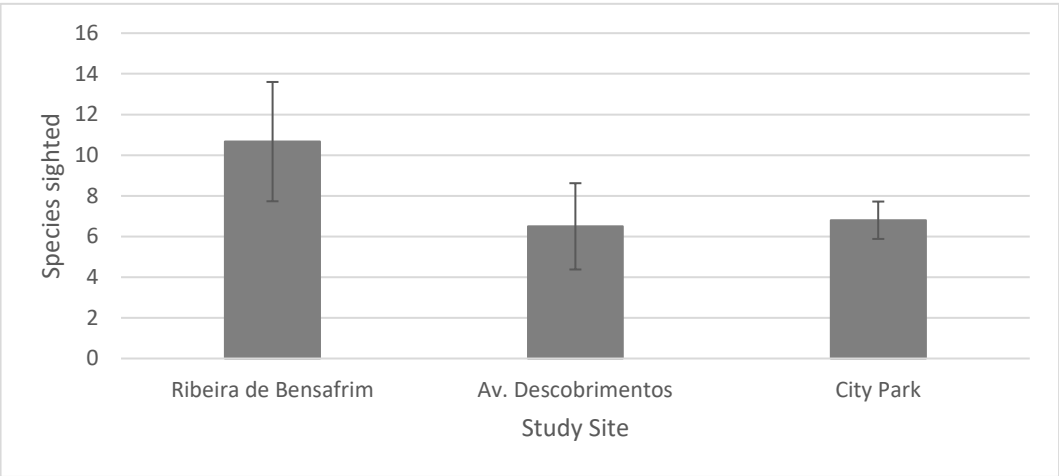
Regarding the number of species sighted in each site, the higher number of different species were sighted in Ribeira de Bensafrim (N=22), followed by Marina (N=16) and City Park (N=14). The species richness was higher in Marina (D=1.67) compared with Ribeira de Bensafrim (D=1.12). The Shannon Wiener's species diversity (H') was higher in the Ribeira de Bensafrim (H'= 2.32) compared with the other site (Avenida dos Descobrimentos).

Figure 9: Accumulation curves for each study site. Source: Authors´ elaboration



In general, the number of species sighted during a sampling period was higher in the saltmarshes area (Ribeira de Bensafrim) compared with the other two sites (Figure 10). During the sampling period, on average, a total of 11 (± 2.93) species were sighted per sampling period on Ribeira de Bensafrim, 7 (±2.12) species in Avenida dos Descobrimentos and 7(±0.92) species in City Park.

Figure 10: Average number of species sighted per visit in each study site in Lagos City. Source: Authors´ elaboration



Of the 35 species, 20 were only recorded in one site. Only 2 species were sighted in the three study sites. Important to note that these two species are synanthropic and classified as generalists. In total 24 species were sighted more than once, with most species displaying high values of frequency of occurrence (Table 3). The other 11 species were sighted only once during the sampling period, thus the

low values of frequency of occurrence, 3 of them were sighted only once in Ribeira de Besanfrim, 4 were sighted only once in Avenida dos Descobrimentos and 4 in the City Park.

Table 3: Frequency of occurrence (%) for each species per study site in Lagos City. Source: Authors´ elaboration

Species	Frequency of Occurrence Av. Descobrimentos	Frequency of Occurrence Ribeira Bensafrim	Frequency of Occurrence City Park
Himantopus Himantopus	0	40	0
Numenius phaeopus	30	70	0
Actitis hypoleucos	70	90	0
Tringa tetanus	0	60	0
Limosa limosa	0	10	0
Arenaria interpres	90	20	0
Thalasseus sandvicensis	30	10	0
Turdus merula	10	30	100
Upupa epops	0	0	30

In general, the 3 websites chosen displayed poor accessibility practices. The "avesdePortugal.info" had a score of 4.4/10; the "m.bird-songs.com" had a

score of 2.7/10, and the "xeno-canto.org" had a score of 3.9/10. Regarding blind disabilities, alternative texts for images are missing. This prevents screen readers from translating image descriptions into sounds, not allowing alternative communication. Errors were also detected related to the contrast. This was lower than the minimum allowed, which might make it harder for people with low vision to access information.

Discussion

Nowadays, the world faces a continuous disconnection with nature. With increasing larger cities all around the world, the environment tends to become more urbanized. So, it is of major importance to protect the natural environments around urban areas to improve the connection between the local population and the surrounding nature. Studies suggest that direct contact with natural environments with perceived high biodiversity are related to positive benefits to humans' well-being regarding mental and physical health (de Vries et al., 2003; Fuller et al., 2007; Sandifer, Sutton-Grier & Ward, 2015). Nevertheless, it is important to bear in mind that not all-natural spaces contribute the same in terms of positive benefits to their users. Thus, it is important to assure healthy green and blue spaces within the urban areas, to sustain adequate biodiversity richness, healthy ecosystems. Besides, it is essential to create safe routes for all pedestrians and, at the same time, be accessible to everyone, especially for people with disabilities, because the natural environment is usually physically inaccessible (Handley et al., 2003). Moreover, people can experience a variety of multi-sensory elements when exposed to these urban and natural environments and their biodiversity. For instance, when asked about their nature-based sensorial experience, tourists visiting the southwest of Portugal highlighted the visual colour green and the different sounds of various animals (Agapito, Valle & Mendes, 2014).

These days, more and more tourists want to escape from cities and be in contact with nature (String & McAvoy, 1992). This has made ecotourism one of the biggest growing tourism sector (Hawkins & Lamoureux, 2009). Although niche tourism regarding disabled people is a recent sector in development, it has the potential to grow. People with disabilities are a significant consumer

in the tourism market, spending billions of dollars per year on holidays around the world (Buhalis, 2005; Darcy, Cameron, & Pegg, 2010; Tourism Australia, 2005).

Discovering which species are part of the avifauna community in the city of Lagos, located in southern Portugal, can be extremely useful to enhance the already existing urban routes or walking tours in the city. Birdwatching and birding by ear consist of observing and hearing, respectively, and then identify the bird's species in their natural environment. Both activities can be practised from a tourism perspective or as a personal recreation. From a tourism point of view, birdwatching is economically viable due to its educational character and, in most cases, can be compatible with conservational activities; also, it takes into consideration the sustainable use of resources and the involvement of local communities (Farias, 2007). Additionally, the birdwatcher community usually travel in groups and, in the majority of cases, have high levels of training and jobs with above-average income (Garrison, Patterson & Barnes, 2005), making this target group one of the main incomes in the ecotourism and nature-based tourism.

Moreover, the consideration of the accessible and inclusive design of local pedestrian infrastructures for proper birdwatching and birding by ear can create the conditions for positive and beneficial experiences for all people considering human diversity as the seven universal design principles. These accessible infrastructures and experiences enable people with access requirements, including mobility, vision, hearing and cognitive dimensions of access to function independently, that is, with autonomy, and equitable guarantee use (first principle). The proposed birdwatching and birding by ear stations consider two floors for the development of these activities, and so, guarantee flexibility in use (second principle). Related to information and web accessibility, the proposed QR codes or technology NFC can increase the access to the information which would be simple and intuitive use and guarantee perceptible information (third and fourth principles). Stations and surfaces with contrast colour and tactile marking strip to guide the pedestrian with impaired vision guarantee some tolerance for error (fifth principle). The quality of the pedestrian infrastructure, in an urban environment, guarantees low physical effort (the sixth principle), as well as the existence of a level

floor at the stations. Size and space for approach (seventh principle) were considered in the dimensions and gradients of the pedestrian infrastructure and in the position of the windows inside stations to allow the experiences of birdwatching by people in wheelchairs, by small adults or by children.

Considering these aspects, the city of Lagos has the potential for inclusive birdwatching and birding by ear activities. These will be very varied and rich, because it is possible to encounter diverse species such as residential ones (Common sandpiper, Common redshank, Hoopoe, among others) as migratory ones (Common ringed plover, Eurasian whimbrel, Black-tailed godwit, among others), some of them being protected species by Portugal red list of threatened species. Additionally, only 2 species, namely the Common blackbird (Turdus merula) and the Yellow-legged Gull (Larus michahellis) were sighted in the three study sites, demonstrating that it is possible to observe a diverse group of different bird species in different areas in the city of Lagos, which is an indicator of the potential for birdwatching and birding by ear in this city.

Regarding the sites chosen in this study, Avenida dos Descobrimentos and Ribeira de Bensafrim are both associated with blue spaces, being expectable the presence of a higher number of species. The presence of water bodies, such as wetlands, creates more ecological niches and provide valuable habitat for migratory bird species (Parihar et al., 2020). Other factors such as season, tide, the hour of the day and human disturbance (traffic or number of people in each site) can influence the chance of seeing certain species, however, due to the short duration of this study, this was not an object of analysis. Given that this is the first bird survey conducted specifically in the urban area of Lagos, it is expected that additional species may be recorded with further surveys targeting different temporal periods. Nevertheless, this study is a starting point for further research on the dynamic of the avifauna in Lagos. It presents a characterization of the avifauna in three different sites characterized by different levels of urbanization, adding more knowledge regarding this group of animals in Portuguese cities.

When analysing the avifauna community in Avenida dos Descobrimentos the number of species sighted (N= 16) was high, being this the reason why the

species richness had a higher value compared with Ribeira de Bensafrim. Considering the high level of urbanization and human disturbance, these results were not expected. The fact that this study was conducted during the end of high tourist season and in a year marked for the pandemic constraints, such as the lockdown and the travel restrictions, it is possible that the maritime traffic along the channel and Marina was low, as well as the number of tourists walking in the venue. These aspects might have contributed to a higher number of species using this area. This cannot be further explored since there is no prior inventory of the species present in this city area and their abundance. The presence of avifauna along the venue can be an asset for the city. Therefore, further research concerning the bird community presence throughout the year in the green and blue spaces surrounding Lago's urban area is necessary to better understand the usage of these habitats by the resident and migratory bird community.

Considering that many species are migratory, it is expected to assume that the avifauna community in Lagos was not entirely characterized. Possibly due to the time and logistic constraints, which limited the sampling period. In this sense, it is expected that different species might be sighted or heard during other seasons. Besides, the season during which this study was conducted is a migratory period. Possibly some species were arriving or leaving during this period, which might have contributed to the sighting of new species during all the study period. These findings are important to highlight the potential for birdwatching and birding by ear inside the urban area of Lagos. However, with the increasing urbanization, it is of major importance the maintenance and protection of green and blue spaces, being valuable for the city to preserve the natural characteristics of the salt marshes and water bodies, as well as the city Park. In this sense, the municipality and decision-makers should take action to ensure the conservation and maintenance of the natural environments surrounding the urban area. Environmental education should be promoted to increase awareness for the presence of iconic bird species that exist in this city, namely, the Azure-winged magpie (Cyanopica cooki), the Black-headed gull (Chroicephalis ridibundus), the Eurasian whimbrel (Numenius phaeopus), the Black-winged stilt (Himantopus himantopus), the

Common kingfisher (Alcedo atthis), the Common redshank (Tringa tetanus), among others.

Conclusions

Birdwatching is usually designed for people who have good sight and hearing. Considering people with disabilities, the accessibility of nature-based tourism is a field of study that is still marginalized (Kling & Ioannides, 2019). Therefore, it is important to add new knowledge regarding this field of study and encourage the tourism sector, the operators, and the decision-makers to consider the universal accessibility approach, which integrates the needs of people with disabilities.

This paper has an inclusive perspective of tourism activity and presents a valuation of the potential for birdwatching and birding by ear for the city of Lagos. It bears in mind an inclusive and accessible approach to allow, to all users, diverse kinds of sensorial experiences. Considering the different bird species observed in the study area, of which some are residents and others migratory, we considered that the city of Lagos has the potential for birdwatching from a tourism point of view. New species were detected through the whole study period, which highlights the importance of the study area. In the context of urban development and expansion, the possibility to observe and hear fauna in the urban environment is an asset as it can add value to green and blue spaces, increasing a cities' potential for ecotourism.

Accessible tourism should "enable people 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). To guaranty the universal accessibility of birdwatching and birding by ear stations, their surrounding must have specific attributes of an accessible pedestrian network, namely accessible pedestrian sidewalks (including infrastructures, urban furniture, traffic signals), pedestrian crossings and modal interface areas, considering bus stops, terminals and reserved parking places for people with disability. For more inclusive tourism, it is crucial to make public and private sector websites and mobile applications related to

tourism activities accessible to everyone. This will allow reducing communication barriers for visually impaired people and other types of disabilities. An important aspect is to increase awareness of society regarding the web accessibility requirements, which in turn, can contribute to effectively make tourism accessible. Creating and facilitating the implementation of training programs related to websites' accessibility and mobile applications can be a way to achieve these aims.

People interested in engaging Birdwatching and Birding by Ear activities are more than 80 million with increasing demands relative to bird observation in the wild. This specific demand provides a direct interest in certain areas and periods of the year, such as wintering season, reproduction or migration (Farias, 2007; SPEA, 2019). In this sense, since the destination selection considers the biodiversity of that region, a direct relationship can be established between the local biodiversity and the financial return that birdwatching can provide to that specific place. Besides, at a local scale, this activity has the potential to provide financial motivation for the protection and conservation of the natural environments where birdwatching is practised (Cordell & Herbert, 2002; Sekercioglu, 2002; Farias, 2007). In conclusion, the ongoing urbanization of territories, the increase in health problems exhibit by the population and the link between nature and human well-being is of major importance. Promoting activities that may bring people closer to nature within cities has a huge value. This study highlights the potential of birdwatching and birding by ear as an inclusive and accessible activity in an urban area, being something that should be addressed in future inclusive urban planning, accessible tourist routes and nature conservation plans.

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ANALYSIS OF THE EDUCATIONAL SPACES AND UNIVERSAL DESIGN: THE CASE STUDY OF DUZCE UNIVERSITY FACULTY OF ART, DESIGN AND ARCHITECTURE CAMPUS

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***Abstract*:** Education should be an equal distance with everyone, the educational environment as a second lecturer is responsible for supporting equality and should present inclusive characteristics. This study is carried out to evaluate Duzce University Art, Design and Architecture Faculty within the context of universal design principles. This study evaluates the existing condition of the campus facilities regarding universal design and searches for possible design interventions to improve inclusivity. At first, within this context, the relation between the physical environment and campus users is examined via video recording and observation studies. Analysis of the findings of the observation and video recordings revealed the interaction pattern between the physical environment and users. With the help of analysis, places requiring universal design solutions are identified and classified according to their priority. Within the classified problem areas, problem areas suitable for increasing inclusivity by small scale design interventions are determined, and initial design ideas are constituted for them. The capability of design interventions in increasing the inclusivity of educational environments is exposed, and the importance of a holistic approach in the educational system for inclusivity is emphasized. As a result, it is revealed that it is possible to improve equality and the participation level of diverse user groups in educational life only by actualizing small-scaled universal design

interventions. While showcasing the potency of the universal design applications in an educational setting, this study underlines the importance of conjoint actions of every actor in the educational system.

Keywords: Universal design, Disability, Inclusive design, Education, Architecture

Introduction

Education is a constitutional right, and it stands to everyone an equal distance. In that sense, by its very nature, inclusivity is the key characteristic of contemporary educational approaches, and educational spaces carry their marks. Since, in the contemporary world, educational actions are carried on in the built environment, the design of educational spaces plays a critical role in making education accessible for everyone. Educational space is a social place experienced by staff, students, and visitors of different ages and different physical capabilities. Therefore it should answer the needs of different user groups without bestowing any privilege on a specific one. Any arrangement in an educational space should not cause any barrier for people in accessing education. Questions arise here: In reality, how inclusive is an educational space, and in which ways does it affect the educational actions for different user groups? This article tries to find answers to these questions and aims to evaluate the effects of the physical environment on the educational actions of diverse users in Duzce University Faculty of Art, Design and Architecture Campus. The main objective of this study is to explore the potential of universal design solutions in improving the participation level of different user groups in educational life and search for equality in education through in terms of physical settings. Due to the indiscriminate nature of education, to understand the interaction between the physical environment and the widest range of users, the campus area has been examined within the framework of the universal design approach. In this study, the potential impacts of developing design solutions within the universal design perspective on inclusive education have been discussed through the case of Duzce University Faculty of Art, Design and Architecture Campus. Being recently

established, having a quota that specifically determined for disabled people, the egalitarian nature of art and design, and being flexible in terms of physical changes are the reasons that make the Faculty of Art, Design and Architecture worthwhile to investigate in terms of universal design. Within the scope of this study, the current physical environment of the campus have been analyzed by considering varying needs of diverse user groups, positive and negative effects of the physical environment on the educational and social life of users have been sketched, ways for more inclusive design solutions have been questioned. To set up a linkage between universally designed educational spaces and inclusive education, at first detailed information about universal design and similar studies have been explained.

Universal Design Concept

Universal design can be defined as a way of suggesting design solutions that fulfil the needs of a wide range of diverse user groups with different ages and different capabilities and does not label users (Story, 1998). In other words, in universal design, design solutions do not point to differences of users, it focuses on reaching the highest number of participants, and considers social values. However, as in the formation of other design approaches, the inclusive structure of universal design has not been suddenly popped up. After the paradigm shift on the disability concept from the medical approach to the human rights approach, the universal design concept has emerged (Lid, 2014). Depending on that, in order to cover universal design, developments and transformations in the design for the disability approach are needed to be examined. Following the formation process of design for disability is only possible by understanding the changes in the disability concept for societies. In the 18th and 19th centuries, due to the industrialization, materialistic point of view and production focus of that time, disabled people are seen as unfunctional and useless actors of society; however, especially after 2. World War, an increasing number of disabled veterans leads to more gentle attitudes to disabled people (Barnes, 2011). With the help of the positive changes to disabled people, the disability concept and its reflections have begun to be examined. First 80 years of the 20th century, the disability concept has been handled respectively as a bio-medical issue, an accessibility problem, and a

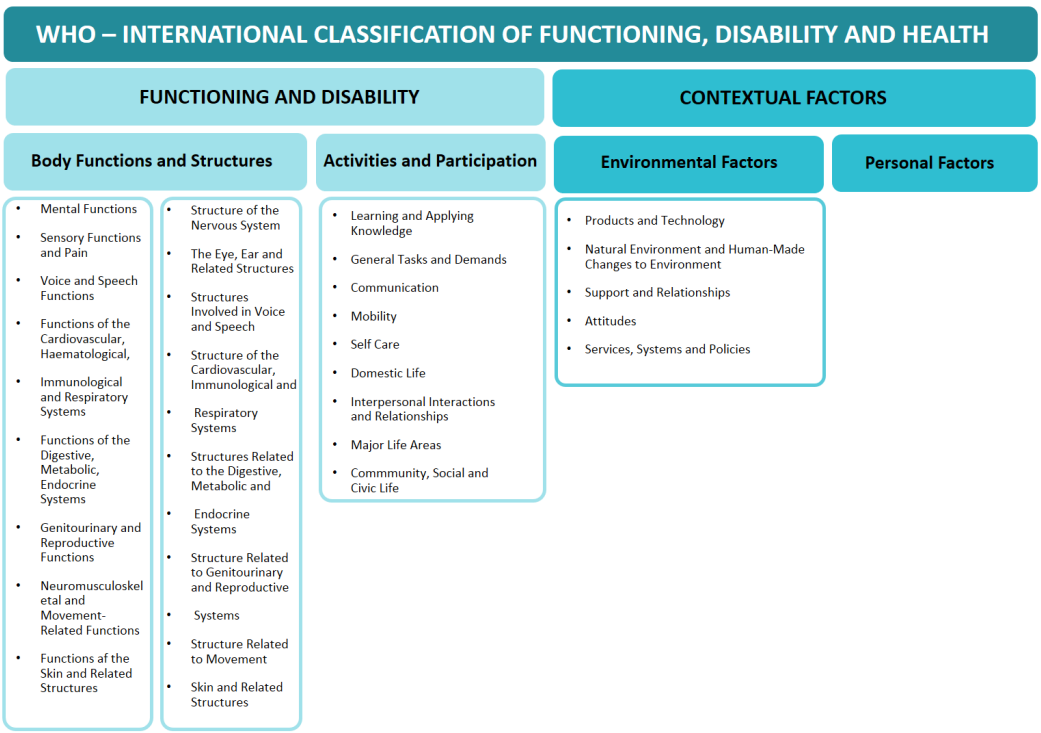
personal, problem; not as a social phenomenon (Rioux, 1994). In 1980 dated ICIDH (International Classification of Impairments, Disabilities and Handicaps), developed by WHO (World Health Organization), disability is related to an anatomic deficiency, and by neglecting the envirınmental and social factors of disability, it stands as an example of a personal medical model. On the contrary, in 1974, in the United Kingdom, UPIAS (Union of the Physically Impaired Against Segregation) mentions the social pressure and exclusion aspects in its disability definition, and this definition carries the characteristics of the social model (Barnes, 2011). Depending on the growing interest in disability issues, United Nations (UN) declares 1981 as the International Year of Disabled Persons, and in the same year, after not including disabled persons in the management of Rehabilitation International (RI) Disabled People International (DPI) is constituted (Barnes, 2012). The Foundation motto of DPI "Nothing About Us Without Us" reflects a new disability centred, independent and human rights-focused ideology in a political, cultural, economic context, and thus, it is adopted by most of the other disability organizations (Charlton, 1998). All of these developments show us how the disability concept transformed from a personal medical condition to a social movement. As a result of evolving into a social movement, different countries have begun to protect the rights of disabled people with laws. In addition to legislation, in 2001, WHO has presented a new classification for disability named as International Classification of Functioning, Disability and Health (ICF)

Within the scope of ICF, disability is defined as difficulties in three elements of functioning as body, activity, and participation (Alagappan et al., 2018). In ICF, there are two main categories as 1) Functioning and Disability, 2) Contextual Factors; and these are divided into sub-categories as 1a) Body Functions and Structures, 1b) Activities and Participation, 2a)Environmental Factors, 2b) Personal Factors (Figure 1). This new WHO classification proves the changes in disability concept from the medical model to the social model.

All of the changes in the disability concept have also affected the relationship between disability and the design of the physical environment. In the mid 20th century, since disability has been considered with a service aspect, there have been some regulations on the physical environment design. Within this

respect, design for the disability approach can be considered to show up in the mid 20th century. Kose (1998) mentions The American National Standards Institute (ANSI) Standard A117.1, "Making Buildings Accessible to and Usable by the Physically Handicapped," as one of the first imprints of the design for disability concept. Following it, with the efforts of disabled people and their supporters, design and disability-related regulations have been protected by the Architectural Barriers Act of 1968, Section 504 of the Rehabilitation Act of 1973, and the Americans With Disabilities Act (ADA) of 1990 (Evans et al., 2017).

Figure 1. WHO International Classification of Functioning, Disability and Health.
Source:https://www.who.int/classifications/icf/icfbeginnersguide.pdf?ua=1



And also, in different countries, there have been similar regulations. However, it should be noted that while some of them were developed with a similar motivation like the USA as a result of social movements, others came into existence as a result of copycat attitude as in Turkey (Çaha, 2016). Within the scope of ADA, which is among the laws mentioned above, it is stated that a solution should be offered for all disability groups without separating any types of disability, and the concept of design for the disabled, which was generally handled in mobility and wheelchair till then, has gained a new

dimension (Imrie, 2012). These legislations that support accessibility for the disabled have steered Ronald Mace, Ruth Hall Lusher, Bednar ve Welch to search for a new way of creating design solutions fort he built environment and came up with a new concept as universal design (Steinfeld at. Al., 2012). Within this context, in 1997, Ronald Mace introduces the seven principles of universal design as 1) Equitable Use, 2) Flexibility in Use Principle, 3)Simple and Intuitive Use 4), Perceptible Information, 5) Tolerance for Error Principle, 6) Low Physical Effort, 7) Size and Space for Approach and Use. (Story et al., 1998). Universal design does not wipe out the accessibility notion of the design for the disability approach, and there has always been accessibility consideration in universal design. It only becomes unnoticed since it has been considered from the first phase of the design process, and it goes beyond being a form of legally protected practice (Story, 1998). Thus, a unifying and egalitarian design language has been formed. As Meşhur and Çakmak (2018) emphasize, the essence of the universal design is being and feeling normal. Gossett, et al. (2009), indicating their shared perspective with Knecht (2004) and Salmen (2011), briefly define universal design as a design process of developing products for the widest range of users and providing solutions to every user. Universal design is interwoven with architecture, design, landscape planning, justice, education, ethic, health, rehabilitation and other disciplines and these characteristics required to be considered in universal design approach-based design practices (Lid, 2014). The universal design approach stays closer to the contemporary human-centred and interdisciplinary design concept.

Education And Universal Design

The strength of an education system is in direct proportion with its inclusive, unifying and egalitarian characteristics. Within this perspective, universal design practices in educational spaces have the power of consolidating the strength of the system. In educational spaces, universal design practices are usually actualized under the framework of disability regulations. Even though these practices seem to be disability oriented, they draw on to universal design in some aspects. Thus, inevitably, while establishing a linkage between educational spaces and universal design, studies related to disability and

learning environment have been used as resources. In these studies, the relationship between disability and educational environment is examined within its physical, social, and experience-oriented aspects. Ay, et al. (2017) evaluate a university campus in Turkey regarding TS9111 numbered standard in a quantitative study and note suitability of outdoor circulation areas. However, they also show unsuitable practices in interiors and toilets and social areas such as the dining hall and lack of design solutions for different disability types. Although the campus has been evaluated quantitatively in this study, it can be interpreted that in a social framework, the campus does not support diverse user groups in terms of socialization and personal hygiene. Similarly, another study, which evaluates the usage of Olbia Cultural Centre in Akdeniz University by disabled people regarding TS911 AND TS12576 standard, showcases limitations of the physical environment and indicates the cruciality of the physical environment in terms of human rights and equality (Yılmaz, et al., 2012). The existence of an exclusive environment is not peculiar to developing or under-developed countries, and it also exists in developed countries. Moriña Díez et al. (2015) transmit the ideas of disabled students in Sevilla University on the educational system. In this study, the students highlight how architecture prevents them from participating in daily life and accessing information and how inclusive design interventions like ramps, tactile stairs, Braille doors, and easy circulation can make a difference in every user's actions. Universal design practices can serve to provide equal opportunity for academic achievement between students (Evans et al., 2012). Designers who are responsible for providing solutions for educational spaces are needed to understand the concept of disability. Within this respect, as Kowaltoski et al. (2015) mentioned in their case study, active and equal involvement of disabled users in architecture and design education lead students to gain awareness of the significance of universal design and make project outcomes more connected to real life and also as Hidayetoğlu and Müezzinoğlu (2018) remark, current human-centred approach in design studios and universal design philosophy perfectly fit together. Lau et al. (2016) suggests two building inclusiveness assessment tools that evaluate the educational buildings in terms of design and management for physically and visually impaired people and underlines the importance of management approaches and operations and maintenance in addition to the design of the

external environment, entrance, horizontal circulation, vertical circulation and facilities. All of the abovementioned studies point to the impacts of the physical environment on accessing and participating in education and show the potential of universal design on strengthening the education system. As education, the universal design does not discriminate, underestimate, or tag any user group.

Methodology

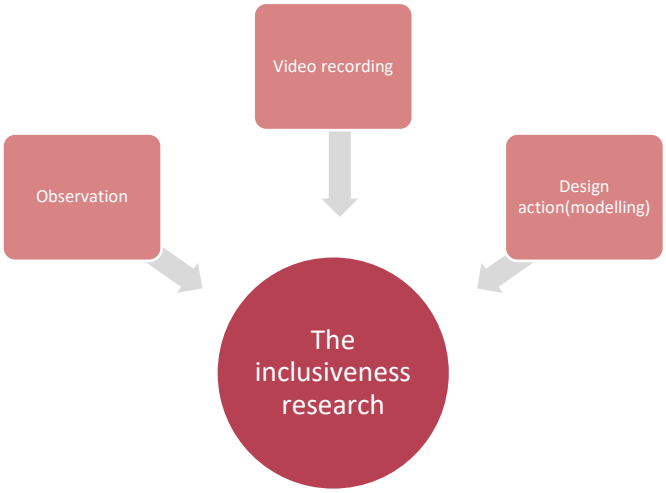
Within the scope of this research, the Duzce University Faculty of Art, Design and Architecture Campus have been evaluated regarding universal design principles. Before serving as Faculty of Art, Design and Architecture, the campus and its buildings served at first as a hospital, then as an educational facility for the Faculty of Science and Literature. When that study was carried out, users from various ages from 17 to late 60 years old, including two disabled students, one with visual and the other one with hearing disability, were advancing from the campus facilities. There are two separate buildings for educational purposes (as Building a and Building B), two other separate ones as management building and Fine Arts Institute, one cafeteria, one for the dining hall, small workshop areas, and a cabin for security (Figure 2). Students and staff regularly experience and interact with the campus environment. In order to fully understand how diverse groups of users interact with the campus environment and to construct empathy and develop a deep understanding of what ways the physical environment affects education, the researcher experienced the campus via altering the ability of her mobility, vision, and hearing. Data is gathered both from these unique experiences and her ordinary everyday experiences. The researcher has recorded her altered experience via empathy maps, photos, and videos. Then, with the help of the collected data from everyday experience and altered experience, the researcher searched for small-scaled design solutions and evaluated the self-design process and outcomes from a universal design perspective. In total, participant observation, video recordings, and the design process itself supplied data for this study.

Figure 2. The Campus of Duzce University Faculty of Art, Design and Architecture

The application of different data collection methods helped to triangulate the data. Using participant observation, as Preiser (2008) underlines, the researcher could measure interaction patterns and social dynamics. Thus, it has been possible to analyze how diverse users interact with the different sections of the campus such as campus entrance, outdoor circulation areas, dining hall and canteen areas, indoor circulation areas, lecture rooms, and office buildings and how this interaction affects the social life of the users. As Holm (2014) explains, both a researcher's or other participants' photos or videos can be visual data sources for research; both video recordings of researchers and a researcher's college were used to measure behaviours, movements, and researcher's interaction with the environment. The researcher kept separate video recordings of her campus experience as a physically and visually impaired user. In both types of experience, she attached her camera to her body and recorded her movements, related environment, and reactions. In her visually impaired experience, a college of her helped the researcher record her experience; thus, the researcher's college interaction with the same environment, her movement, her reactions also constituted valuable data to compare how diverse users react to the same environment. After analyzing corresponding points of observation and video

recording data, places that cause obstacles for diverse campus users were photographed to identify the locations where universal design solutions were needed. Since it is impossible to solve and actualize all of the users' needs in universal design, needs should be prioritized (Afacan & Demirkan, 2010). Within the scope of this research, after determining campus users' needs via observation and video recording, places that need design interventions were prioritized in accordance with their importance level by using the Priority Grouping method of Karlsson et al. (2007), which have been adapted from Planning Game method. While grouping and prioritizing the places their impact level on fundamental rights and freedom, inclusivity, usage frequency, the possible cost of the needed solutions were considered. A design solution primarily requires needs analysis and problem definition (Roth, 1973). Similarly, An Introduction to Design Thinking Process Guide (n. d.) explains the stages of the iterative, human-centred thinking way of design as begins with empathy and definition. Then ideation, prototyping, and test come. So, in this study, participant observation and role-playing can be considered as empathy stage and prioritizing places that need design interventions helped the researcher make needs analysis and frame problem definition. The researcher and her colleague are the two participants of the survey process. With the help of initial ideas and prototypes search for increasing the inclusivity level of the campus has continued. Thus, the inclusivity level of the campus was evaluated through observation, video recordings, and design action (Figure 3).

Figure 3. The Research Procedures



Findings

With the help of the participant observation and video recordings that were actualized within the scope of this research, areas causing inequality and exclusion in the Duzce University Faculty of Art, Design and Architecture have been revealed (Table 1). The determination of environmental challenges for users on the campus plays a critical role in framing possible design solutions.

Table 1. Campus areas and identified problems.

Area	Problems
Campus main entrance	Narrow turnstile Not being able to perceive the audio stimulus Undefined card reader section Not being able to see inside of security cabin Interrupted pedestrian path by vehicle road suddenly after entering campus Not having tactile surfaces on the pedestrian entrance side of the sidewalks.
Circulation areas	Misleading tactile surfaces Narrow sidewalks Bumpy ground Urban furniture barriers on walking routes Disconnected pedestrian paths High stairs High slope roads Undefined main entrances of the facilities Interrupted pedestrian paths by vehicle roads
Dining areas	Limited space for movement Misplaced furniture Dining hall interior stairs Accessibility of green space
Institute Building	Limitation in circulation Having only stairs as the access option to the main entrance of the building

Area	Problems
	Curbs in green social spaces
Building A	Accessing the entrance by stairs without any stairhead The high slope of the disability ramp and closed door at the end of the ramp Closed-door at the place where tactile surface leads you and urban furniture on tactile route Hard to perceive the numbering and naming of the rooms Risky interior organization in classrooms Undefined beginning and endpoints of stairs Lack of disabled toilet Lack of guides inside toilets
Building B	Hard to perceive the numbering and naming of the rooms Risky interior organization in classrooms Undefined beginning and endpoints of stairs Insufficient and risky disabled toilets Not having audio alerts in elevators

Following the collected data, problematic aspects in the interaction between users and the campus space can be stated as main entrance experience, outdoor and indoor circulation and wayfinding, entrances of buildings, existing conditions for personal care, the usability of social facilities (Figure 4-11).

Figure 4. The campus entrance.

Figure 5. Dining hall and cafeteria.

Figure 6. The main entrance of building A (music department block)

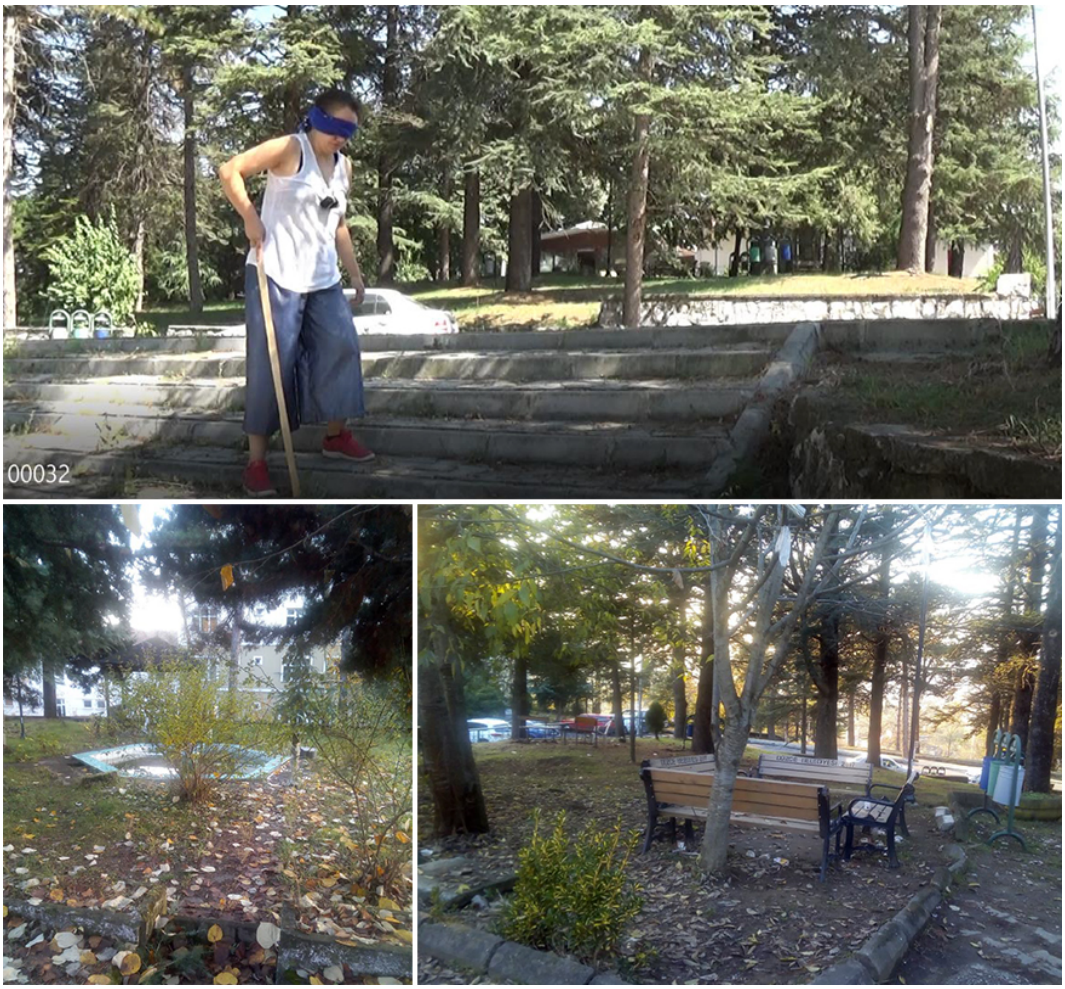
Figure 7. Entrance of Graduate Management Office

Figure 8. Entrance of building of dean's office and faculty rooms

Figure 9. Building B toilet

Figure 10. Building A toilet

Figure 11. Outdoor circulation areas and social spaces.



Regarding the daily life practices of the campus users, places that need universal design interventions are grouped according to their priority level (Table2).

Table 2. Priority grouping of the spaces.

High	Medium	Low
• Walking areas, outdoor circulation areas • Turnstile • Accessibility of toilets • Building the main entrance • Undefined entrances of facilities	• Undefined beginning and endpoints of stairs • Hard to use toilet spaces • Naming and numbering issues in buildings • Interior arrangements in classrooms • Interior circulation areas • Lack of handrails on both sides of the stairs • Lack of audio information system in the elevator	• Access to green space • Building B main entrance • Management building main entrance • Institute main entrance

The places that require improvement for inclusivity are examined regarding how they conflict with universal design, their priority level, and possible design solutions (Table 3).

Table 3. Identified problems and possible solutions analysis within the framework of universal design.

Problem	Priority Level	Unsatisfied Universal Design Principles	Aim Of The Possible Design Solutions
Walking areas, outdoor circulation areas	High	Equitable Use, Simple and Intuitive Use Perceptible Information, Size and Space for Approach and Use	Enlarging walking areas, defining connected routes, improving for disabled people

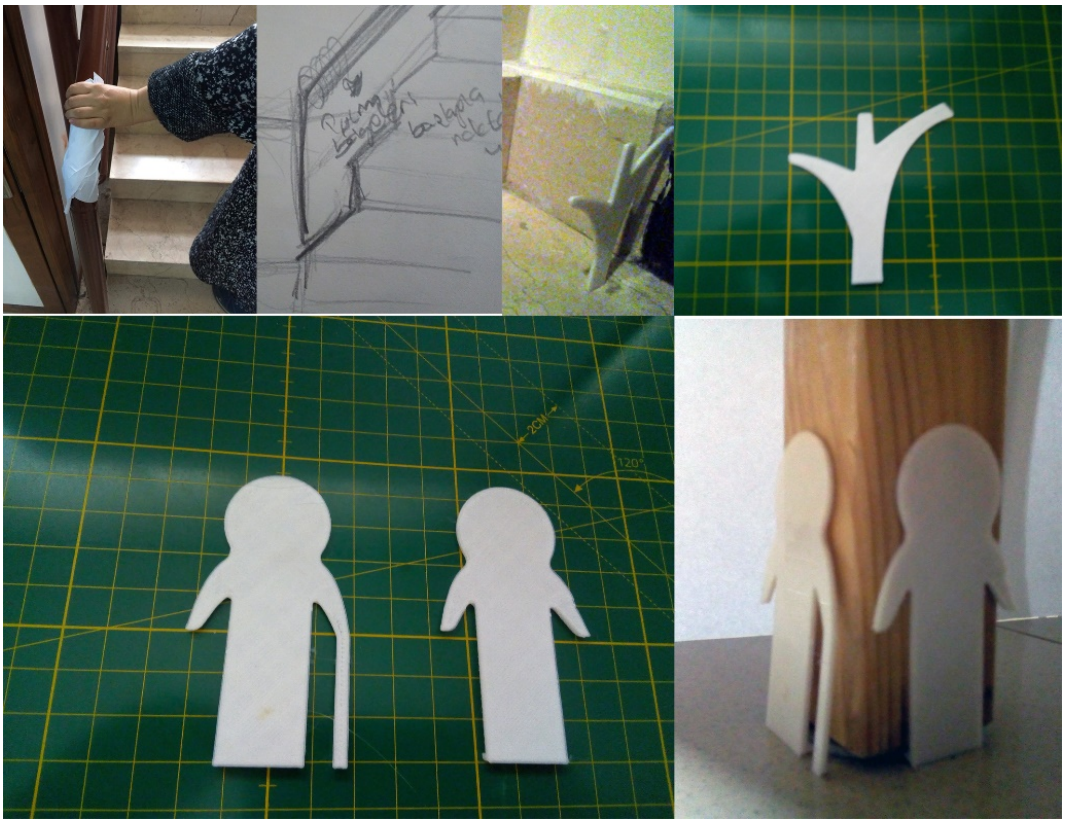
Problem	Priority Level	Unsatisfied Universal Design Principles	Aim Of The Possible Design Solutions
Turnstile	High	Equitable Use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Low Physical Effort, Size and Space for Approach and Use	Easy pass from the turnstile, defining card reader area, making audio stimulus more informative
Accessibility of toilets	High	Equitable Use, Flexibility in Use, Tolerance for Error, Size and Space for Approach and Use	Developing solutions for diverse user groups
Building the main entrance	High	Equitable Use, Simple and Intuitive Use, Size and Space for Approach and Use	Easier entering to the building
Undefined entrances of facilities	High	Perceptible Information, Tolerance for Error	Supporting user to identify the surrounding environment
Undefined beginning and endpoints of stairs	Medium	Equitable Use, Tolerance for Error, Low Physical Effort, Size and Space for Approach and Use	Providing equally safe and usable vertical circulation
Hard to use toilet spaces	Medium	Equitable Use, Tolerance for Error, Low Physical Effort, Size and Space for Approach and Use	Developing solutions for diverse user groups inappropriate size and space

Problem	Priority Level	Unsatisfied Universal Design Principles	Aim Of The Possible Design Solutions
Naming and numbering issues in buildings	Medium	Equitable Use, Perceptible Information, Tolerance for Error	Easier access to different spaces in the campus for diverse user groups
Interior arrangements in classrooms	Medium	Equitable Use, Flexibility in Use, Tolerance for Error, Low Physical Effort, Size and Space for Approach and Use	Providing equally safe and accessible classroom
Interior circulation areas	Medium	Equitable Use, Tolerance for Error, Low Physical Effort, Size and Space for Approach and Use	Supporting users to circulate safely in the buildings
Lack of handrails on both sides of the stairs	Medium	Equitable Use, Flexibility in Use, Size and Space for Approach and Use	Supporting safe vertical circulation of all users
Lack of audio information system in the elevator	Medium	Equitable Use, Flexibility in Use, Simple and Intuitive Use, Tolerance for Error,	Supporting equality and safety in the vertical circulation of all users
Access to green space	Low	Equitable Use, Tolerance for Error, Low Physical Effort, Size and Space for Approach and Use	Providing equal opportunities inaccessibility and socialization

Problem	Priority Level	Unsatisfied Universal Design Principles	Aim Of The Possible Design Solutions
Building B main entrance	Low	Equitable Use, Tolerance for Error, Size and Space for Approach and Use	Making easier entrance for diverse user groups
Management building main entrance	Low	Equitable Use, Tolerance for Error, Size and Space for Approach and Use	Making easier entrance for diverse user groups
Institute main entrance	Low	Equitable Use, Tolerance for Error, Size and Space for Approach and Use	Making easier entrance for diverse user groups

When we consider the spatial problems that cause a deficiency in meeting universal design principles and their impact level, it has been revealed that most of the universal design interventions require a high budget. For this reason, in order to improve testability in the following studies, the places that have high or medium priority and need small-scaled interventions are chosen as the study area. Within this respect, disambiguation of the beginning and endpoints of the stairs and disorganized interior of the lecture rooms are defined as the design problems. Initial ideas were searched through quick mock-ups by considering universal design principles (Figure 2). Thus even if being at the very beginning of the ideation process, it is understood that small interventions can make positive impacts on usage. Only by using different materials and patterns at the beginning and end of the handrails, illustrated reminders to keep furniture in the classroom tidy can make a difference in the inclusivity level of the space.

Figure 2. Initial idea mock-ups.



Discussion

Above mentioned findings show us, as pointed by Lau et al. (2016) design of the external environment, entrance, horizontal circulation, vertical circulation and facilities of the campus directly affects the actions of people, thus affects the inclusivity level of the educational institution (Table 4).

Table 4. Areas and design problems analysis of the campus environment

Problematic area	**Related Problem**
External environment	Difficulty in entering the campus area Discomfort in walking due to disconnected, narrow, bumpy walking areas Being unable to find the facilities due to lack of signage and information panels Much effort is required because of high slope circulation roads
Entrances	Difficulty in entering into the buildings
Horizontal circulation	Numbering and naming deficits of rooms cause difficulty in wayfinding Lack of audio, visual and tactile signs cause wayfinding and feedback problems
Vertical circulation	Inadequate size for access cause a decrease in vertical mobility Lack of audio, visual, and tactile signs cause safety concerns
Facilities	Difficulty in moving Lack of size, space and order for mobility

The first barrier that the campus environment created is placed at the first interaction point with the user, at the main entrance of the campus. Whether disabled or not, every day, every pedestrian campus user is challenged by the

limited, hard use of the turnstile. It is very hard to enter the campus for people with physical or visual disabilities, or people with an ordinary backpack, or people with art portfolio cases, or people carrying their mock-ups, and also audio and visual feedbacks are insufficient. Thus, the experience of every pedestrian user begins negatively, and at first sight, they feel how their needs are ignored comparing the vehicle users. On the contrary of untagging characteristics of the universal design, as Story (1998) mentioned, their lifestyle and socio-economic conditions are being unbundled from other users at the first interaction.

When we look at the outdoor circulation areas of the campus, disconnected, narrow, bumpy walking roads, lack of informative elements, high slope circulation routes limit disabled users' ability to move independently on the campus. Thus, they lose more time circulating on the campus, and thus, their participation level to the social and educational activities decreases. It is very hard for them to socialize in coffee breaks as other normal users do, however being and feeling normal is the basis of universal design (Meşhur and Çakmak, 2018).

While the main entrances of office buildings or educational buildings do not offer suitable solutions for disabled people, at the same time, they also do not have enough size and space for users who carry musical instruments or art supplies. Thus, neither disabled users nor users with their professional equipment can move freely. In indoor circulation areas, exhibited goods and furniture limit user's movements, and also, users cannot get enough information about the location via audio or visual signs. Numbering and naming deficits cause being unable to be perceived by everyone. And also consistent with the findings of Ay et al. (2017), Yılmaz et al. (2012). and Moriña Díez et al. (2015), the design of the buildings prevent disabled people from advancing from the social facilities and using vertical circulation in the same manner with other user groups, and so, again, creates inequality. Even though some practices improve the accessibility of the educational environments following legislation and mandatory standards, they usually fall behind in fulfilling disabled people's needs. Not comprehending the idea behind the applied standards and laws, budget issues, not being able to make necessary changes simultaneously in an existing built environment, not being able to meet

decision-makers and users in the design process can cause this. Thus, inequality in the usage of educational spaces continues its existence. In the case of Duzce University Faculty of Art, Design and Architecture, all of the before-mentioned causes can be counted as the reasons why following standards and laws did not create a more inclusive environment. Universal inequality in educational environments can be solved via applying universal design principles at the very beginning of the design process, and it requires the full participation of all actors in the system.

Conclusion

The inclusivity level of educational environments reflects the egalitarian characteristics of an education system. The application of universal design principles while creating educational spaces provides the highest level of inclusivity and, therefore, supports equality in education. In this study, Duzce University Faculty of Art, Design and Architecture Campus was examined from the perspective of universal design via observation, video recording, and initial idea designs. Being relatively young, equality and inclusivity, caring characteristics of art and design and understanding the importance of physical environment make Duzce University Faculty of Art, Design and Architecture a perfect candidate for universal design and education research. As a result, it is revealed that the campus environment requires new universal design solutions to meet their diverse users' daily life needs and to give equal opportunity in education to any individual.

It should be noted that an individual interacts with the surrounding environment in accordance with the intended action, and during this process, requirements of the intended action, properties of environmental elements and personal characteristics of the individual are determinants. So, any universal design practice will fail if one of these three is neglected. It is only possible to analyze the inclusivity of an educational environment by considering its physical properties, its users' characteristics, and related actions. The campus environment has been handled holistically and initial design solutions have shown the positive impacts of small-scaled universal design solutions on the inclusivity level within this perspective. It has been

thought that, for further studies, in addition to role-playing, including diverse user groups in the data collection and design phase will result in a more improved design solution in terms of universal design. And, of course, to achieve a successful inclusive design solution in an educational organization, it is strongly suggested to involve management actors to design phases in further studies.

To conclude, it should be appropriate to mention that providing only equal opportunities in education is not sufficient to make the environment more inclusive. Of course, physical changes are linked with social change. However, they are only effective if they find a response in every actor of the system. So, it is crucial to make every actor of the system take part in educational space design.

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BUILT ENVIRONMENT ACCESSIBILITY IN THE EASTERN PROVINCE OF THE KINGDOM OF SAUDI ARABIA AS SEEN BY PERSONS WITH DISABILITIES

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***Abstract*:** According to the World Health Organization, the rights of persons with disabilities (PwD) worldwide are limited by social and physical barriers that prohibit their full participation in society. Built environment barriers can limit accessibility to transportation, goods and services, healthcare, employment, and overall independent movement. The Eastern Province (EP) of the Kingdom of Saudi Arabia (KSA) has about six per cent of its population designated as having some type of physical disability. Previously KSA-instituted rules and standards have not improved accessibility for PwD in the local built environment. This research attempted to determine the extent of accessibility in EP by surveying 183 persons with disabilities to ascertain what elements of the built environment are problematic for them and what they believe requires improvement. According to this survey, PwD felt elements that are essential to accessibility, such as ramps, elevators, restrooms, signage, and egress, are difficult to navigate. Commonly used public locations such as medical centres, restaurants, shopping, mosques, and banks each had obstructive elements that prevented PwD from fully using the spaces. Saudi Arabia is currently in the process of phasing in technical and social programs regarding the built environment that should improve accessibility for PwD, but current conditions are inadequate.

Keywords: Saudi Arabia, accessibility, built environment

Introduction

Accessibility in the built environment is critical to the segments of any society who have physical limitations and participate in everyday activities such as employment, access to goods and services, and transportation. Without what the United Nations terms 'equalization of opportunities', many people are relegated to lives of isolation and poverty, especially in developing countries. According to a World Health Organization and World Bank Group report, about 15% of the world's population experience some form of disability, with more than 80% of these people being citizens of developing countries. Moreover, the World Bank Group classifies excluding differently-abled people or people with disabilities (PwD) from the workforce as having a possible negative social and economic impact on the Middle Eastern and North African (MENA) region. Its report specifically cites physical barriers that prevent access to built environments that include transportation facilities, school buildings, employment opportunities recreation, shopping, and health services as serious contributing factors. Currently, disability is considered a human rights issue where PwD options are not only limited by their physical functioning but by barriers- physical and social- placed by the society in which they live. Saudi Arabia has been lagging in participation in international PwD agreements as well as accessibility improvements for built environments. Analysis of existing KSA built environments shows there is limited accessibility for PwD. This paper researched, from the viewpoint of PwD, the extent to which barriers exist in common public locations like shopping centres, medical centres and mosques, and with typically problematic elements such as ramps and restrooms (Al-Jadid, 2013; Hakim & Jaganjac, 2005; Mulazadeh & Al-Harbi, 2016; UNGA, 1994; WHO/WB, 2011; WHO, 2018).

Initially proposed in 1993 and updated in 2004, the United Nations introduced Standard Rules for the Equalization of Opportunities for Persons with Disabilities (SREOPwD), which all members adopted. These standards outlined the basic rights and services adopting nations should pursue. Accessibility to the built environment fell under Rule 5, part a where the adopting country committed to legislation, standards and guidelines for accessible interior and exterior built environments; design professional training and information from the state on achieving barrier-free environments as well as requirements to incorporate these design processes in the

initial stages of design; and design decisions, especially for public spaces, should include organizations for the disabled to maximize accessibility. In 2005-2006, a global survey of adopting states, including Saudi Arabia, found that the progress toward accessibility based on Rule 5 still needed significant improvement since nearly 50% of the countries surveyed had no set standards for built environment accessibility (Rbeihat, 2006; UNGA, 1994). While UN members all agree that barriers exist for PwD, action to remedy environmental barriers was sluggish.

Due to the lack of enforcement mechanisms in the Standard Rules and the slow rate of action toward enacting the standards, the UN ratified a 2004 update to the SREOPwD treaty that further protected the rights of PwD. It included monitoring and reporting by the ratifying states to a UN Committee on the Rights of Persons with Disabilities regarding each country's progress toward meeting the Convention on the Rights of Persons with Disabilities (CRPwD) expectations (UNGA, 1994; UNDESA, 2004). This required countries to be more accountable for remedying shortcomings for PwD, including removing architectural barriers.

In addition to UN studies, international researchers also find that PwD encounter built environment obstacles that limit their access to facilities and services. These physical barriers can erect social barriers to inclusive participation in society by PwD. Public transportation, public buildings, commercial spaces, and healthcare settings all have design aspects that constrain PwD full use of and inclusion in the built environment. Soltania et al. (2012) found that public transportation facilities in Malaysia required a redesign to increase accessibility. In particular, ramps, steps and walkways were found to be inaccessible. Gamache et al. (2020) similarly found that ramps and restrooms were universally problematic for PwD who used mobility devices in Canadian urban locations. Jamalunda & Kadirb (2012) analyzed commercial structures in Kuala Lampur and reported that while a newer building provided better accessibility, all three built environments that they surveyed lacked some elements required to provide full accessibility. Elevators had no Braille buttons or audible signals, areas inaccessible due to lack of elevator service, reception desks too high to reach, no signage for facilities or signage too small to read, level changes without ramps or curb cuts, and too few accessible parking spaces. Poldma et al. (2014) focused on shopping malls which are locations that PwD often view favourably for accessibility. Here, too built environment barriers existed with difficulty reading signage and wayfinding, floor materials causing glare

and inadequate contrast that confused users, and restricted wheelchair access from the subway entrance. Healthcare settings in the United States also demonstrated areas of inaccessibility. Kirshner et al. (2007) and O'Day et al. (2002) both emphasize that environmental barriers to healthcare for PwD can have profound adverse effects on their healthcare outcomes. PwD in these settings are concerned with accessible restrooms, offices, and examination rooms as well as overall building accessibility. PwD patients surveyed often chose their healthcare plan based on the physical accessibility of the medical facilities included in the plan (O'Day et al., 2002).

When discussing environmental barriers, authors emphasize that the physical environment can determine how PwD socialize while often signalling negative social cues. When barriers exist, PwD are made to feel unwelcome, disempowered, lacking rights. The suggestion is to change the approach to how spaces are designed. Move away from the abled-disabled binary, make built environments all-inclusive. Appreciate, accept and include bodily diversity no different from the consideration given to any diversity such as racial, ethnic or cultural (Crews & Zavotka, 2006; Enginz & Savli, 2016; Kirshner et al., 2006; Poldma et al., 2014). Universal/inclusive design that benefits all users of space while greatly increasing accessibility for PwD is the goal to pursue when designing all built environments (Crews & Zavotka, 2006; Kadir et al., 2012; Soltania et al., 2012).

From the UN studies and independent research, it is apparent that, in spite of rules and good intentions, PwD still routinely encounter architectural barriers that limit their basic human rights to move independently and freely participate in society. This condition exists in Saudi Arabia as well.

The Kingdom of Saudi Arabia (KSA)

Compared to other Middle Eastern and North African countries, Saudi Arabia was late joining and participating in the CRPwD. A global survey written in 1997 regarding government action on disability policy included most industrialized countries as well as MENA countries such as Bahrain, Iran, Iraq, Israel, Jordan, Lebanon, Morocco, Oman, Qatar and Yemen, and others. MENA countries notable by their absence were KSA and the United Arab Emirates. A 2005 study by the World Bank regarding MENA disability issues also does not include KSA. However, a

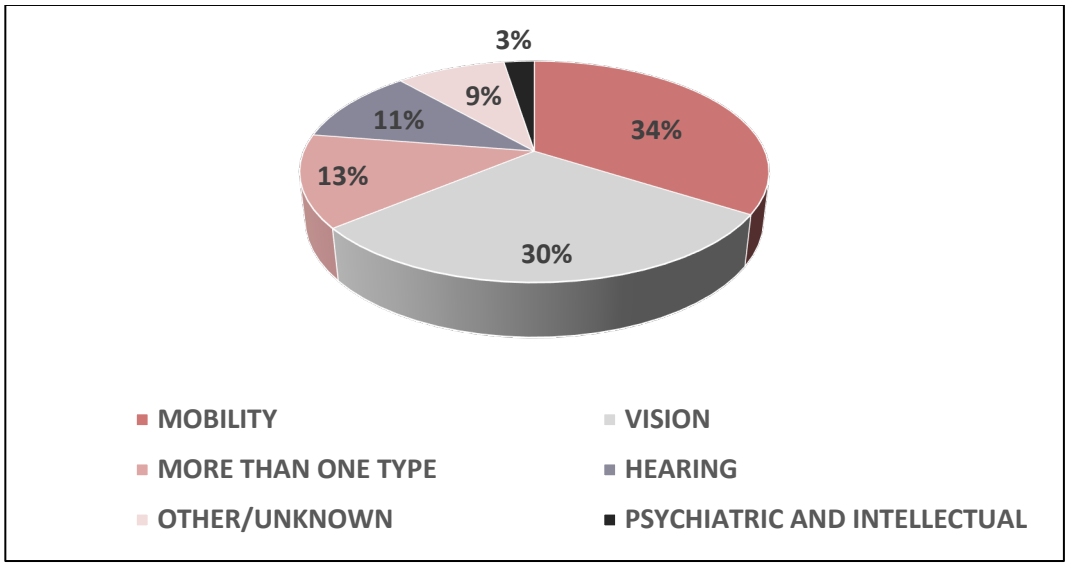
separate global survey performed in 2005-2006 for the United Nations does list over 86 per cent of Arab states, including KSA. (Hakim & Jaganjac, 2005; Michailakis, 1997; Rbeihat, 2006).

While KSA has had disability policies in place for decades, the delay in actual progress with accessible environments has been hampered by a lack of data regarding rates, types, and specific needs for PwD in the country. A 2002 international report regarding disability in KSA found that the data collected could be more complete and especially should analyze disability in KSA based on gender and area of the country. More recently, in its National Transformation Program 2018-2020, KSA stated that roadblocks for identifying and addressing the needs of PwD were no standardized database and lack of understanding about the difficulties PwD face, including inaccessible environments. As part of this initiative, KSA instituted a National Register of Disability and a Persons with Disability Survey (PwDS), which is comprehensive and contains important, relevant information regarding PwD in KSA. (GAStat PwDS, 2017; JICAPED, 2002; NTP, 2016).

PwD Frequency in KSA

KSA has evaluated its number of PwD in the past and provided basic information on overall numbers. For example, a survey taken in 1997 listed the breakdown by per cent of each type of disabilities out of the total PwD shown in Figure 1.

Figure 1. Per cent disability type in Saudi Arabia 1997

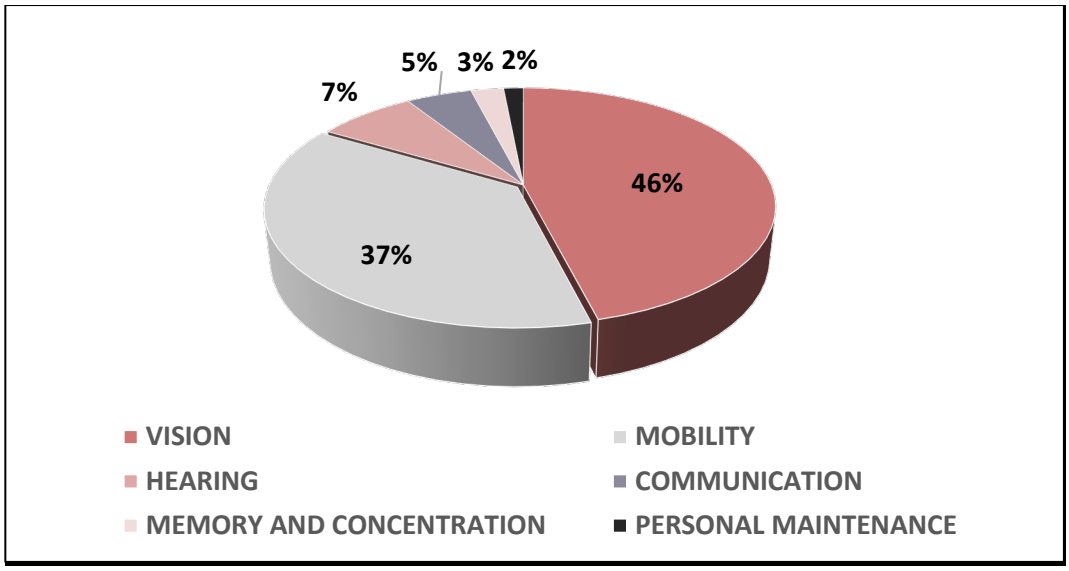


This survey also included meagre age-specific information, comparing rural (59%) versus urban (41%) prevalence of PwD, but no gender-specific data or country-wide

data on PwD. This information is cited and available in a Country Profile on Disability for KSA written in 2002 (JICAPED, 2002).

The current 2017 Disability Survey published by the KSA General Authority for Statistics is very complete in its analysis of PwD in KSA. The survey was scientifically tested and included a random sample of 33,375 households throughout KSA. There are general questions such as household, economic, social and demographic characteristics. Specific questions encompassed types of difficulties and degree of disability, as well as reasons for the disability, duration, government services used and where the person resides. Based on this survey, 7.1% of the KSA population (32.5 million) has some form of disability. See Figure 2 for distribution according to disability type. PwD are divided equally among KSA males (3.7%) and females (3.4%) (GAStat PwDS, 2017).

Figure 2. Per cent disability type in Saudi Arabia (GAStat PwDS, 2017)



Vision 2030

Although an updated KSA Disability Law was enacted in 2000 that protected the rights of PwD and guaranteed them equal access to all government services and employment, and the Universal Accessibility Built Environment Guidelines for the Kingdom of Saudi Arabia were published in 2010, action and implementation regarding the law was deficient. Saudi Arabia also has a dearth of skilled construction workers or professionals that specialize in building code implementation. Design firms, until recently, did not emphasize building code training (Abu Tariah et al., 2018; Al-Jadid, 2013; KSADCS, 2000; Meyers, 2014;

Mulazadeh & Al-Harbi, 2016; UABEG, 2010). In 2016, Saudi Arabia formulated a country-wide Vision 2030 plan for the growth and development of KSA into a multidimensional economy independent from oil. Included in the Vision 2030 document is a commitment to PwD for education, work and inclusion in society.

"We will also enable those of our people with disabilities to receive the education and job opportunities that will ensure their independence and integration as effective members of society. They will be provided with all the facilities and tools required to put them on the path to commercial success." (Vision 2030, p.37).

Development of this area was under the aegis of the Sixth Theme of the National Transformation Program (NTP, 2016). The challenges to moving toward identifying needs and integrating PwD were stated as a lack of a clear definition of disability and no database of PwD in KSA. It also maintained that there is inadequate awareness of obstacles PwD have when trying to work and that work environments are not adequately designed for PwD. The strategies proposed to overcome these issues are: "providing opportunities, establishing infrastructure, and developing their professional and social skills" (NTP, 2016, pp. 79-80).

With this research focusing on the built environment, the infrastructure solutions for workers are relevant. To encourage a reduction of environmental employment barriers, KSA established the Mowaamah (Arabic for adaptability) Program in 2017, which outlines best practices and standards enterprises should meet to increase accessibility in their workplace. These practices include basic ideals such as commitment to hiring PwD, appropriate use of communication types, staff training to treat PwD as full colleagues, recruit and retain PwD, provide IT services enabled to meet PwD needs, and develop products and services for PwD customers. The final standard specifically relates to the built environment since firms must guarantee easy access for PwD staff and customers to their facilities. Businesses provide documentation as proof of attaining these requirements and submit to independent auditing to earn the certificates (HRSD, 2017; HRSD, 2019; Mowaamah, 2017). The company then is awarded a certificate designating to what level space meets the Mowaamah standards: Gold, Silver, Bronze and Participant. The certification must be renewed every two years or one year for the Participant level. The KSA Ministry of Labor and Social Development in 2018 stated that there were 150 firms with Mowaamah certificates. The companies include healthcare,

construction, financial services, and food production. Several have recent online advertisements that they have Mowaamah certificates (see website listing at the end of the references).

Built Environment Current Situation

For general inclusion and accessibility, Saudi Arabia adopted its own form of the 2003 International Building Code that it has recently updated to align with the 2015 International Building Code and known as the Saudi Building Code 2018 (SBC, 2007; SBC-18, 2018). Both these documents contain accessibility chapters that became law when adopted. Enforcement of the SBC-2018 has been phased since 2018 with penalties for non-adherence to the code (Saudi Gazette, 2018). In 2018, the structures included governmental and administrative buildings, high-rise buildings (towers higher than 23 meters), hospitals, hotels; 2019 phased in assembly buildings (mosques, sports arenas), educational buildings, commercial malls, communication towers, industrial buildings, buildings that are less than 23 meters and buildings of high hazard; 2020 expands to additional assembly buildings (wedding halls, cinema auditoriums, theatres) health care centres, motels, residential buildings and entertainment buildings; and finally, 2021 will encompass airports, banks, TV stations and post offices (SBC FAQ, 2018).

However, as documented by several authors, implementation and enforcement of previous accessibility codes in KSA has been limited. Abu Tariah et al. (2018) evaluated the accessibility of mosques in Riyadh based on the input of 48 wheelchair users, and 86% of these people had difficulty accessing mosques. Alkawai & Alowayyed (2017) studied wheelchair patients' attitudes about accessibility in a hospital in Riyadh and found that most of these patients experienced difficulty moving independently through the hospital due to built environment barriers. Mulazadeh & Al-Harbi (2016) explored 13 public buildings and 6 roads in Riyadh for accessibility features. They found that most of the buildings, even the newer structures, did not comply with accessibility requirements listed in the Saudi Building Code. Accessibility to employment, healthcare, government buildings, schools and recreational facilities was restricted, and some facilities were completely wheelchair inaccessible. Public roads had virtually no accommodation for safe passage for PwD. There tends to be a general disconnect between legislation written on paper and action taken with improving and regulating the

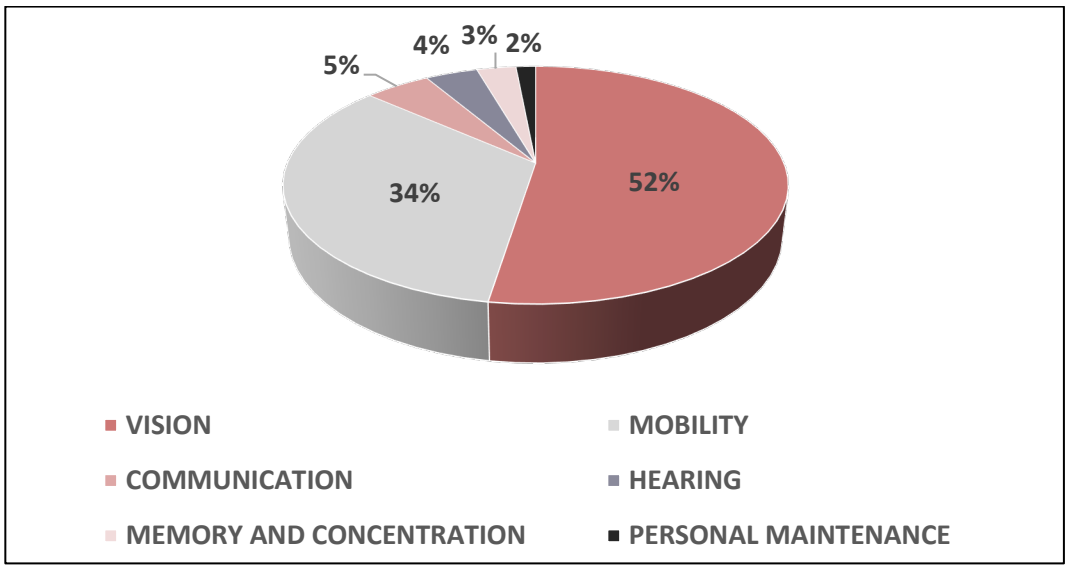
construction of the built environment for PwD (Al-Jadid, 2013; Mulazadeh & Al-Harbi, 2016).

Eastern Province of KSA

Data for this research was gathered from residents of the Eastern Province (EP) in Saudi Arabia, the third most populated Saudi Arabian region. The area is a major contributor to Saudi Arabia's overall economic strength since some of the largest oil fields are located here. Commercial, educational, and recreational expansion has resulted in increased construction and development. The population of the Eastern Province is just over 5 million inhabitants (GAStat, 2018).

For the KSA 2017 PwD survey, 4,200 Eastern Province households were contacted to evaluate the prevalence and severity of disabilities in the area. The Eastern Province has 6% PwD by population and 12.25% of the total Saudi PwD population. EP PwD were also evenly split between male and female (2.8% each). See Figure 3 for distribution according to disability type (GAStat PwDS, 2017).

Figure 3. Per cent disability type in the Eastern Province (GAStat PwDS, 2017)



Similar to conditions found in Riyadh, the built environments of the EP have limited accessibility for PwD. The photographs below illustrate a few typical examples of the barriers PWD face. Inaccessible entrances, as shown in Figure 4, are common. Figure 5 displays just a few of the ramp challenges faced by PwD. The author has a large collection of inaccessible ramp examples. Figure 6 shows an inaccessible reception counter in a medical centre constructed in 2018 and a classroom doorway

(built 2006) with inappropriate signage and doorknob. Figure 7 is two photos put together and illustrates a hospital room restroom that has insufficient accessibility accommodations.

Figure 4. Entrance to office and clinic building. Source: photo- author archives.

Figure 5. Ramps- restaurant retail and street entrances. Source: photos-author archives.

Figure 6. Healthcare reception and classroom doorway. Source:photos-author archives.

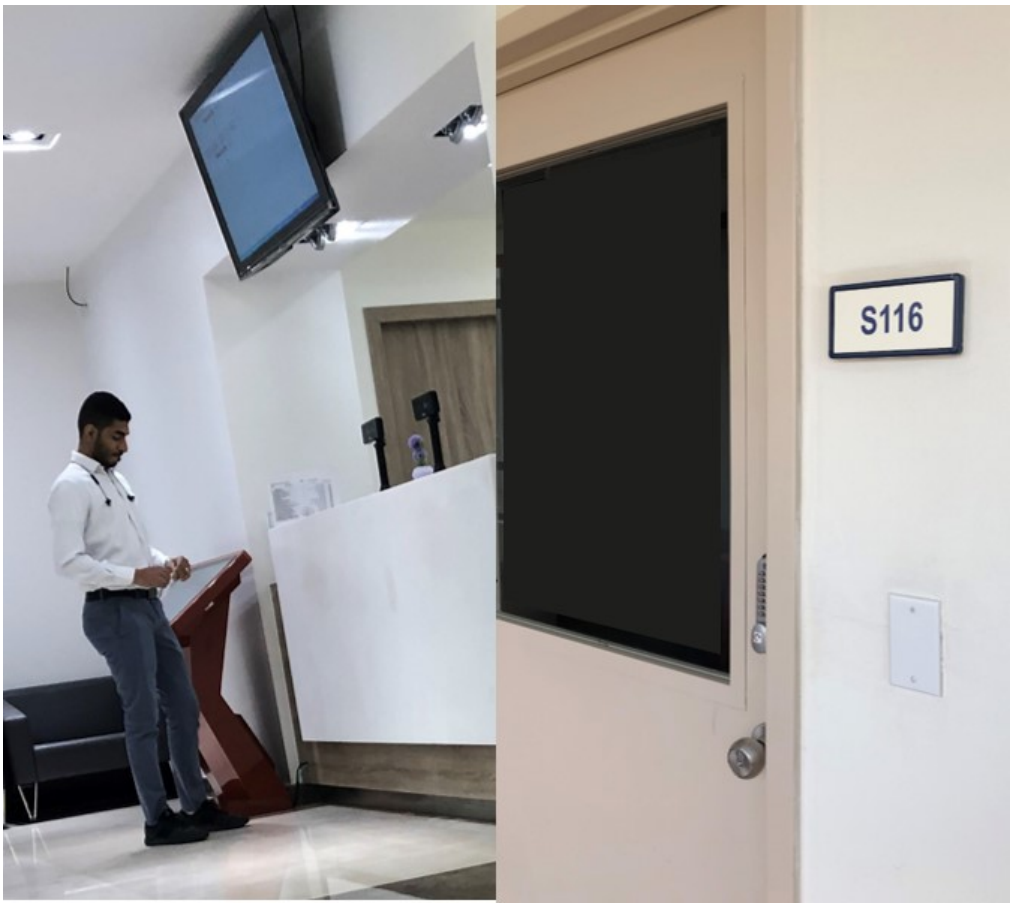


Figure 7. Healthcare- hospital room restroom composite photo. Source: photos-author archives.

Methodology

Based on the information from the literature review that indicated environmental barriers do exist for PwD and are hurdles for their full participation in society, the question was, do existing EP facilities meet the needs of people with disabilities, and if not, what improvements are needed? A Likert scale survey was developed to answer this question that included the basic architectural barriers mentioned in the literature and covered by SBC 2018. The survey items contain typical environmental barriers encountered by PwD. This would provide insight into how people experiencing the built environment felt about accessibility. A copy of the survey is in Appendix 1.

For the survey, 183 residents of the Eastern Province who experience physical disabilities were asked to determine their impressions and feelings about accessibility in various public spaces. It included rankings of accessibility in general, but also for specific areas such as ramps, restrooms, shops and malls, hospitals, mosques, restaurants, fast food premises, banks and their automated money machines (ATM). One final question asked the respondents their opinion of overall respect for PwD. The rankings were very good, good, average, poor and very poor, where each respondent would indicate what level they experienced. They also commented on their feelings about the accessibility of each area.

Due to the difficulty of freely accessing the disabled population, female interior design university majors who were immediate relatives of the subject administered the surveys. They spoke to the subject directly or to the subject's caregiver if the subjects could not answer for themselves and requested comments from the disabled person. Instructions to the students were to follow the script of the questionnaire and simply record answers. They were not to coach the respondent.

The results of the surveys were analyzed for demographics and Likert scale responses for each category. For the Likert responses, each level is shown separately, as well as grouped into Poor and Very Poor, Average, Good and Very Good. Furthermore, for ease of overall rating, a mean of the Likert responses was calculated.

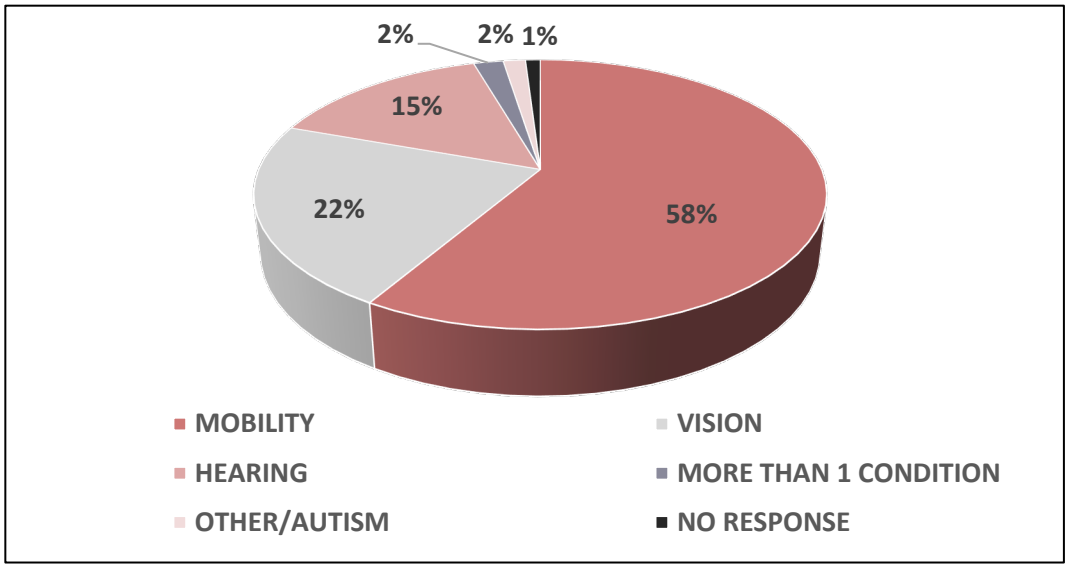
Comments were evaluated within their category, and general questions about feelings and best places were analyzed and grouped according to the similarity of the responses.

Results

Basic Demographics

The demographics of the respondents offer a representative cross-section of KSA residents. Of the 183 people surveyed, 46% were males, and 54% were females. Their ages ranged from three years to eighty-five years. The mean age was 38 years, and the median age was 32 years. The number of years the person has been disabled ranged from less than a year to 66 years. The mean number of years was eleven, and the median was seven. Figure 8 shows distribution according to disability type from survey respondents.

Figure 8. Per cent disability type from survey respondents



Accessibility Ratings

All respondents rated their experiences with the accessibility of various built environment locations. The ratings from respondents regarding the categories of ramps, restrooms signage, shops and malls, restaurants and fast food establishments are shown in Table 1. These are not for comparison, but merely a listing of

responses for each element or location. Due to the number of categories, Table 2 lists the remaining categories.

Table 1. Ratings for Ramps, Restrooms, Signage Shops and Malls, Restaurants and Fast Food Establishments

a) Ratings

Per cent	RAMPS	RESTROOMS	SIGNAGE	SHOPS MALLS	RESTAURANTS	FAST FOOD
VERY POOR	15.3	21.9	15.8	21.3	24.8	23
POOR	19.1	20.8	23	20.8	26.8	20.8
AVERAGE	45.4	35	33	33.3	26.2	31.7
GOOD	8.7	10.4	17.5	11.5	12.6	9.8
VERY GOOD	2.2	1.6	3.3	8.2	2.7	4.9

b) Grouped ratings

Per cent	RAMPS	RESTROOMS	SIGNAGE	SHOPS MALLS	RESTAURANTS	FAST FOOD
POOR & VERY POOR	34.4	42.7	38.8	42.1	51.6	43.8
AVERAGE	45.4	35	33	33.3	26.2	31.7
GOOD & VERY GOOD	10.9	12	20.8	19.7	15.3	14.7

c) Mean all ratings

Per cent	RAMPS	RESTROOMS	SIGNAGE	SHOPS MALLS	RESTAURANTS	FAST FOOD
RATINGS MEAN	52	48.6	53.4	52.6	47.6	49.6

For ramps, 34% of the respondents felt access to, and construction of ramps was poor or very poor, 45% found them to be average, and about 11% found them to be good or very good. The overall rating out of 100 was 52%. Access to and accessibility of restrooms had an overall rating of 48.6%. About 43% thought they were very poor or poor, 35% found to be average, and 12% were very good or good. Visible and clear signage was rated 53.4% overall out of 100, with almost 39% poor or very poor, 33% average, and nearly 21% were good or very good. Respondents

assessed accessibility to shops and malls as poor or very poor at about 42%, as average at about 33% and as good or very good at about 20%. The mean of all the ratings for accessibility to shops and malls was 52.6%. When asked to rate accessibility of restaurants, about 52% of respondents found restaurants to be poor or very poor, 26% rated them as average, and 15% believed they were good or very good. The mean rating for accessibility of restaurants was 47.6 per cent. Respondents found the accessibility of fast-food restaurants to be almost 44% poor or very poor, nearly 32% average and close to 15% good or very good. The mean percentage for accessibility to fast food restaurants was 49.6%

The respondents' ratings of the accessibility of hospitals and doctors' offices, mosques and banks, including their ATM machines, are shown in Table 2. Hospitals and doctors' offices were the only category where good and very good accessibility was rated higher than poor and very poor: almost 45% versus a little more than 28%. About 22% of these spaces were deemed average. The average per cent rating was 62.6%. Mosques were rated 33% poor or very poor, about 22% average and more than 28% good or very good for PwD accessibility. The mean of the evaluations was 57.4%. Accessibility to banks and ATM machines were rated a bit over 36.5% poor or very poor, about 28% average and just over 27% good or very good for PwD accessibility. The mean of the assessments was 55%.

In addition to specific locations, the survey asked respondents to give their opinion on the overall accessibility of the built environment and the respect the general public shows to PwD and their accessibility requirements using the same Likert scale. Table 2 also illustrates those evaluations. For overall built environment accessibility, respondents felt 53% of built environments were poor or very poor, 29.5% were average, and 12.5% good and very good. The overall rating was 48.6 %. When assessing public respect for PwD needs, almost 45% of respondents felt that respect for them was poor or very poor, 24% believed their respect was average and a little more than 19% expressed good or very good respect for their needs. Overall, PwD rated their respect as 51.6%.

Table 2. Ratings for Hospitals and Doctor Offices, Mosques, Banks and ATM Machines as well as Overall Accessibility and Respect for PwD and their Accessibility Needs

a) Ratings

Per cent	HOSPITAL/ DOCTOR	MOSQUES	BANKS/ ATM	OVERALL ACCESSIBILITY	RESPECT FOR ACCESSIBILITY
VERY POOR	10.9	16.9	16.4	18	14.8
POOR	17.5	16.4	20.2	35	30.1
AVERAGE	22.4	33.9	27.9	29.5	24
GOOD	37.7	18.6	24.6	8.7	15.8
VERY GOOD	7.1	9.8	2.7	3.8	3.3

a) Grouped ratings

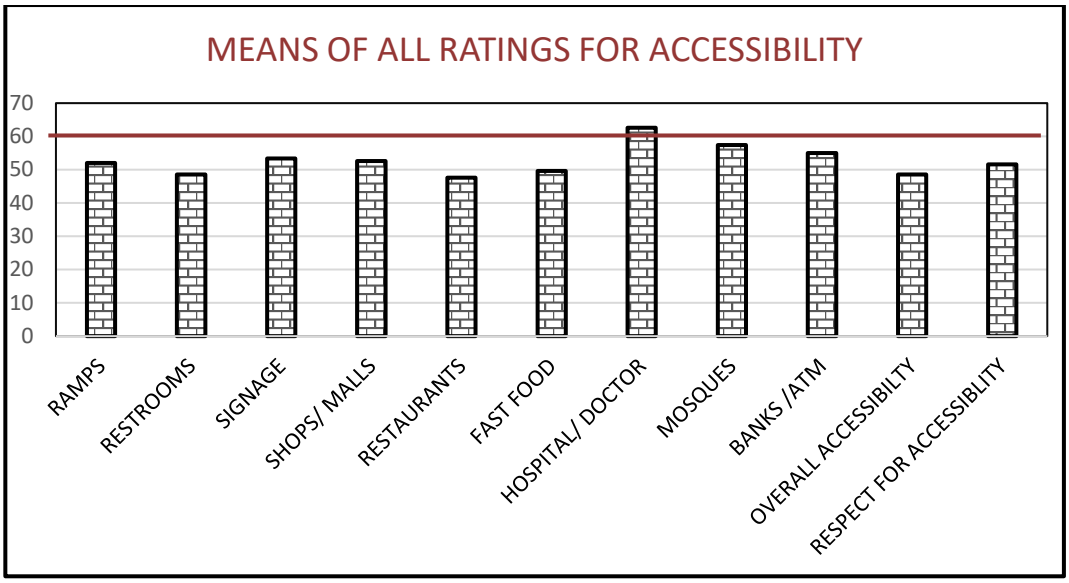
Per cent	HOSPITAL/ DOCTOR	MOSQUES	BANKS/ ATM	OVERALL ACCESSIBILITY	RESPECT FOR ACCESSIBILITY
POOR & VERY POOR	28.4	33.3	36.6	53	44.9
AVERAGE	22.4	33.9	27.9	29.5	24
GOOD & VERY GOOD	44.8	28.4	27.3	12.5	19.1

a) Mean all ratings

Per cent	HOSPITAL/ DOCTOR	MOSQUES	BANKS/ ATM	OVERALL ACCESSIBILITY	RESPECT FOR ACCESSIBILITY
RATINGS MEAN	62.6	57.4	55	48.6	51.6

Based on overall survey ratings and using a mean passing grade of a sixty-per cent, the only EP built environment locations that PwD respondents felt passed were hospitals and doctors' offices. As shown in Figure 9, all other surveyed locations had lower means.

Figure 9. Graph of All Per cent Means for Accessible Environments



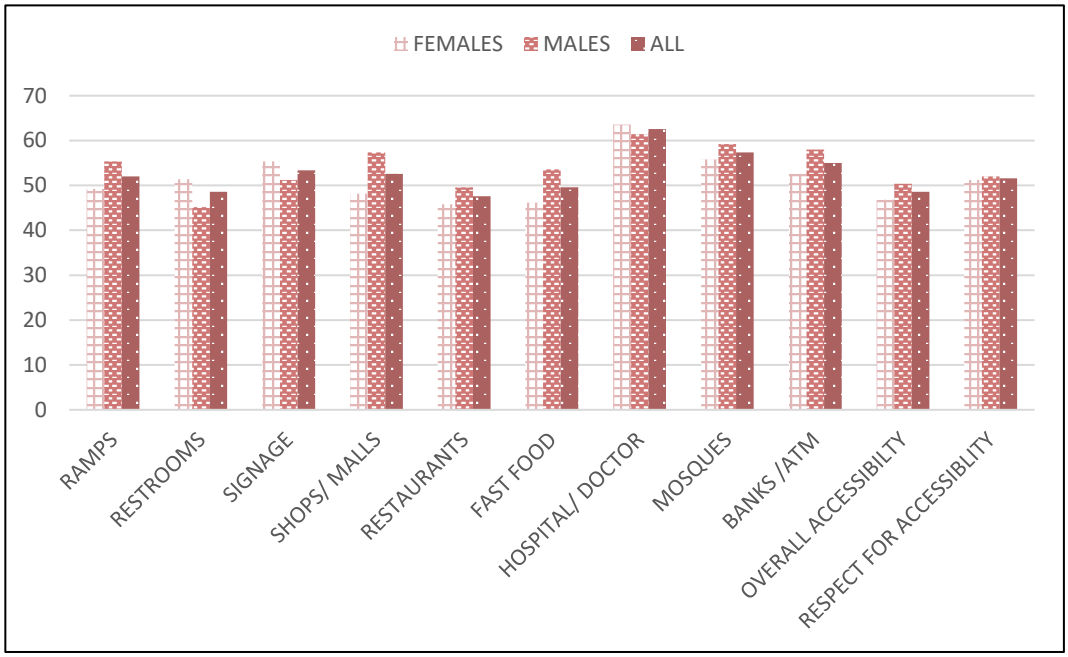
It graphically demonstrates the difficulties PwD may have when encountering the built environment in the Eastern Province of KSA. In addition, the spaces that should have the most accessibility, such as medical facilities, only barely exceeded sixty per cent (62.6%). As documented in the research completed by Abu Tariah et al. (2018), Alkawai & Alowayyed (2017), Mulazadeh & Al-Harbi (2016), and this survey, most public accommodations in KSA lack accessibility. Ramps, restrooms, reception counters, doorways, egress, signage and much more are not meeting the accessibility standards published in the 2018 Saudi Building Code (Chapter 11) or the Accessibility Built Environment Guidelines for the Kingdom of Saudi Arabia (SBC-18, 2018; UABEG, 2010).

Responses by Gender

Looking at the survey responses by gender, males rated accessibility to most locations higher than females. Figure 10 illustrates that women found restrooms, signage and hospitals/doctor offices easier to navigate than men did. All other locations or categories were more difficult for women. The restroom data may be unexpected except that urinals are not at all common in KSA, so what could be an area of easier access for men located outside of the Middle East could be more difficult for men in KSA. Analysis of age for each gender showed a mean of about 37.5 years for the males and a mean of about 39 years for the females, with a median of 32 years for both. This removes age differences to explain why women find their disability more difficult. Some of the variances could be cultural as

women's movements, in general, may be constrained by family expectations. Another aspect could be that women with disabilities tend to be discriminated against more than men are, which is beyond the scope of this paper and possibly avenue for further research (Mertens et al., 2007).

Figure 9. Graph of Means Separated by Gender



Responses by Disability Type

Another analysis based on disability type shows the disparity among the opinions of those who are differently abled. Figure 11 illustrates these variations. While KSA surveys show that people with vision difficulties are the largest group of PwD in the country and EP (52.5% of all disability types shown in Figure 12), they are the least acknowledged in the built environment. The ratings of ease of movement for vision-impaired survey respondents were significantly lower in all categories than overall ratings. Fast food establishments were the least challenging, with a mean difference of 1.4 %. All others were lower in a range between 3.2% and 7.8 %. Notable were the ratings for signage at 7.6 % lower and respect for accessibility at 7.8 % lower than the overall average. People with mobility challenges are the second most populous group in KSA and EP (34% of all disability types), and their opinions on ease of accessing spaces were basically equal to the overall ratings. They found fast-food restaurants the most challenging, with a 2.2 mean per cent lower than typical. However, restrooms, signage and respect for accessibility rated over 2% higher than the overall rating. People with hearing limitations (4% of all EP

disability types) rated accessibility within most spaces higher than the overall ratings. Restrooms were the only spaces they felt more challenged than typical. They rated them 2.6 % less accessible for them than the overall rating (GAStat PwDS, 2017).

Figure 11. Graph of Means Separated by Disability Type

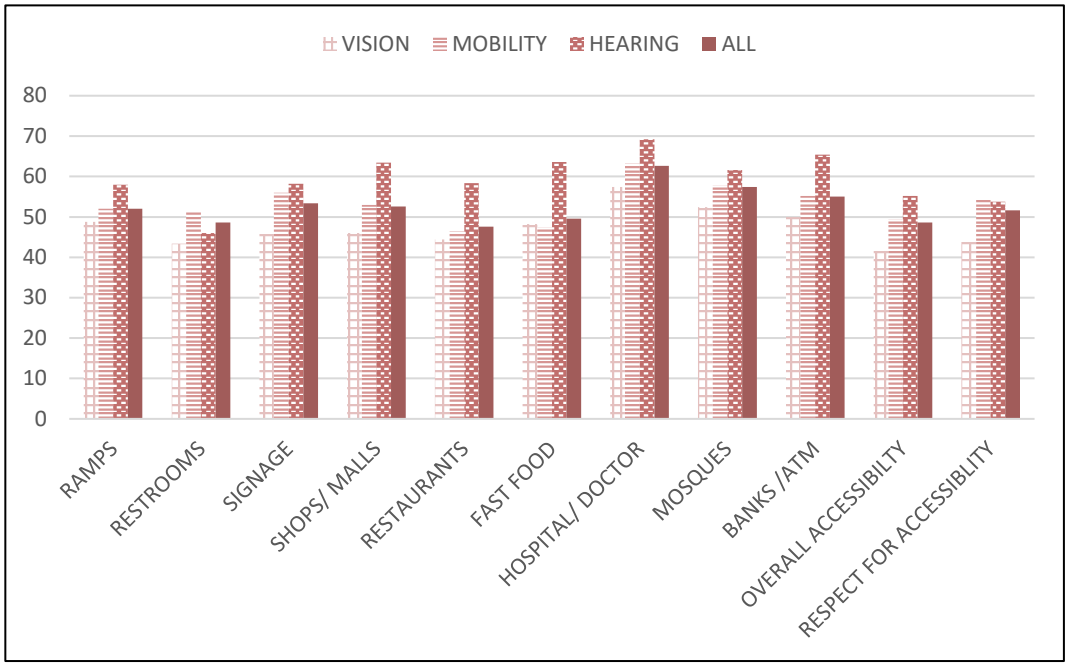
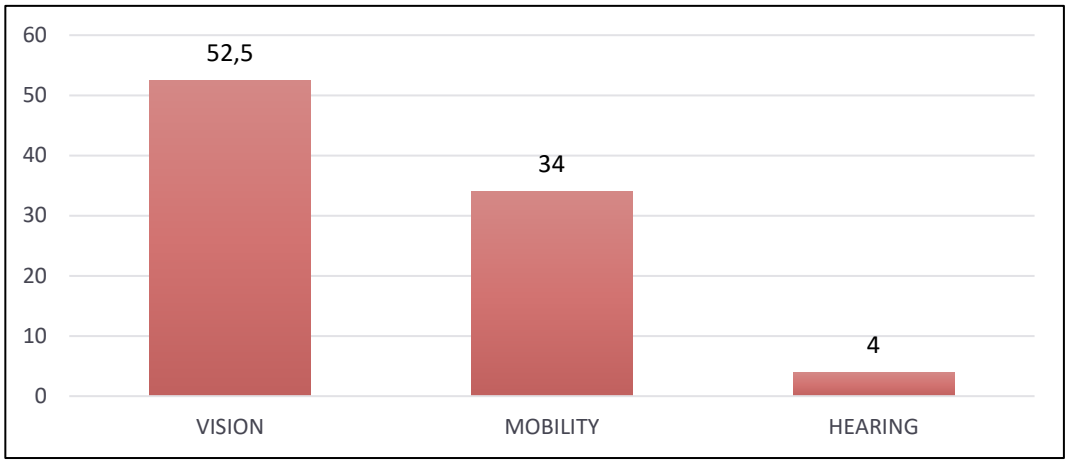


Figure12. Graph of Per cent Disability Type Out of Total in Eastern Province. (GAStat PwDS, 2017)



Comments from Respondents

Respondents were asked to comment on each category as well as give their impressions of how it feels to be a PwD in Saudi Arabia. They were also asked where they felt the most comfortable as a PwD. The comments underscore the

isolation and feelings of inequality stressed by the WHO, World Bank and UN documents (UNGA, 1994; UNDESA, 2004; WHO/WB, 2011; WHO, 2018). Not all respondents answered each category, and some gave multiple answers.

Comments about ramps noted their absence (7 comments out of 13) and/or that they were unusable (9 comments). Common access problems included slippery surfaces, partial ramp and then stairs, ramps too steep, and two mentioned that they needed people to carry them into a building- one of which was in a healthcare setting.

Comments regarding restrooms illustrate the challenges of these spaces when they are not adequately designed. Of the 21 comments listed, 2 simply stated that they do not use restrooms outside of their homes which has to severely limit their ability to work, socialize and move about. Five respondents stated they always needed assistance when using public restrooms because they are not accessible, while additional people mentioned that public services either did not exist (4 comments) or what were there were non-accessible (6 comments). Slippery floor surfaces also seemed to be a concern (3 comments).

For signage and wayfinding, the ability to view signage and adequate signage seemed to be the most concerns with PwD respondents. Of the 32 comments, 14 mentioned that the signs were either difficult to see (8 comments) or too high to see from a wheelchair (6 comments). Ten additional requests were for Braille signage, and 6 respondents asked for more signage since they felt existing signage was insufficient. Other comments mentioned that PwD required guides to escort them through buildings since wayfinding was not adequate (2 comments).

When asked about level changes, respondents to this question (6) felt too few buildings provided elevators, and if they did, they were too small for wheelchair access. This limits access to facilities, especially in restaurants where the family and female dining, due to cultural customs, is almost always above ground floor level.

Eight PwD made comments on the accessibility of shopping and malls. Their answers had no specific pattern but ranged over the gamut of typical PwD challenges. The spacing in stores is too tight for movement, cashier counters are too high to reach from a wheelchair, floors are slippery for wheelchair and crutch

users, no Braille signage for wayfinding or to even know what store the person is entering, inadequate acoustic control that makes the spaces loud and uncomfortable for people with diminished hearing. One respondent specifically said they could not go there alone due to the environmental barriers. Conversely, 32 respondents listed local malls and IKEA as their best places to go due to wide main corridors, accessible restrooms in IKEA and one of the malls, and overall ability to move independently through the spaces.

Although participants rated healthcare settings as having the highest accessibility for PwD, the comments (10) reflected areas where improvement is needed. Entry into hospitals is difficult; one respondent mentioned 'stairs everywhere.' Once inside, 3 respondents commented on how narrow the corridors were and that it was difficult for them to get into and fit the spaces allowed. Two respondents stated the reception desks were too high. Navigation through the spaces concerned 4 respondents. They mentioned poor signage, difficulty communicating- specifically asking for employees with sign language- and that often poor design of the space required them to need people to guide them through the facility rather than move independently.

Mosques earned the next highest rating by the survey takers. However, here too, there were comments (10) on areas for improvement. Half commented on general accessibility to the building- entrance steps with no ramps. Other mentions were lack of accessible restrooms, no Braille signage, no accessibility to upper levels for prayer, and no place for wheelchair seating. Two reduced hearing participants enjoyed the quiet of the mosque and that only one person at a time spoke, enabling them to hear more clearly.

Restaurants and fast food establishments will be analyzed together since they earned similar comments from respondents. There was a total of 22 comments, with the most revealing being that one participant stopped going out to restaurants with friends because it was too difficult, and the person felt they embarrassed their friends. Another mentioned that they always travel with an assistant to help them. Eight people said that the dining area was inaccessible to them since it was located on an upper level with no available elevator. Six felt the spacing in the restaurant was too tight, and they could not manoeuvre well. Three commented on inaccessible restrooms. Two referenced that the noise level in these places is too

high for their comfort, one asked for Braille menus, and another person mentioned that the service counters in fast-food restaurants were too high.

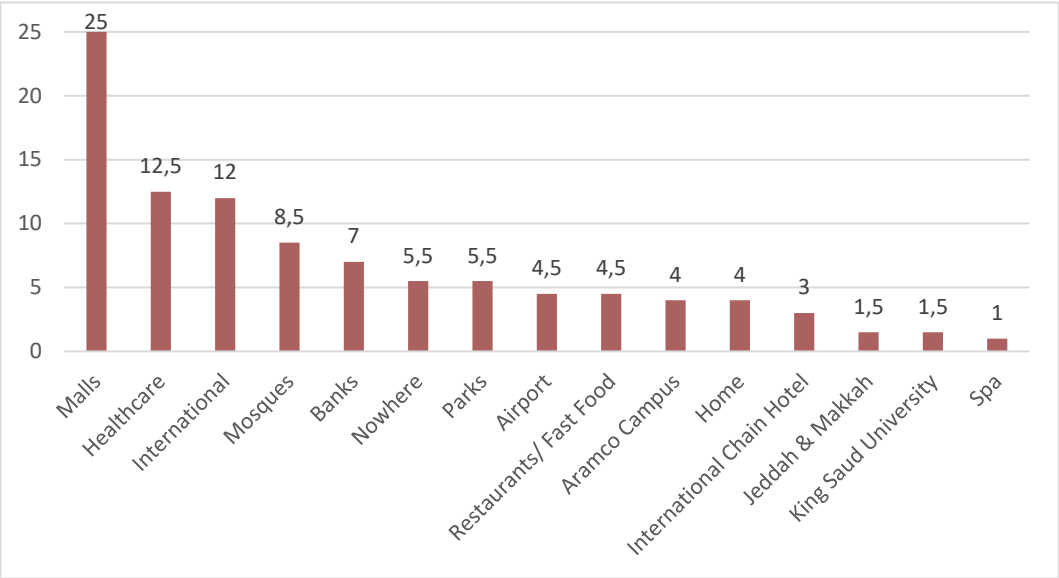
When commenting on banks, respondents mostly critiqued automatic teller machines (ATM) rather than the bank facilities as a whole. Many respondents mentioned that they interfaced with their banks and ATMs by car, so access was not difficult. Eight people mentioned aspects they would like improved. Three said the ATMs were too high to reach with a wheelchair, two asked for Braille on the ATM keys, and an additional two requested signage to make bank accessibility clearer. One person said that staff with sign language ability would help them.

The survey requested comments on PwD opinion of the overall respect they felt the public had for accessible features. Parking spaces were given as an example and most of the seven comments referred to them. Four people said that if there were PwD parking spaces, no one respected them or left them open for access. Two others commented that there were not enough spaces arranged, or when they were, they did not allow full access to the facility they were using; there were no ramps or sidewalks were too narrow. One person commented that the public mostly does not respect PwD rights. This impression is expanded in the section below on how PwD people feel when they cannot access places they want to visit.

To locate structures that PwD felt accommodated their needs, they were asked to describe their preferred place to visit. There were 128 responses, with some people listing more than one location. The answers were grouped by overall locations, as shown in Figure 13. Malls and IKEA received the highest percentage, with a total of 25% of the comments (32 responses) saying these locations were the best. Explanations included freedom of independent movement and accessibility of restrooms. Hospitals ranked next with 12.5% of the comments (16), saying they were the easiest for PwD to access. The next highest location is outside KSA, with 15 comments or almost 12% listing other countries as more accessible. Mosques (8.5%) and banks (7%) were deemed accessible in 20 comments. Seven remarks (5.5%) stated that the respondents felt in their experience, there was nowhere locally to go that was accessible. The same number listed parks as their best place due to freedom of movement and wide sidewalks. Airports and restaurants were each the favourite spaces of 4.5% of the comments (6 per category). These

respondents mentioned that wide corridors and good signage made airports easier to navigate.

Figure 13. List of Preferred Places by Per cent



The last few places include the Aramco Campus and personal homes with 4% each (5 comments). Aramco is a large international oil company that has enforced building codes in its EP campus structures for years, making access to most of their spaces much easier for PwD. Local hotels that are part of large international chains that follow building accessibility rules regardless of where they build are rated 3%. The commenters (4) appreciated the accessible ramps and restrooms. Two comments (1.5%) mentioned that accessibility was best on the way to and at the pilgrimage site in Makkah. King Saud University in Riyadh has a large medical complex and library that 1.5% of the comments (2) reflected were good places for PwD. One comment indicated that the person's best place was a spa because it was quiet and restful.

Respondents were asked how they felt when architectural barriers prevented them from accessing the places they wanted to visit. The answers to this question were poignantly illuminating and supported the stance that lack of accessibility is a human rights issue. There were 106 comments made to this question, and of them, 79 (74.5%) referred to lack of rights and the feelings that caused. Respondents said that the absence of accessibility made them feel lonely, sad, isolated, depressed, frustrated, annoyed, forgotten about, ignored, unappreciated, embarrassed, and uncomfortable. More were specific about their reactions: being prevented from

participation made them feel disrespected, or as a human being who does not have rights, less than others, feeling their disability, and that no one cares; they are a stranger their own country. The remaining 23.5% of the comments (25) refer to a desire to be independent and how not having that freedom feels. PwD stated that it is hard to move alone, they do not feel safe, and because they do not want to embarrass or bother the people with them, they just want to stay home. Two people mentioned that they wanted to leave KSA and find a place where PwD were respected.

The final question asked participants what improvements they would like to make the built environments of KSA better for them as PwD. There were 160 responses. The most requested area to fix were ramps. Twenty-three per cent of the comments (37) asked for more ramps and/or better-constructed ramps. One respondent said, 'build ramps according to codes, not only adding them randomly.' In addition, 19% of the comments (31) stated that overall building design should accommodate PwD. The request was that buildings be created for 'specialized people' with everything designed for PwD needs. Other comments (27 or 16.5%) focused on accessibility to upper levels. Whether elevators do not exist, or if they do, they are too small for wheelchair access. Spaces mentioned include upper floors in general as well as restaurants, classrooms, shopping and homes. Twenty-three comments (14%) referenced Braille availability. The requests were for Braille signage, elevators with Braille, as well as detectable floor and sidewalk surfaces. General accessibility in restrooms (4%), wider hallways, sidewalks and doors (5.5%), safer flooring material (4%), accessible parking (3%), and lowered reception desks (2%) were also mentioned. All of these items are basic egress and/or accessibility considerations that should exist in every built environment. Nine comments refer to navigating spaces with hearing loss. Better acoustics and sound systems (3%), specialized equipment to assist with hearing (2%), voice instructions and employees with sign language (2.5%) were important improvements PwD requested.

Conclusion

This research surveyed EP residents who experience the challenges presented by a built environment inhospitable to PwD. The desire to be accepted and treated as equals was shown in the comments made by the interviewees. Several stated that

they have rarely found accessible buildings in Saudi Arabia. One interviewee requested that designers create spaces that "make our lives easier because we are already suffering." This research implies that for most of the respondents, the built environment in the EP has limited accessibility. There is a continual struggle to accomplish activities that should be easily accessible.

While KSA has the admirable goal of increasing inclusion for PwD in the workplace and is working on enforcing accessibility in newer structures, this study shows that the following improvements must be completed to make built environments available to all PwD. First, training of building and design professionals must be mandatory. There should be a full cadre of building code specialists working in Saudi Arabia, from architects and designers to plan reviewers, contractors and building inspectors. Accessible built environments will not happen without this.

Second, uniform enforcement of KSA building and accessibility codes is essential. A review of two well-known international restaurants that follow building codes with their structures in the United States recently (late 2019) opened facilities in newly constructed EP buildings, and their accessibility is far below standards. Neither site had accessible restrooms, access to upper levels (containing the female restrooms in one establishment) was by stairs only, doorways were too narrow for wheelchair access. Building code documents and good intentions are not enough; the regulations require enforcement.

Third, it is critical to include PwD in accessibility decisions, as shown by the PwD comments in this paper and stated in Rule 5 of SREOPwD. Their voices and demands could assist in finding the best approaches to designing spaces that are accessible by all.

The ability to move freely and independently, pursue employment, live comfortably, and attain equalization of opportunities is a basic human right frequently denied to PwD residents of the Eastern Province in Saudi Arabia. Recently updated professional standards as found in the SBC 2018 and social change directives included in Vision 2030 hopefully will address these issues. Limitations of this study include the small sample size. Access to PwD is difficult and mostly through family members. Larger sample sizes could assist with reinforcing the data in this paper. Further research as KSA implements more of the proposed

transformations could document whether the changes increase the quality of life for PwD in Saudi Arabia.

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Appendix 1: Survey

جامعة الأمير محمد بن فهد
PRINCE MOHAMMAD BIN FAHD UNIVERSITY

Department of Interior Design
College of Engineering

Questionnaire on Barrier Free Environments

Background Information

Gender: M F

Age: _____

Disability type: Vision Hearing Mobility Other_____

How many years? _____

Experiences

Using your experience, please rate the following about architecture and interiors in Saudi Arabian public spaces.

1. Overall accessibility of buildings in Saudi Arabia.

	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None
Rating						

Comments:

2. Availability of ramps, if needed?

	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None
Rating						

Comments:

3. Accessibility of restrooms?

	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None
Rating						

Comments:

1

4. Adequate signage?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

5. Adequate level change access- elevators, for example?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

6. Accessible features in shops and malls?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

7. Accessible features in hospitals and doctors' offices?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

8. Accessible features in mosques?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

9. Accessible features in restaurants?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

2

10. Accessible features in fast food outlets?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

11. Accessible features in banks and at ATM machines?

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

12. If accessible features exist, how well are they respected? Parking spaces, for example.

Rating	5-Very Good	4-Good	3-Average	2-Poor	1-Very Poor	0-None

Comments:

13. Where has been the best place for you to visit and why?

14. How do architectural barriers make you feel?

15. What architectural improvements do you suggest to make your life easier?

Student ID number: _____

Interviewee's name, if allowed_____

3

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INSIGHTS FROM AN INAUGURAL EIGHT-MONTH INTERPROFESSIONAL COLLABORATIVE CO-DESIGN EDUCATIONAL EXPERIENCE BETWEEN OCCUPATIONAL THERAPY AND INDUSTRIAL DESIGN

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Abstract: The design of the built environment greatly impacts how all types of individuals and populations actively participate in their daily lives. Lack of access in the built environment for disabled populations remains a daily reality, negatively impacting engagement and life satisfaction, leading to isolation, loneliness, and depression. A university in the Northeastern United States sought to expand current constructs of the end-user and environment within a universal design (UD) perspective. On an eight-month inaugural interprofessional collaborative co-design experience, third-year occupational therapy doctoral (OTD) students were embedded in a first-year masters of industrial design (MSID) curriculum, which ran the course of the academic calendar (two consecutive semesters: Fall and Spring). Primary aims wanted to determine, via an interrupted time-series quantitative design, if embedding OTD students within the industrial design curriculum influenced the MSID students' prior assumptions, understanding of disability and enhanced their willingness to create more inclusive final products. Quantitative findings indicated that it was difficult to capture the meaningful change that occurred in the doctoral capstone program experience with the existing psychometric tools available.

Anecdotal mixed-method findings indicated that informal interprofessional learning experiences in the classroom, such as lectures and learning activities created and facilitated by the OTD students and delivered in real-time, broadened and enhanced the MSID students' knowledge surrounding disability and accessibility in a more nuanced way than the chosen quantitative survey tools were constructed to capture. A detailed literature review and description of the program have been provided, along with suggestions to capture meaningful outcomes for longer-term interdisciplinary collaborations.

Keywords: Industrial design, occupational therapy, interprofessional education, disability, co-design.

Introduction

The design of the built environment greatly influences how all individuals interact and function with their immediate surroundings (Amiri, Wagenfeld, & Reynolds, 2017; Hitch, Larkin, Watchorn, & Ang, 2012; Larkin, Hitch, Watchorn, Ang, & Stagnitti, 2013). Internationally, about one billion individuals worldwide have a disability (Medola, Sandnes, Ferrari, & Rodrigues, 2018). Lack of access in the built environment for disabled populations remains a daily reality, negatively impacting engagement and life satisfaction, leading to isolation, loneliness, and depression (Rigby & Letts, 2003). Frequently, design solutions do not take into account the needs of disabled populations, limiting independent performance during necessary tasks and meaningful activities despite the inherent abilities existing within the person to function if the design in the built environment was different (Rigby & Letts, 2003). Laws such as the Americans with Disability Act (United States Department of Justice Civil Rights Division, 2020) became federally mandated in the United States in 1990, with the aim to provide more inclusive and accessible environments for all individuals, regardless of health condition or level of function. (Medola et al., 2018; Watchorn, Larkin, Hitch, & Ang, 2014).

Starting in the 1970s, designers began to play a role in implementing broader end user-accessible design solutions for all abilities, leading the way in creating more collaborative and end user-centred buildings and products (Amiri et al., 2017; Sanders & Stappers, 2008).

Universal design (UD), a seven-point methodology introduced during the latter 20th century, aims to provide guidance for designing for all individuals regardless of abilities and capacities (Center for Excellence in Universal Design, 2020). Successful UD application requires interdisciplinary skills, knowledge in human conditions and factors, and close collaboration during various planning and design stages for built environments and product development (Altay & Demirkan, 2014; Hitch et al., 2012; Lid, 2014).

One example of a collaborative approach that can be combined with UD methodology is co-design, which is defined as a diverse group of individuals interacting during the design process, such as the designer, stakeholder, researcher, and end-user (Amiri et al., 2017; Sanders & Stappers, 2008). End users can be defined as those individuals who experience and engage with a product and/or environment. Interprofessional collaboration, particularly between allied healthcare and design professionals, has become more common and has been implemented via a co-design approach to support the growing need for creating products and environments that are more functional for a wider variety of end-users (Amiri et al., 2017; Goodman-Deane, Cassim, Langdon, & Clarkson, 2007).

Occupational therapists are one type of allied healthcare professional who supports individuals to build, recover, and/or maintain daily activities (also known as occupations). Occupational therapists have knowledge in both the medical and therapeutic view of human diagnostic and developmental conditions, which can be important factors to consider when designing for all individuals (Amiri et al., 2017; Hitch et al., 2012; Lid, 2014). Furthermore, occupational therapists are emerging as key collaborators with designers; their professional training offers a holistic and functional perspective regarding the needs and wishes of end-users in their daily lives (Amiri et al., 2017). The Person-Environment-Occupation (PEO) model, a theory often used by occupational therapists and developed by Law et al. (1996), asserts that an individual's performance in their daily life is impacted by the person, environment, and their occupations (Rigby & Letts, 2003). The PEO model suggests that the occupational therapist can intervene by making changes to the environment, reducing environmental barriers and demands to facilitate end users' greater performance (Rigby & Letts, 2003). Research has purported that rehabilitation professionals, such as occupational therapists, who are well-versed in impairment, needs, preferences, and abilities of the end

user, and are trained in UD, could be valuable collaborators to inform design solutions for varying individuals (Lid, 2014; Medola et al., 2018).

In an effort to expand current constructs of the end-user and environment within a UD perspective for designers to make design solutions more inclusive for those with disabilities in the built environment, a university in the Northeastern United States embarked on an eight-month interprofessional collaborative co-design experience with third-year occupational therapy doctoral (OTD) students embedded in a first-year master's of industrial design (MSID) curriculum which ran the course of the academic calendar (two consecutive semesters: Fall and Spring). The primary aims of this experience initially sought to determine, via an interrupted time-series quantitative design, if embedding OTD students within the industrial design curriculum influenced the MSID students' prior assumptions, understanding of disability, and enhanced their willingness to create more inclusive final products that could be used by all individuals. However, as the collaboration progressed, it became increasingly clear that the chosen quantitative survey tools were not constructed to fully capture the informal interprofessional learning experiences in the classroom. The lectures and learning activities created and facilitated by the OTD students and delivered in real-time, broadened and enhanced the MSID students' knowledge surrounding disability and accessibility in a more nuanced way than the chosen quantitative survey tools were constructed to capture. With this in mind, this paper will take a mixed-methods approach. First, the authors will aim to present the reader with a comprehensive literature review of interdisciplinary collaborations between design, healthcare, and occupational therapy, followed by detailed descriptions of the OTD/MSID curriculum learning experiences that occurred throughout this eight-month collaboration. We will conclude with the quantitative survey findings, descriptively enhanced by informal participant interviews and observations, and suggestions for future co-design collaborations within the design professions.

Literature Review

A search of the literature identified barriers to interdisciplinary work between allied healthcare and design, directly related to limited understanding of the respective professions' roles and skills (Amiri et al., 2017; Hitch et al., 2012; Wagenfeld, Reynolds, &

Amiri, 2017). Findings suggested that interprofessional education can increase interest and success in the partnership between occupational therapy and design (Altay & Demirkan, 2014; Hitch et al., 2012; Larkin et al., 2013). As Altay & Demirkan (2014) asserted, "The education of a novice designer plays a significant role in how he or she finds solutions to the requirements of end-users with differences in age, gender, race and abilities, later in professional practice" (Altay & Demirkan, 2014, p.196).

Several studies have investigated the interprofessional collaboration between design and occupational therapy professions (Amiri et al., 2017; De Couvreur, Detand, Dejonghe, & Goossens, 2012; Hitch, Dell, & Larkin, 2016; Hitch et al., 2012; Larkin et al., 2013; Wagenfeld et al., 2017; Watchorn, Larkin, Ang, & Hitch, 2013) but details remain limited regarding the type of settings involved and the purpose of these collaborations outside of the academic setting (Amiri et al., 2017; Hitch et al., 2012; Wagenfeld et al., 2017). While the evidence demonstrates the potential benefits of the interdisciplinary relationship, such as developing creative solutions to meet the needs of all end-users, challenges of professional collaboration have also been identified, such as a misconception of the respective professions' skills, language, and values (Larkin et al., 2013; Wagenfeld et al., 2017). Additionally, there is an emerging body of literature exploring both the impact of UD education and how students may benefit from an interdisciplinary approach (Chang, Tremblay, & Dunbar, 2000; Hitch et al., 2016; Lid, 2014; Mulligan, Calder, & Mulligan, 2018; Watchorn et al., 2013). Findings demonstrate a positive impact of both collaborative and educational modules on students' understanding and awareness of disability and the needs of all end-users (Hitch et al., 2016; Medola et al., 2018).

Evidence of collaborative initiatives between design and occupational therapy within the academic setting identified students working together during week-long to semester-long projects to create solutions for a particular individual with a disability or a population (Chabot, 2017; De Couvreur et al., 2012; Dong, 2010; Larkin et al., 2013). While the collaborative projects varied in terms of objectives, design professions, and length, common themes regarding the values and challenges emerged (Larkin et al., 2013). Chabot (2017) described fifth-year architecture and third-year occupational therapy students working together to redesign a local train station to make it more accessible for the community. Benefits for the architecture students included a clearer understanding of

occupational therapy and an increase in awareness of design's impact on disability and participation. The occupational therapy students gained skills in communicating their profession's value and expertise. Similar to findings in Wagenfeld et al. (2017), challenges of the collaboration were identified and included a difference in shared language and interests. Findings from the literature are informative in helping to understand the complexities of interprofessional education between design and occupational therapy; yet, with this in mind, there remains an unmet need to explore these types of collaborations further (Chabot, 2017; Larkin et al., 2013; Wagenfeld et al., 2017).

In other examples of interdisciplinary projects between occupational therapy and design professions, outcomes indicated that having an allied healthcare professional on the team aided in filling the knowledge gap between the end user and designer and advanced the design student's understanding of disability (De Couvreur et al., 2012; Dong, 2010; Medola et al., 2018). De Courvreur et al. (2012) illustrated a co-design team involving multiple stakeholders, including an industrial design student, an occupational therapy student, an individual diagnosed with ankylosing spondylitis, a caregiver, and another rehabilitative expert. Similarly, Dong (2010) described a summer-long course involving two co-design teams of engineering design students, individuals living with multiple sclerosis, and an occupational therapy student. Lastly, in an inclusive design collaboration, industrial design, architecture, urban studies, and visual art students collaborated with rehabilitation professionals to learn more about the needs of individuals with disabilities (Medola et al., 2018). Results from these co-design collaborations identified that including the end-user greatly benefitted the design process (De Couvreur et al., 2012; Dong, 2010). Furthermore, the engineering design students who collaborated with the occupational therapy student commented that the design students increased their understanding of the rehabilitation profession and valued occupational therapy's perspective on the end user's needs and expectations.

Methodology

Participant Demographics

Participants in this eight-month interprofessional collaborative co-design experience included two third-year occupational therapy doctoral (OTD) students with undergraduate educational backgrounds in neuroscience, psychology, human biology, and occupational science and 10 first-year MSID students with undergraduate educational backgrounds in mechanical engineering, architecture, bioengineering, fine arts, mathematics, graphic design, civil engineering, and aerospace. Five of the ten MSID students were non-United States citizens. Demographically, the OTD and MSID student participants were comprised of six females and six males with an age range of 23 to 32 years of age. Two occupational therapy faculty mentors had prior and ongoing careers in design (landscape architecture, industrial design, and graphic design; 15+ years), and the two remaining course faculty were seasoned industrial designers (30+ years). See Table 1.

Table 1. Collaboration Participants.

Professional Background	# of Participants
Occupational Therapy Doctoral (OTD) Students	2
First-year Masters of Industrial Design (MSID) Students	10
Occupational Therapy Faculty Mentors	2
Industrial Design Faculty	2

Collaboration Design

Within Month 1 of the eight-month interprofessional collaborative co-design experience, the two OTD students first completed a "SOAR" Analysis (strengths, opportunities, aspirations, results) (Group Map Technology, 2019) with extensive input from both the industrial design faculty and the MSID students. Under the guidance of the occupational therapy faculty mentors, the OTD students also concurrently completed a comprehensive literature review of healthcare and design collaborations related to occupational therapy. Those findings, as reported earlier in this paper, served to frame and context the informal learning experiences that would eventually be created and delivered throughout the

collaborative experience. In line with the embedded interprofessional co-design model, the occupational therapy faculty mentors arranged for the OTD students to attend multiple MSID courses weekly over the entirety of the eight-month collaboration. While in the program, the OTD students continually consulted and collaborated directly with designers while also receiving direct mentorship from the industrial design faculty and MSID peers for the duration.

Project Descriptions and Timeline

In Month 1, the first collaborative design project involved a design competition for drinkware conducted by a well-known international glassware corporation. Here, MSID students sought consultation from the healthcare perspective regarding form, usability, and function of the glassware products. In turn, the OTD students gained initial insight into MSID design thinking and iterative processes. In Months 2 to 4, a six-week toy project commenced between the OTD, MSID, and UX/UI students in a design research class. Here, toys containing digital interface for the four-to-eight-year-old pediatric population were co-designed. The OTD students, using end user-research principles, delivered informal lectures on typical play, physical, social, and cognitive development for this age range to support MSID and UX/UI students' understanding of the end-user.

Following these introductory collaborative projects, in Month 3, the OTD and MSID students embarked on a six-month-long caregiver project. Here, the MSID students were tasked to design a product for the caregiver of an individual diagnosed with either autism spectrum disorder, stroke, neurocognitive disorder, or intellectual disability. In Month 3, OTD students researched, designed, and led informal learning experiences for the MSID students and industrial design faculty by stimulating living situations in which a caregiver may face and also presented background information on the specified health conditions through the caregiver lens (Dong, 2010; Ergenoglu, 2013; Medola et al., 2018). From month 5 to 8, the OTD students also facilitated multiple end-user research experiences, thus exposing the MSID students and industrial design faculty to various end-users and stakeholders. This included volunteer caregivers and/or individuals with the assigned conditions to allow the MSID students and industrial design faculty to experience first-hand about end-user needs and to discuss the scope of potential design solutions. Additionally, beginning in Month 5,

after close consultation with industrial design faculty and occupational therapy faculty mentors, didactic learning modules on the occupational therapy perspective through UD principles were created and inserted into the MSID curriculum by the OTD students, which was content not addressed previously in the MSID students' current curricula (industrial design faculty member, personal communication, October 18, 2018). See Table 2 for timeline and Table 3 for a comprehensive list of collaborative co-design experiences.

Table 2. Collaborative Co-Design Timeline

Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Rapport								
Needs								
	IRB Process and Approval							
Consultation with Design								
	User Research							
				Data Collection				
Glassware Comp.								
		Toy Project						
				Independent Project				
		Caregiver Project						
			Medication Packaging					

Table 3. Description of Experiences.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 1 (September): Rapport Building and Needs Assessment.	Occupational therapy doctoral (OTD) students arrived on-site to the industrial design program. OTD students completed a SOAR Analysis and attended ID coursework. OTD students attended and observed year 1 & 2 MSID studios. OTD students met with the MSID students individually and offered consultation on design projects including for the glassware design competition on as-needed basis.	OTD students attended courses in curricula: Cross-disciplinary course in ergonomics with occupational therapy & industrial design: *Health Factors & Ergonomics* User Research courses with industrial design and user experience/user interface design students.	OTD students Interviewed ID faculty and students to complete SOAR Analysis.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 2 (October): Toy Project, Literature Review, & Consultation.	OTD students continued to attend and engage in courses in the curricula, started literature review for scholarly capstone and began the Institutional Review Board process. OTD students attended and observed year 1 & 2 MSID studios. OTD students met with MSID students and started consulting design projects on an as-needed basis.	OTD students attended courses in curricula: Health Factors & Ergonomics in which the students attended field trips and consulted on an as-needed basis; In the User Research course: the students began the Toy Project; the OTD students delivered a formal lecture on child development.	OTD students consulted on a Medication Packaging Project in an undergraduate graphic design course

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 3 (November): Introduction to Caregiver Project.	OTD students implemented education modules, based on needs presented by design instructors, literature/evidence, and perspectives from the faculty mentor. OTD students attended and observed year 1 & 2 MSID studios. Along with the Design faculty members, the OTD students introduced the Caregiver Project Brief. The OTD students provided formal lectures on occupational therapy practice framework, occupational therapy theory, disability etiquette, and experience. In addition, the year 1 MSID studio took a class trip to the occupational therapy Activities of Daily Living (ADL) suite to discuss the impact of health conditions on occupations and surveyed AT/AD (assistive tech/assistive devices).	OTD students attended courses in curricula: In the Health Factors & Ergonomics course attended field trips and consulted on an as-needed basis. The students continued to work on the Toy Project in the User Research course.	OTD students continued to work on the medication packaging project in the undergraduate graphic design course. OTD students began exploring design areas for independent project.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 4 (December): Problem Identification of Caregiver Project & Narrowed Focus for Independent Project.	In the last month of the semester, the OTD students continued to attend classes in the curricula, aided in identifying problem areas for "Caregiver Project" & continued with independent project by starting CAD tutorials. OTD students attended and observed year 1 & 2 MSID studios. The OTD students continued with the Caregiver Project, facilitated disability simulation, gathered a compilation of resources for students, and started reaching out to volunteers for caregiver/user visits. OTD students consulted on other projects on an as-needed basis.	OTD students attended courses in curricula: In the Health Factors & Ergonomics course, the OTD students attended field trips and consulted on an as-needed basis The students finalized the Toy Project in the User Research course.	OTD students finalized independent project focus through user research. OTD students began learning computer-aided design software (CAD) through online tutorials and practice.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 5 (January): Data Collection Time 1 (RIPLS & ADTP-A) & User Visits.	The team received Institutional Review Board approval for scholarly projects and began data collection. OTD students attended and observed year 1 & 2 MSID studios. The OTD students continued facilitating the *Caregiver Project*. The OTD students continued to reach out to volunteers and coordinate for caregiver visits. OTD students consulted on other projects on as-needed basis, including wheelchair use for *Circular Economy Project* and needle management for *Safety Project*.	OTD students attended courses in curricula: In a *Healthcare + Design* course: attended field trips and continued to work on independent projects. In the course, the OTD students also gained exposure to architecture field (one of the OTD students collaborated with architecture student for independent project). OTD students also attended the undergraduate *OT/ID Junior Collaboration* course and consulted on an as-needed basis.	OTD students continued to work on independent projects.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 6 (February): Continued User Visits & Design Phase	OTD students attended and observed year 1 & 2 studio: Continued with "Caregiver Project:" facilitated user visits with caregiver and individuals; Consulted on other projects on an as-needed basis.	OTD students attended courses in curricula: In a *Healthcare + Design* course: attended field trips and continued to work on independent projects. OTD students continued to attend the undergraduate *OT/ID Junior Collaboration* course and consulted on an as-needed basis.	OTD students continued to work on independent projects. Created "big ugly" prototypes with feedback from 1 & 2-year students and faculty mentors.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 7 (March): Universal Design, User Visits, Design Phase & Data Collection Time 2 (RIPLS & ADTP-A).	OTD students continued to assist with *Caregiver Project*, completed data collection for scholarly projects, and continued to work on independent projects. OTD students attended and observed year 1 & 2 MSID studios. In year 1 MSID studio, continued working on the *Caregiver Project*. The OTD students provided a formal lecture on the occupational therapy perspective of Universal Design. Continued with caregiver visits. OTD students continued to consult on other projects on an as-needed basis.	OTD students attended courses in curricula: In a *Healthcare + Design* course: attended field trips and continued to work on independent projects. OTD students continued to attend the undergraduate *OT/ID Junior Collaboration* course and consulted on an as-needed basis.	OTD students continued to work on independent projects. OTD students continued to explore and work with prototypes and deliverables- including CAD modeling.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 8 (April): Caregiver Project, Independent Project & Scholarly Project Wrap-up.	OTD students continued to consult on the *Caregiver Project* and facilitated follow-up visits with caregivers as-needed.	OTD students attended courses in curricula: In a *Healthcare + Design* course: attended field trips and continued to work on independent projects. OTD students continued to attend the undergraduate *OT/ID Junior Collaboration* course and consulted on an as-needed basis.	OTD students presented their independent projects in the *Healthcare + Design* course. OTD students presented their scholarly projects in Occupational Therapy course.

Timeline for OTD	MSID Program Participation	MSID Courses	Additional Experiences
Month 9 (May): Completion of Caregiver Project & Completion of Time On-Site	MSID students gave their final presentations of the *Caregiver Project*.		

Quantitative Procedures

Exempt approval was obtained from the university's Institutional Review Board for data collection later than anticipated (Month 5). Data were collected at two points via an interrupted time series design format. Two self-report questionnaires were provided to the MSID students at Time 1 (Month 5) and Time 2 (Months 7 and 8) to access MSID student attitudes towards interprofessional learning and individuals with disabilities. Microsoft Excel and Statistical Package for the Social Sciences (Version 25.0) were used to analyze findings. Because of the small sample size, nonparametric statistics were used. A Wilcoxon signed-rank test was used to compare students' responses for both questionnaires over two time periods.

RIPLS

The *Readiness for Interprofessional Learning Scale (RIPLS)* by McFadyen et al. (2005) is a 19-item self-report questionnaire that accesses both students' and professionals' attitudes towards interprofessional learning in the healthcare fields. The questionnaire is a revised version of the original report developed by Parsell & Bligh (1999) and shows good test-retest reliability on three out of the four subscales (McFadyen, Webster, & Maclaren, 2006). While the survey is intended for individuals in the healthcare field, no other instruments that assess interprofessional learning in other professions are currently available (Larkin et al., 2013).

The MSID students were instructed to insert "industrial design and occupational therapy" when coming across the phrase "healthcare students." Participants were asked to rate their responses using a five-point Likert Scale with responses ranging from "strongly disagree" to "strongly agree." Participants received a score ranging from 19 to 95, with a higher number suggesting a more positive attitude towards interprofessional learning (A. McFadyen, personal communication, November 7, 2018; Larkin et al., 2013).

ATDP-A

The *Attitudes Toward Disabled Persons – form A (ATDP-A)* (Yuker, Block, & Younng, 1970) is a 30-item self-report questionnaire that assesses a person's attitude and understanding

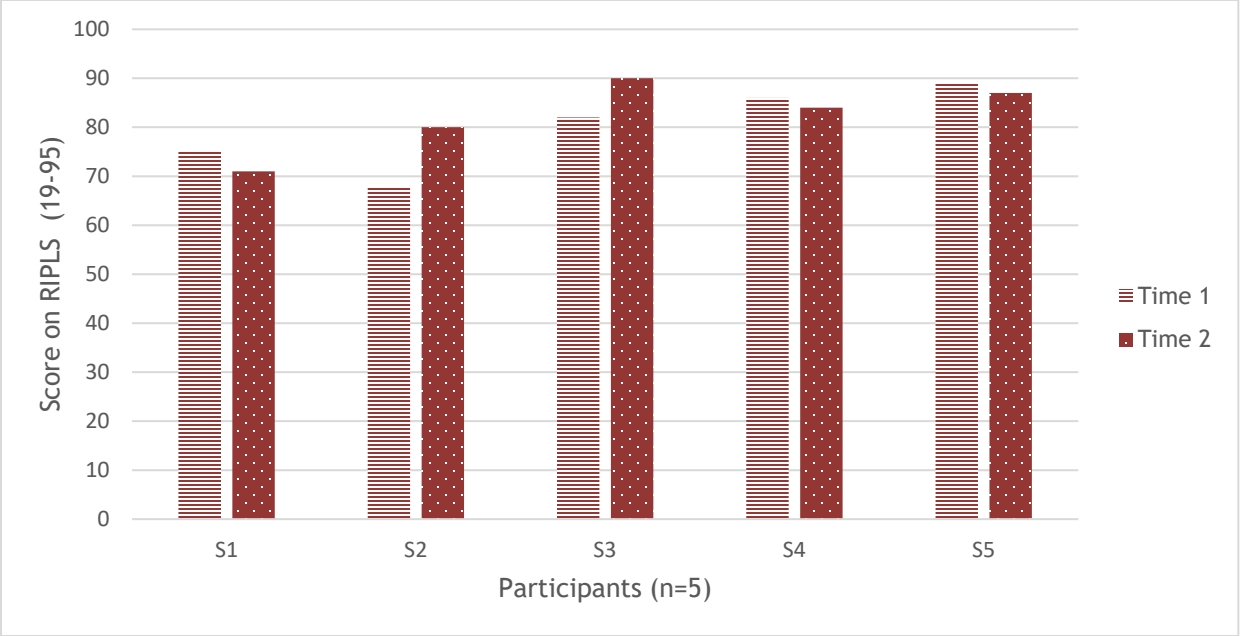
towards individuals with disabilities (Chang et al., 2000). The results of the test-retest reliability for ATDP-A was .78, which the authors of the questionnaire assert were comparable to other instruments (Yuker, Block, & Younng, 1970). The MSID students were asked to rate their response using a Likert Scale format of six options from -3 (strongly disagree) to +3 (strongly agree). Students received a score ranging from 0 to 180, with a higher number suggesting a more positive attitude (Chang et al., 2000).

Assessment Tool Results

RIPLS

Across two time periods (Month 5 and Month 7), five (50%) MSID students accurately completed the RIPLS questionnaire. Responses of MSID students who did not completely fill out the questionnaire and/or who did not accurately code their questionnaire were not analyzed. A Wilcoxon signed-rank test showed that from Time 1 to Time 2, there was not a statistically significant change in student responses for the RIPLS questionnaire ($Z= -.406$, $p=.684$). Two of the MSID students had a slight increase in score at Time 2, while three of the MSID students had a slight decrease in score at Time 2. Itemized analysis of the questionnaire revealed a statistically significant change in MSID student responses from Time 1 to Time 2 for question 17: “The function of nurses and therapists is mainly to provide support for doctors” ($Z=-2$, $p=.046$). See Figure 1.

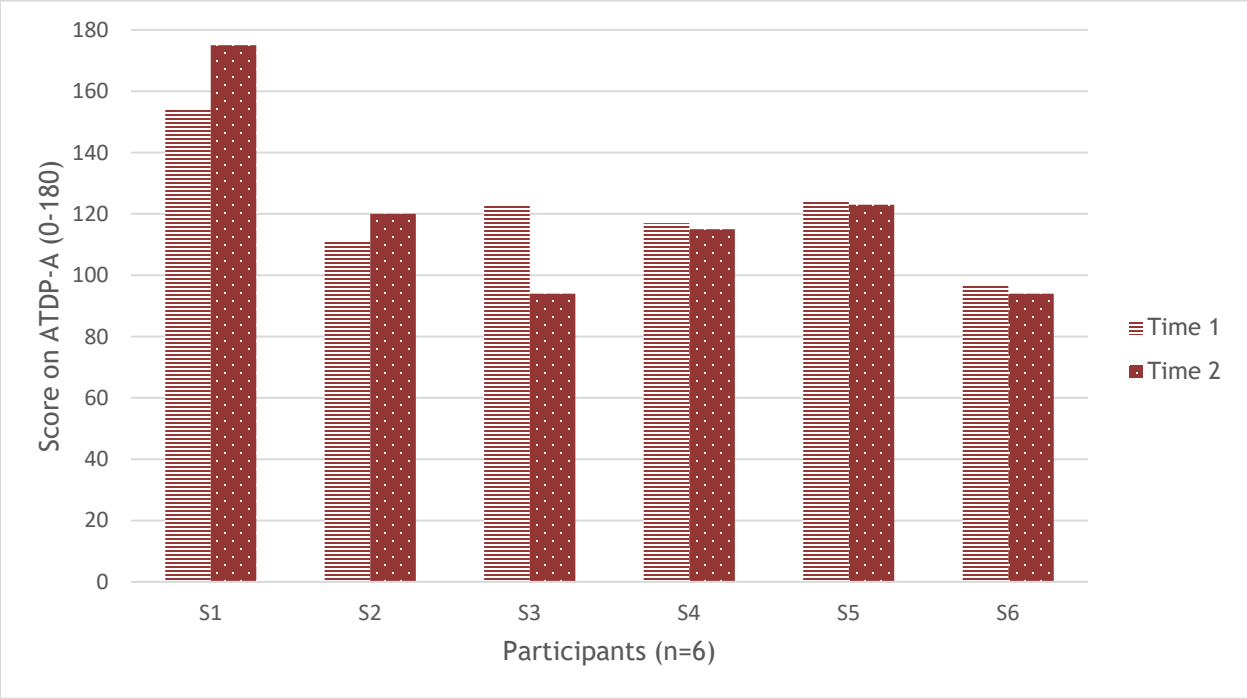
Figure 1: Student Scores on the RIPLS Questionnaire at Time 1 and Time 2.



ATDP-A

Over the two time periods (Month 5 and Month 7) of data collection, six (60%) MSID students accurately completed the ATDP-A questionnaire. Responses of MSID students who left more than 10% of the items blank and/or who did not accurately code their questionnaire were not analyzed (Yuker, Block, & Younng, 1970). A Wilcoxon signed-rank test showed that over a six-to-eight-week period that there was not a statistically significant change in student responses for the ATDP-A questionnaire (Z=-.314, p=.753). With a score range of 0 to 180, the median ATDP-A score was 117.0 at Time 1 and 121.0 at Time 2. Two MSID students had a slight increase in score at Time 2, while four MSID students had a slight decrease in score at Time 2. Itemized analysis of the questionnaire revealed a statistically significant change in MSID student responses from Time 1 to Time 2 for question 2: "Disabled people should not have to compete for jobs with physically normal persons" (Z=2.060, p=.039). See Figure 2.

Figure 2. Student Scores on the ATDP-A Questionnaire at Time 1 and Time 2.



Discussion

The primary aims of this experience initially sought to determine, via an interrupted time-series quantitative design, if embedding OTD students within the industrial design curriculum influenced the MSID students' prior assumptions, understanding of disability and enhanced their willingness to create more inclusive final products that could be used by all individuals. Over two consecutive semesters, the OTD students established a professional and collaborative relationship with the MSID students and industrial design faculty. The results for the RIPLS questionnaire at Time 1 were high, showing a positive attitude towards interprofessional collaboration. While the results for the ATDP-A questionnaire did not produce statistically significant results, overall findings suggested that the students had a relatively positive attitude towards individuals with disabilities, which may have occurred secondary to the OTD students spending considerable time within the design program observing and building rapport with both MSID students and industrial design faculty members prior to Time 1 data collection.

The formal and informal educational modules on child development, occupational therapy theory, disability experience, UD, and the specified health conditions for the caregiver project provided an additional, outside, non-design perspective to the industrial design curriculum. These components arose spontaneously in the collaboration, broadening and enhancing the MSID students' knowledge surrounding disability and accessibility in a more nuanced way than the pre-selected quantitative survey tools were constructed to capture. Informal meetings with both individuals with various disabilities and their caregivers also broadened the MSID student's view of the end-user. As one student noted, "No matter how many things I read online or watched YouTube clips of, nothing compared to the actual experience of speaking with an [end] user" (Industrial design student, personal communication, March 7, 2019). This anecdotal evidence is consistent with findings, highlighting the importance of including end-users in the design process (De Couvreur et al., 2012; Dong, 2010; Goodman-Deane et al., 2007; Medola et al., 2018).

The addition of both the occupational therapy and caregiver perspectives to the design curriculum enhanced the MSID student's design process, which supports the literature on the co-design approach (De Couvreur et al., 2012). When MSID students did not have access to various end-users, they were able to obtain input from the OTD students regarding the needs of the end-user (Dong, 2010). As Dong (2010) asserts, including the end-user is not always feasible due to ethical and time constraints, and thus having insight from a professional, such as the occupational therapist, can offer insights regarding the health conditions. Furthermore, during the informal end-user visits, the OTD students facilitated the conversation between the caregivers and the MSID students, helping bridge and translate the communication between both parties (Dong, 2010; Lid, 2014). In these instances, the role of the occupational therapist became critical. As Lid (2014) asserts, "Knowledge derived from rehabilitation professions and from people with disabilities are both necessary in order to expand upon the individual dimension in UD" (Lid, 2014, p.1347). Evidence suggests that using a co-design approach, knowledge, and insight from both the caregiver and the occupational therapy perspective benefits the MSID students' design process in framing and defining the needs of the end user (Amiri et al., 2017; Lid, 2014).

Previous collaborations found in the literature between occupational therapy students and design students consisted of singular projects over shorter time frames (Chabot, 2017; De

Couvreur et al., 2012; Dong, 2010; Larkin et al., 2013); however, this eight-month interprofessional collaborative co-design experience aimed to go one step further in creating a multifaceted exposure of interprofessional collaboration through various longer-term projects and educational modules. The OTD students had ample opportunities to work and consult with the MSID students, occupational faculty mentors, and industrial design faculty on many projects throughout their eight-month tenure in the industrial design department. Additionally, while some of the design projects may have focused primarily on individuals with disabilities, the OTD students had the opportunity to provide insight on other design projects, such as a design competition for drinkware conducted by a well-known international glassware corporation. The MSID students sought consultation from the occupational therapy perspective regarding form, usability, and function of the glassware products and their impact on the scope of various end-users, which is important to consider as there is variability in the needs and wants of all end users. It is possible that not only did the OTD students' presence serve to educate and advocate for end-users with disabilities, but their outside perspective may have helped to broaden the MSID students' knowledge of end-user diversity (Lid, 2014).

In addition to furthering the MSID students' notion of the end-user, the eight-month collaboration in turn also greatly benefitted the OTD students. As a result of the symbiotic relationship between occupational therapy and industrial design, the OTD students learned about the design process through three avenues:

- Observation and attendance of various design courses, including an end-user research course;
- The completion of an independent design project led by the OTD students requiring the acquisition of skills in computer-aided design programs, prototyping, and sketching; and
- Collaborations on various design projects, including the caregiver project and the toy project.

In addition to learning more about another profession's culture, similar to findings described in Chabot (2017), the OTD students further developed their skills in

communicating the values and mission of occupational therapy to a broader community. Lastly, by advocating for the end-user, the OTD students were able to pursue the goal of the American Occupational Therapy Association's (2017) Vision 2025 mission, in that occupational therapy "maximizes health, well-being, and quality of life for all people, populations, and communities through effective solutions that facilitate participation in everyday living" (American Occupational Therapy Association [AOTA], 2017, p. 7103420010p1).

Limitations: Lessons Learned

Good research design purports that baseline measurements should be implemented early in any collaboration in order to fully capture participant attitudes from the beginning of the collaboration. Using accessible and validated assessment tools already described in the literature was the chosen approach decided by occupational therapy faculty mentors during Month 3 of the experience to ensure reliability and validity. The expectation that the OTD students would also independently draft and submit their own IRB submission did not commence on this project until Month 4. Approval from the Institutional Review Board was not granted until Month 5 (a direct result of the newness of the experience and the challenges with launching an inaugural OTD third-year program within the confines of an academic year), which further prevented the OTD students' ability to capture a true baseline measure, as the relationships between the MSID students and OTD students had been already established by the time IRB approval was granted. Due to the novelty, uniqueness, and organic nature of this eight-month interprofessional collaborative co-design experience, the varied backgrounds of the MSID students (including language barriers experienced by the five international students), difficulties with capturing outcome approaches with the RIPLS and the ATDP-A tools became readily apparent as soon as data collection commenced. In the end, these requirements proved to be too constrictive and posed a significant barrier to the OTD students' ability to capture meaningful outcomes for this type of longer-term interdisciplinary program experience. While the ATDP-A grasped the basic aspects of the disability experience, the tool proved to be too simplistic in its ability to assess and portray the students' attitudes and awareness of human diversity or the ongoing novel, interdisciplinary collaboration occurring within this specific program

experience. While the RIPLS was a tool commonly used to assess students within the healthcare fields, the MSID students reported difficulty with contextualizing the questions in relation to their own understanding as designers.

Conclusion

This inaugural eight-month interprofessional collaborative co-design experience aimed to engage OTD, MSID students, and their concurrent department faculty in an embedded collaboration between occupational therapy and industrial design to promote more accessible design solutions that better addressed the needs of disabled populations. As noted by Altay & Demirkan (2014), the opportunity to educate and broaden design students' understanding of disability during their curricular experiences can greatly influence who they become as future professionals regarding having the skills necessary to problem-solve successfully for a variety of end-users. Our findings had hoped to significantly quantify the positive impact of both collaborative and educational modules on MSID students' understanding and awareness of disability and needs of all users in a longer-term interprofessional co-design experience as purported by Hitch et al. (2016) and Medola et al., (2018). While this was not the case, anecdotally, a few of the MSID students reported that the OTD students were helpful in advancing their understanding of disability, which supports the findings of De Couvreur et al. (2012), Dong (2010), and Medola et al. (2018). As these interprofessional collaborations continue to broaden and develop, it is recommended that future experiences utilize qualitative approaches such as interviews or invest time in developing a tool that can be more flexible towards accommodating other types of professions beyond the scope of healthcare. Queries and/or tools designed to accommodate the fluid nature of the design process and that allow for data collection at multiple points in longer-term experiences would allow for a richer understanding and improved captures of student learning outcomes.

By breaking down the professional silos, exposing both disciplines to one another, and introducing the lived experience for those with disabilities, the OTD students, MSID students, occupational and industrial design faculty appeared to have anecdotally benefitted from partaking in this longer, eight-month inaugural interprofessional

collaborative co-design experience. The hope is that future professional trajectories have been influenced as they will carry the concepts learned and experiences into future employment scenarios. Our mixed-method qualitative findings hinted of richer opportunities moving forward. Future interprofessional collaborative co-design experiences should aim to focus on the impact on students from both professions in a bi-directional manner. Programming may want to examine and explore the long-term effects through longitudinal studies of the collaborations' impact on occupational therapy and industrial design beyond academia and into professional employment; including, but not limited to nursing, physical therapy, speech therapy, exercise science, architecture, landscape architecture, interior design, graphic, and the fashion design fields. There is great potential for upcoming studies to investigate the process of knowledge translation and how the interdisciplinary relationship impacts both attitudes of the students and faculty and later professional outcomes of design solutions in relation to end-user experience for those living with a disability.

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