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Research Paper

Concept of Sensory Gardens: Design Proposal of a Sensory Garden for Izmir

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Abstract: Sensory gardens, in which the effects of landscape design on humans can be observed clearly, are used all over the world for various purposes. A sensory garden's main purpose is to address users' senses and stimulate the sense of sight, touch, smell, taste and hearing by the use of the softscape and hardscape elements. These gardens are known to have therapeutic and educational effects. The design principles of these gardens are yet to be defined, therefore, the design process is shaped by the designer's approach, their experience and examination of the case studies. In this study; the concept of sensory gardens was examined and a design proposal of a sensory garden for Izmir was made. The design proposal covers almost 1660 m^2. The decision-making process was explained, a detailed table of the selection of plants was created. The final work consists of a 2D plan with plants and hardscape elements, 3D visualization with material selections of hardscape elements and a plant material legend.

Keywords: *design, landscape design, sensory garden, garden design, Izmir*

Introduction

Plants are items that have a positive impact on human psychology (Yazici & Gülgün, 2017; Yazici *et al.,* 2017; Yazici & Unsal, 2019). For this reason, plants are also important in terms of health in the area where they are used (Akca & Yazici, 2017; Gülgün *et al.,* 2019). With the dense population and urbanization, people turn to different demands in open green areas (Gülgün *et al.,* 2013; Gülgün et al., 2014; Gülgün *et al.,* 2015). The most important of these are the sensory gardens. Sensory gardens in which the healing effects of nature on human psychology can be observed best, have become a very significant research subject in recent years. These gardens aim to enrich the users' sensory experiences and stimulate their senses by their specific design approaches, softscape and hardscape elements. One of the most crucial points of landscape design is known to be 'safety'. In the design process, the concept of 'safety' is taken into consideration firmly. The importance of 'safety' is emphasized in the following statement: "One of the main purposes in landscape design is to provide people with an environment that allows them to perform their activity with minimized factors of accidents. Therefore, the design process is not only related to dimensional data which people and activities require, but also to the physical environmental conditions". (Baytin, 1980, as cited in Gulgun & Turkyilmaz, 2001; Çolak *et al.,* 2020) Thus; starting from the selection of plants, 'safety' is a pivotal step. The enrichment of the users' sensory experiences is the main purpose throughout the entire design process. The primary user group is intended to be everyone regardless of age and physical condition. Especially children with autism, learning disabilities and special needs are considered to be potential visitors. The design proposal in which the idea of enrichment of the sensory experience is the key point suggests design principles and softscape-hardscape material selection for future sensory gardens in Izmir.

Sensory Gardens

Sensory gardens are derived from gardens for visually impaired people; over time, their user profile has become general public (Hussein, 2012). The multi-sensory environments are known to be a form of therapy and used all around the world. Safe and relaxing rooms are created in order to provide the users with the opportunity to stimulate, develop or balance their sensory systems (National Autistic Society 2006 as cited in Wilson, 2006).

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According to Hussein, 2012, multi-sensory environments can be categorized into 4 main themes. The first type of environment is created for the relaxation and recreation of individuals with special needs. The second is created with the aim of the treatment of a particular disorder or illness. The third type supports the learning process and education of the individuals. The last one is created to provide individuals with a space of relaxation and leisure, they can be a combination of the three mentioned. People on the autism spectrum often have difficulty processing, combining and organizing sensory experiences (Grandin, 1995; Wilson, 2006).

commonly observed behaviours in an individual on the autism spectrum are listed below (Wilson, 2006):

I. Impairment of social interaction: Failure use of eye-contact, facial expressions or gestures. Failure to develop peer relationships.
II. Impairment of communication: Failure to use spoken language, without compensating by gesture; deficit in initiating or sustaining a conversation.
III. Limited and repetitive interests and behaviours: Intense preoccupation with one subject or activity; distress over change; insistence on routines or rituals with no purpose; repetitive movements.

As mentioned by Grandin (1995) as cited in Wilson, 2006), people with autism see the world through images, not words. This may be an explanation for why these individuals have a hard time communicating with others. Therefore, it indicates that visual sense is extremely important (Wilson, 2006). Some individuals on the spectrum do not mind hearing loud noises whereas some are very sensitive to them. Accordingly, some are uncomfortable with intense fragrances but some tend to smell anyone or anything. A certain group of them enjoy touching objects around them (Wilson, 2006). "For children with autism, they may 'seek sensory stimulation from the environment in order to calm or self-regulate their nervous system" (Stadele & Malaney, 2001; Hussein, 2012).

Materials and Methods

The main material of the paper is the design proposal area of the sensory garden. The proposal's aim is to set an example for future projects in Izmir. Today, there is no sensory garden in Turkey. The design proposal was made without the size limitation of the area (Figure 1).

Materials of the paper consist of scientific literature; digital resources; original diagrams, tables, drawings and visuals specifically created for the study. The research methods used are reviewing the scientific literature and digital resources regarding the topic as well as the examination of case studies. The conclusions from the literature review and the author's professional approach formed the design proposal. Architectural visualization applications and software were used in the process of creating 2D and 3D drawings.

Figure 1. Satellite image of Izmir (Google Maps, 2020)

The study area, Izmir, is the third-largest city of Turkey (Figure 1). Izmir's DMS latitude and longitude coordinates are 38° 25' 25.4388" N and 27° 8' 34.1736" E (Degrees/ Minutes/ Seconds). The length in the north-south direction is approximately 200 km and the width in the east-west direction is 180 km. The surface area of the city is 12.012 km^2 (Governorship of Izmir, 2020). The winters in Izmir are warm and rainy whereas the summers are dry and sunny. The annual temperature ranges between

14-18 ºC. In winter, the average temperature is 7 ºC. The average annual rainfall is 700 mm and more than 50% of the precipitation occurs in the winter season. The highest temperature in the city is observed in August in which the humidity rate goes up to the rate of 49% (Izmir Metropolitan Municipality, 2020).

Results

Plant Materials and Sensory Impacts

The elimination of toxic plants is an essential step in the process of material selection for sensory gardens. Today, many plant species used in parks and gardens are toxic and the consumption of these plants causes poisoning. In sensory garden design, it is important that the selected plants do not have toxic effects or any harmful characteristics such as thorns, poisonous sap, etc. In the design proposal, the selection of non-toxic plants is put emphasis on. If the plant is known for any hazards, it is indicated in the table *(See Table 1)*. However, even if the plant selection is done amongst the non-toxic species, children's interactions with plants should always be monitored by adults. Another element that plays an important role in the selection of plants is the plant's contribution to the sensory experience. Perspectives on their contributions to the sensory experience can be seen in *Table 1.*

Sight

All plants address to the sense of sight with their shape, colour and texture. Therefore, any plant in the proposal has some sort of visual contribution. Additionally, certain colours that plants have various impacts on users.

Purple is the most powerful visible wavelength of electromagnetic energy and symbolizes intellectuality, spirituality, the sub-conscious, creativity, dignity and royalty (Morton, 2020). Colour expert J. L. Morton states that purple has been used in the treatment of nervous disorders because the colour has shown to help balance the mind and transform obsessions and fears, although there are no valid studies have been conducted to confirm.

The predominant colour used in the plant material of the proposal is the shades of purple. *Thymus serpyllum* (wild thyme), *Lavandula angustifolia* (english lavender), *Agastache foeniculum* (blue giant hissop), *Pennisetum setaceum* (fountain grass), *Allium schoenoprasum L.* (chives) ve *Syringa vulgaris* (lilac) with their purple hue; *Citrus Limon L. Burm. f.* (lemon), *Acacia saligna* (blue-leaved wattle) ve *Euonymus japonica 'Aurea'* (japanese euonymus) with their yellow hue lay the groundwork for the colour combination of two complementary/contrast colours (purple+yellow). *Magnolia grandiflora* (large-flowered magnolia), *Bellis perennis* (daisy) and *Viburnum opulus* L. (european cranberrybush) are selected for being the third colour: white.

Smell

The second most efficient impact in contributing to the enrichment of sensory experience is the sense of smell. A plant with a characteristic smell enhances the sensory practice. The selection of plant materials is based on the scent characteristics.

Citrus Limon L. Burm. f. (lemon), *Aloysia triphlla* (Lemon verbena), *Allium sativum L.* (garlic), *Thymus serpyllum* (wild thyme), *Lavandula angustifolia* (english lavender), *Mentha suaveolens* (pineapple mint), *Ocimum basilicum* (Sweet basil), *Magnolia grandiflora* (large-flowered magnolia), *Allium schoenoprasum L.* (chives) and *Syringa vulgaris* (lilac) are selected in accordance with this principle.

Touch

Plants address the sense of touch with their shape, texture, fruits and leaves. Firm leaves, soft flowers, cones, fruits, sticky saps, smooth surfaces, barks and many more provide the environment with the enrichment of sensory experience. Every plant in the design proposal addresses the sense of touch.

Taste

The most important step when selecting the plants that will contribute to the experience of "taste" is the selection of non-toxic plants. The easiest way to achieve this goal is to choose the plants, shrubs or trees with edible fruits. *Citrus Limon L. Burm. f.* (lemon), *Aloysia triphlla* (Lemon verbena), *Allium sativum L.* (garlic), *Thymus serpyllum* (wild thyme), *Lavandula angustifolia* (english lavender), *Mentha suaveolens* (pineapple mint), *Ocimum basilicum* (sweet basil), *Rubus ideaus L.* (raspberry), *Morus nigra L.* (black mulberry)*, Olea europaea L.* (olive) and *Ficus carica* are used in the design proposal.

Sound

There are indirect ways to establish a sound effect through plants. Rustling, swinging and crackling leaves, birds-bees-bugs, seed pots and falling fruits can create a sensory experience. *Morus nigra L.*

(black mulbery)*, Olea europaea L.* (olive) and *Ficus carica* have fruits that can fall down from the trees. Also, *Carex tenuiculmis* (carex) ve *Pennisetum setaceum* (fountain grass) create a rustling sound. 'Insect Hotels' attract the bugs so that animal noises can be heard.

Table 1. Plant materials used in the design proposal. (Sources: [1]Url, 1; [2]Url ; [3]Url; [4]Url; [5]Url; [6]Url; [7]Url; [8]Url; [9]Url; [10]Url,; [11]Url; [12]Url; [13]Url)

Citrus Limon L. Burm.			
General Characteristics	**Known Hazards**	**Sensory Impacts**	**Photograph**
Evergreen shrub Fragrant flowers Grows in no shade Edible fruits Avg. height: 3 m Avg. plant spread: 1 m (2)	Low potential for sensitization through skin contact with volatile oil	Sight, Smell, Taste touch	
***Aloysia triphlla*- Lemon verbena**			
Deciduous shrub Avg. height: 3 m Avg. plant spread: 3 m Edible leaves Lemon-like flavour	The essential oil from the plant might sensitise the skin to sunlight. Large doses of the tea can cause gastric irritation	sight smell taste touch	
***Allium sativum L.*-Garlic**			
Bulb Avg. height: 0.6 m Avg. plant spread: 0.2 m Grows in no shade Edible flowers, leaves, roots and seeds Intense flavour and fragrance 2	There have been cases of poisoning caused by the consumption, in large quantities. Avoid with anticlotting medication. Breastfeeding may worsen baby's colic. Avoid several weeks prior to surgery	sight smell taste touch	
***Thymus serpyllum* Wild thyme**			
Evergreen shrub Avg. height: 0.1 m Avg. plant spread: 0.3 m Grows in no shade Edible leaves Intense flavour and fragrance 2	None known	sight smell taste touch	
***Lavandula angustifolia* English Lavender**			
Evergreen shrub Fragrant flowers Attracts bees and butterflies Essential oil Furry leaves 1 Avg. height: 1.2 m Avg. plant spread: 1 m Calming 2	The volatile oil may rarely cause sensitization	sight smell taste touch	
***Mentha suaveolens* Pineapple mint**			
Perennial Avg. height: 1 m Avg. plant spread: 0.8 m Attracts wild life Grows in shade Edible leaves Furry leaves 2	Especially when taken in the form of the extracted essential oil, can cause abortions	sight smell taste touch	

Table 1. Plant materials used in the design proposal (continue)

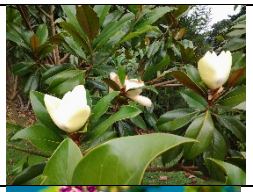
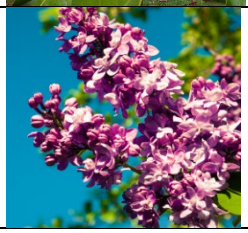
General Characteristics	Known Hazards	Sensory Impacts	Photograph
***Agastache foeniculum* Blue giant hissop**			
Perennial Avg. height: 0.9 m Avg. plant spread: 0.4 m Grows in no shade Attracts wild life Edible leaves Leaves tend to have a drying effect in the mouth and so cannot be eaten in quantity	None known	sight taste touch	
***Ocimum basilicum*- Sweet basil**			
Perennial Avg. height: 0.5 m Avg. plant spread: 0.5 m Herb Grows in no shade [1] Intense flavour and fragrance Edible seeds	Basil contains estragole a potentially carcinogenic and mutagenic essential oil. Do not take during pregnancy or give basil oil to small infants/children	sight smell taste touch	
***Carex tenuiculmis*- Carex**			
Perennial Evergreen Grows in shade Avg. height: 0.6 m Avg. plant spread: 0.6 m **(6)**	No information was found regarding its toxic effect	sight sound	
***Pennisetum setaceum*- Fountain grass**			
Perennial Avg. height: 1.5 m Avg. plant spread: 1.5 m Grows in no shade	None known	sight touch sound	
***Magnolia grandiflora* -Large-flowered magnolia**			
Evergreen tree Fragrant flowers Nonedible fruits Avg. height: 10 m Avg. plant spread	None known	sight touch sound	
Deciduous shrub Attracts wild life Avg. height: 5 m Grows in no shade	None known	sight smell touch	
***Acacia saligna* -Blue-Leaved wattle**			
Evergreen shrub Avg. height: 6 m Avg. plant spread: 6 m Grows in no shade	None known	sight touch	

Table 1. Plant materials used in the design proposal (continue)

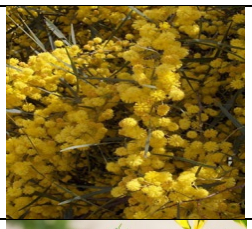
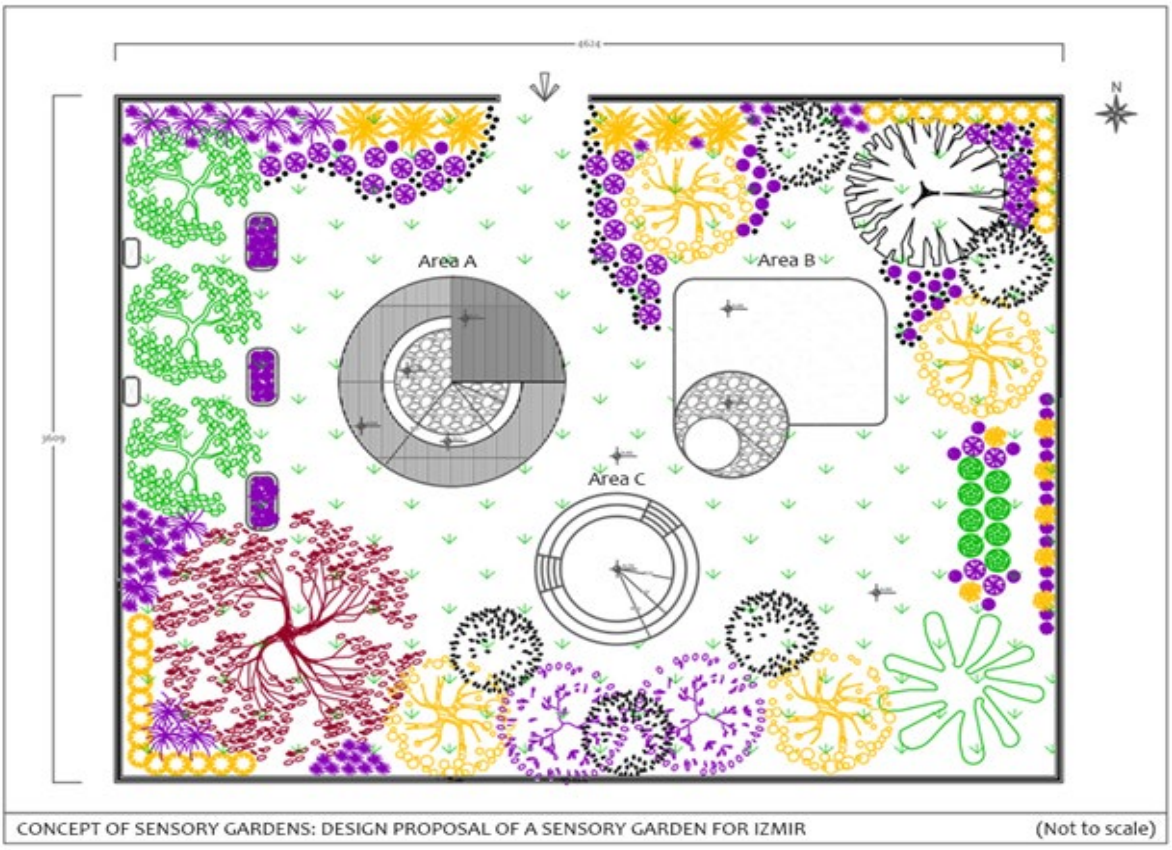
General Characteristics	Known Hazards	Sensory Impacts	Photograph
***Acacia saligna* -Blue-Leaved wattle**			
Evergreen shrub Avg. height: 6 m Avg. plant spread: 6 m Grows in no shade	None known	sight touch	
Evergreen shrub Avg. height: 3 m Avg. plant spread: 3 m Grows in shade or no shade. Topiary Nonedible fruits	None known	sight touch	
***Rubus ideaus L.*Raspberry**			
Deciduous shrub Avg. height: 2 m Avg. plant spread: 1.2 m Grows in semi-shade or no shade Edible fruits Tea made from leaves	None known [2] (Thorns)	sight taste touch	
***Morus nigra L.* Black mulberry**			
Deciduous tree Avg. height: 10 m Avg. plant spread: 15 m Grows in semi-shade or no shade. Edible fruits	None known	sight taste touch	
***Olea europaea L.*-Olive**			
Evergreen tree Avg. height: 10 m Avg. plant spread: 8 m Grows in no shade	The sap and the half-ripe fruits are said to be poisonous. The sap can be a serious eye irritant.	sight taste touch	
Ficus carica			
Deciduous tree Avg. height: 10 m Avg. plant spread: 8 m Grows in no shade Edible fruits	The sap and the half-ripe fruits are said to be poisonous. The sap can be a serious eye irritant.	sight taste touch	
***Allium schoeno-prasum L.* Chives**			
Bulb Avg. height: 0.3 m Avg. plant spread: 0.3 m Edible flowers, leaves and roots	There have been cases of poisoning caused by the consumption, in very large quantities .		

Table 1. Plant materials used in the design proposal (continue)

General Characteristics	Known Hazards	Sensory Impacts	Photograph
***Bellis perennis*-Daisy**			
Evergreen perennial Ground cover Attracts bees Avg. height: 0.2 m Avg. plant spread: 0.2 m	None known	Sight Touch	
***Viburnum opulus* L.-**			
Perennial shrub White flowers Bright red fruits Avg. height: 5 m Avg. plant spread: 5 m Grows in shade	Large quantities of the fruit can cause vomiting and diarrhoea. The fruit is of very low or zero toxicity, it only causes mild upsets when eaten unripe or in large quantities	sight touch	



SYMBOL	BOTANICAL / COMMON NAME	QTY
	Citrus Limon L. Burm. f. (Lemon)	7
	Aloysia triphlla (Lemon verbena)	6
	Allium sativum L. (Garlic)	20
	Thymus serpyllum (Wild thyme)	17
	Lavandula angustifolia (English lavender)	31
	Mentha suaveolens (Pineapple mint)	4
	Agastache foeniculum (Blue giant hissop)	12
	Ocimum basilicum (Sweet basil)	5
	Carex tenuiculmis (Carex)	54
	Pennisetum setacum (Fountain grass)	12

SYMBOL	BOTANICAL / COMMON NAME	QTY
	Magnolia grandiflora (Large-flowered magnolia)	1
	Allium schoenoprasum L. (Chives)	26
	Bellis perennis (Daisy)	129
	Viburnum opulus L. (European cranberrybush)	5
	Syringa vulgaris (Lilac)	2
	Acacia saligna (Blue-leaved wattle)	4
	Euonymus japonica 'Aurea' (Japanese euonymus)	26
	Rubus ideaus L. (Raspberry)	8
	Morus nigra L. (Black mulberry)	1
	Olea europaea L. (Olive)	3
	Ficus carica (Edible fig)	1

Figure 2. The Design Proposal of a Sensory Garden

Hardscape Elements

The selection of hardscape elements is based on the safety of the users and sensory experience to be gained. Selected flooring materials are nonslip, durable and long-lasting.

Area A

Area A provided the users with a dripping system that allows users to experience the water. The users can feel as if they were in the rain. Therefore, the senses of hearing and touching can be stimulated. The flooring material is nonslip, durable and long-lasting composite decking. Pile of pebbles (grade: 0.00) are surrounded with a water path (grade: -0.17) which is a pool for recirculation of dripping water. Pebbles create diversity in size and texture. Also, users can walk on the water path which enriches the sensory experience. The difference in grades ensure a sense of movement in the design.

Area B

The key element of Area B is the chrome water feature. Both the sound of the water and light reflected back from the sphere create a multi-sensory environment. Pebbles and sand playground are two different textures in the area. Both temperatures under the sun and textures would be different.

Area C

Area C is created for educational purposes. With its circular seating arrangement, a place is created in the center where various activities such as small-scaled presentations and plays can take place. The center is below the sea level (grade: -0.70) so that it offers the users a different perspective on the environment. This will result in a variety of experiences of the visual sense.

Raised Plant Beds

The plants to be harvested such as *Allium sativum L.* (garlic), *Thymus serpyllum* (wil thyme), *Mentha suaveolens* (pineapple mint) and *Ocimum basilicum* (sweet basil) are planted in the raised plant beds in order to ensure accessibility (Figures 2, 3).

Figure 3. 3D visualization with material selections of hardscape elements

Conclusion

Sensory gardens visited by individuals who want to be in touch with nature in order to strengthen their bond with the green or their health needs, have been remarkable examples of landscape design in recent years (Yazici, 2019). These gardens are intended to stimulate the users' senses with their plant materials and design elements. The design criteria of sensory gardens are based on the designer's approach and experience. In sensory garden design, the selection of plants and hardscape elements are essential steps. Sensory gardens' user profile is the general public especially children with autism, learning disabilities and special needs.

According to OECD-AB, approximately 15% of the world population consists of individuals with disabilities, this rate corresponds to approximately 1 billion people. In Turkey, there are 1.559.222 individuals with special needs (EyDer, 2020). All over the world, one in 59 children is on the autism spectrum. In Turkey, the number of children with autism is estimated to be 550,000 (Url, 15).

This world, in which we all live together, is a home for everybody regardless of physical and mental differences. Every person has a right to live and have their life respected. Therefore, the concept of sensory gardens is extremely important in order to make the lives of these special people a little easier and to make them safer in their sensitive world. Thus, there are sensory gardens in many countries such as Great Britain, The United States. In Turkey, the number of individuals with autism cannot be underestimated. Unfortunately, there is no practice in the creation of a multi-sensory environment. This paper puts emphasis on the importance of sensory gardens and suggests a design proposal along with design principles. In this study; the concept of sensory gardens was examined and a design proposal of a sensory garden for Izmir was made. If the necessary changes regarding the plant species and site characteristics are done, a revised project can be executed in Izmir

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