

A Qualitative Therapeutic Design Approach for Sensory Garden Design for People with Dementia

Manar Elsayed Mohamed Elbasyoni^{1,*}, Sherin Ali Gammaz²

¹Department of Architecture, Faculty of Engineering, Modern University for Technology and Information, Cairo, Egypt

²Department of Architecture, Faculty of Engineering, Cairo University, Giza, Egypt

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Abstract Many gardens have been established in daily-care institutions serving people with dementia however, individuals with dementia experience disabilities to be engaged in pleasant and useful activities in their physical outdoor environments which could unexpectedly have a negative impact on their behavior and cognitive functioning. People with dementia need to be involved in activities that stimulate the senses and environments that deal with their sensory disorder challenges and provide a multisensory experience through active and passive activities. Therefore, the research addresses the interrelationship between the therapeutic goals of dementia and the design qualities of outdoor sensory spaces used by them by analyzing the behavior of people with dementia due to sensory challenges facing them in their physical environment, followed by the analysis of selected international case studies of gardens designed specifically for dementia patients. To reach successful relationships between therapeutic goals and sensory garden qualities, dementia specialists and caregivers were engaged to link these goals and qualities through interview form and three phases of analytical studies, the research formulated a design model for appropriate landscape therapeutic sensory features and elements that can be applied in gardens serving dementia patients.

Keywords Dementia, Sensory Disorder Challenges, Therapeutic Goals, Design Qualities, Sensory Garden

1. Introduction

In the case of dementia, memory impairment causes deficits in sensory functioning, especially in late-stage dementia [1]. Sensory impairment increases cognitive problems and leads individuals to isolate due to their disability to communicate with their surroundings, and is reflected in their behavior in their indoor and outdoor physical environment [2]. Since the gardens represent the human outdoor environmental content, the design qualities of the gardens' landscape elements have an impact on human performance, cognitive and sensory functioning, and physical and social interaction [3], therefore the outdoor environment should help individuals with dementia and their caregivers to overcome the challenges that face them in the surrounding environment and carry out their activities in an effective and safe context.

Despite the growing theoretical and practical studies in the fields of dementia-friendly outdoor environments, requirements and measurements related to their needs and disabilities. However, it is possible to observe a clear disconnect between dementia therapeutic goals set by dementia specialists and the design qualities of sensory gardens concerning dementia patients' sensory needs and design aspects of dementia outdoor spaces.

Accordingly, this research aims to study the relationship between the design qualities of landscape elements in dementia gardens and the therapeutic goals of dementia. To reach a full understanding of these relations the research examines dementia characteristics, challenges, and needs

that affect the behavior of people with dementia in their built environment, then determines the therapeutic goals and design qualities of garden elements through theoretical and practical analysis, then finally dementia specialists, caregivers, and family members have been engaged practically to extrapolate the interrelationship between therapeutic goals of dementia people and design qualities of sensory gardens in a way that allows formulating an appropriate design model of landscape features in gardens that serve people with dementia.

1.1. Dementia: Definitions, Symptoms, and Types

Dementia is a syndrome; it describes different diseases that affect the brain and usually are progressive effects that cause deterioration in cognitive functioning. Dementia is accompanied by symptoms and signs such as memory problems, difficulties in communication, concentration, judgment, organizing and planning daily issues, and also behavior and mood changes [4]. Dementia has a different effect on each person, and this depends on some factors and the personality of each one before the illness and how the disease affects the brain [5]. Dementia can occur in approximately 100 types of diseases. The most common form of dementia is Alzheimer's disease with an estimated rate of 60% to 80% of cases worldwide [6]. Vascular dementia is the second most cause of dementia after

Alzheimer's disease. Dementia with Lewy bodies is the 3rd most common type of dementia, about 10% of the cases [7].

1.2. Sensory Disorder Challenges Facing Individuals with Dementia in Their Physical Environment

In the case of dementia, memory impairment causes deficits in sensory functioning. Individuals with dementia, especially in late-stage dementia, experience a reduction in the acuity of basic senses; seeing, hearing, touch, taste and smell, and hidden senses; proprioception and vestibular, and in some cases suffer from sensory hallucinations, this reduction might lead to sensory deprivation [8]. Sensory impairment increases cognitive problems and leads individuals to isolate due to their disability to communicate with their surroundings, and also causes discomfort and agitation, and deficits in their daily activities and affects social interaction, and is reflected in their behavior in their physical environment [9] as shown in Fig. 1. Environments that provide appropriate sensory stimuli to people with dementia encourage them to be engaged to social and routine activities and enable a person to interact with his surroundings, multisensory physical environment enable individuals with dementia to live a stress-free, enabling and positive experience [10].

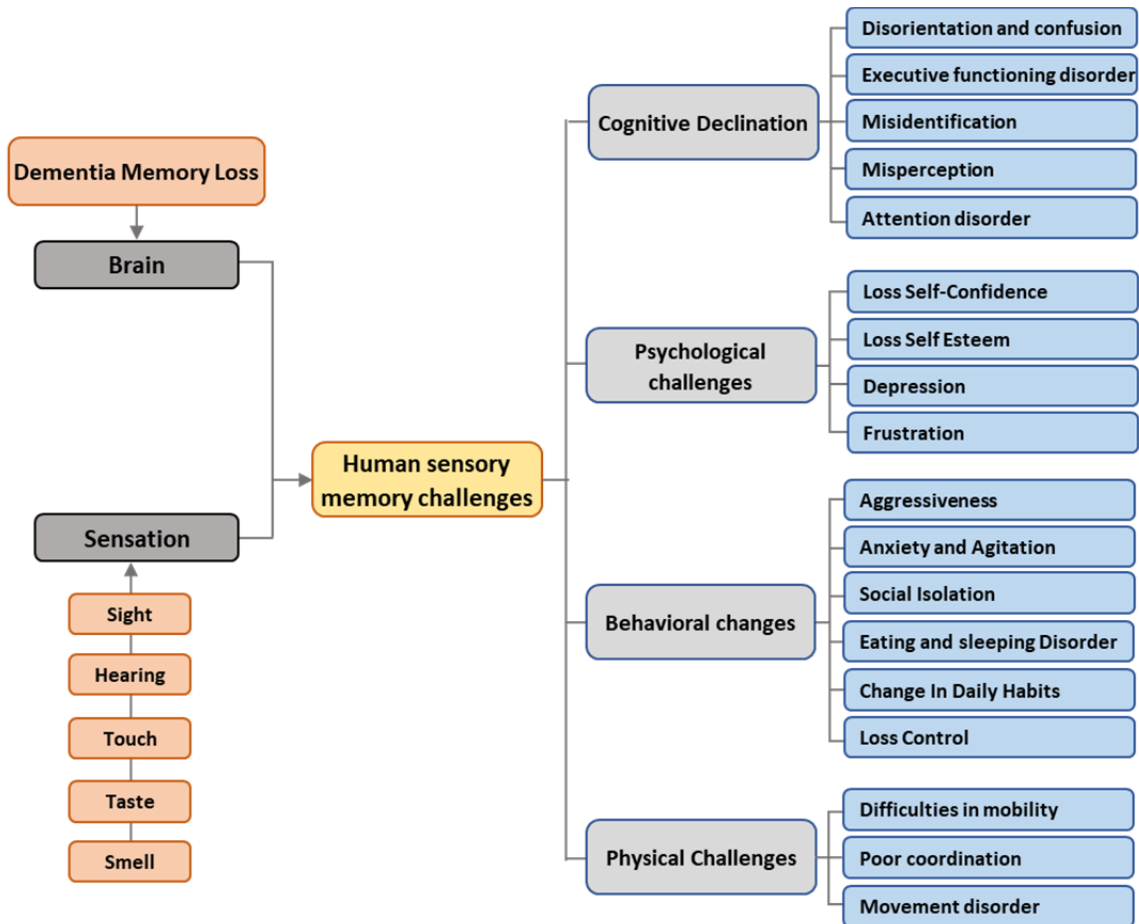


Figure 1. The impact of dementia on human sensory memory, based on [8-10]

In case of sight loss or visual impairment in dementia, individuals act differently, as they experience some difficulties and disabilities in the interpretation and perception of the brain to what they see, which affect the person’s visual perception (visual perception difficulties) and spatial awareness and cause misidentification, blurring, depth perception difficulties, changes in color perception, visual disorientation and confusion in the determination of space and distance, difficulties in mobility and moving around, visual hallucinations, and impairment in the biological body clock [11].

The most common impact of hearing problems on people with dementia is that they experience hypersensitivity to sounds and certain tones and become unable to interpret what they hear clearly. They may become very sensitive to noise levels which a normal person can accept. Noise is a very stressful and distracting feature in their daily life and sometimes background noises make it so difficult to have a conversation with others, noise may cause illusions, disorientation, frustration and anxiety, difficulties in mobility and moving around, and Auditory hallucinations. The acoustic environment has a significant impact on the behavior of a person with dementia that experiences hearing impairment [12].

People with dementia experience changes in their sense of touch due to memory impairment and deficits in brain functioning. Which may cause over-sensitivity or less sensitivity to touch and it is necessary for a person to be able to interact with his environment and objects by

physical touching, these problems in touch sensation lead a person with dementia to lose connection and prefer to be isolated from others and his familiar environment [13].

Smell sense is often affected by dementia, causing olfactory dysfunction which leads to changes in the way a person experiences his daily activities and surroundings. Sense of smell is responsible for identifying pleasant odors and the smell of favorite food it is also the detector that alerts people to dangerous smells like spoiled food, the smoke of fires, and the leak of gases, which can cause distress and danger to individuals with dementia. Taste sense is related to the smell sense and they work together in experiencing objects, places, and food in daily activities. The impairment in taste sense can make food and drinks taste different [14].

2. Methodology

The research methodology is presented in Fig. 2 which illustrates the methodology through three consecutive phases which depend on different tools and methods in each phase to achieve the research objective.

The research utilized multi-method qualitative research tools that included analysis of dementia theories and interviews with dementia specialists and caregivers, and comparative analysis of international case studies of dementia gardens.

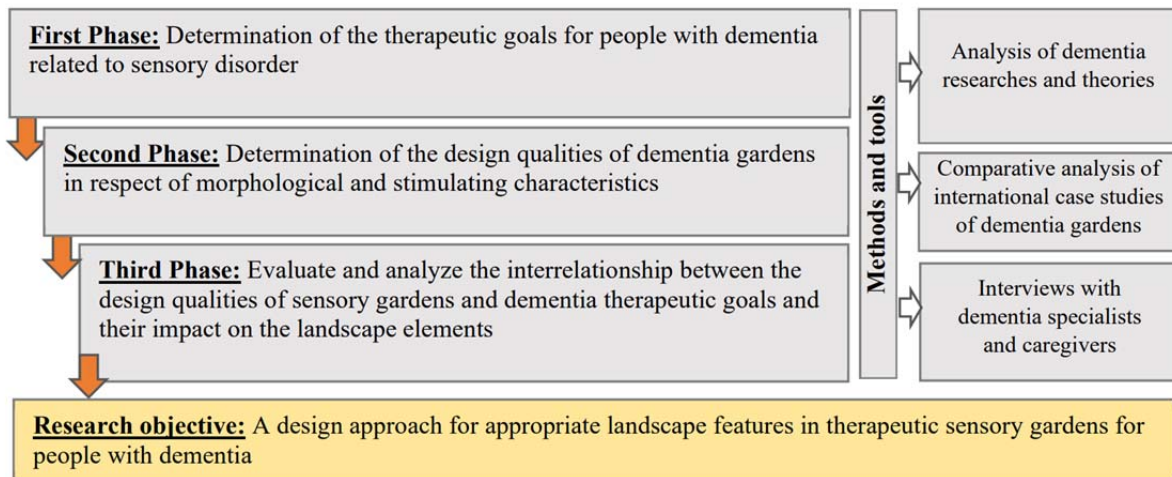


Figure 2. Phases of the proposed design approach of therapeutic sensory gardens for dementia patients.

2.1. First Phase: Determination of the Therapeutic Goals for Dementia Patients

This paper provides a methodical review of the literature and scientific theories related to dementia that conducted qualitative research to explore the therapeutic goals for dementia patients from the perspective of dementia specialists and caregivers and patients in early staged dementia. Accordingly, these goals were analyzed and categorized into five main therapeutic goals which are:

1. Cognitive functioning therapeutic goals which are based on functional independence, cognitive stimulation, reality orientation, communication, address memory, and interaction [15].
2. Psychological and emotional therapeutic goals are based on managing stress, self-confidence, self-esteem, ownership, sense of belonging, and reminiscence [16].
3. Physical health therapeutic goals are based on supporting mobility, relaxation, safety and security, supporting abilities, and promoting exercise [17].
4. Behavioral management therapeutic goals are based on improving mood, pleasant activities, support hobbies [18].
5. Communication and interaction therapeutic goals are based on social support, participation, and support activities [19].

2.2. Second Phase: Determination of the Design Qualities of Landscape Elements in Dementia Gardens a Comparative Analysis of International Case Studies

The research in this part analyzed three case studies of gardens serving dementia patients that applied design qualities of landscape elements of gardens by using different methods in applying these qualities and different design aspects. Accordingly, these case studies were chosen, namely: Resthaven Paradise-Aged Care institution in Australia, Magnolia House for the elderly in the United Kingdom, and Fontenuovo Elderly Care Facility and Residence in Italy. Then the research set a comparative analysis between the case studies according to different therapeutic goals and the design qualities of landscape elements used in each garden in an attempt to reach a design approach for these qualities concerning therapeutic goals.

2.2.1. First Case Study: Resthaven Paradise-Aged Care Institution, Australia

The Resthaven paradise aged care institution was constructed in 2011 in paradise city in South Australia. This institution provides a specially designed garden for dementia accessible through a dementia building as shown in Fig. 3.



Figure 3. Resthaven Paradise Aged Care institution garden plan [20]

The Dementia-Enabling Garden is designed with qualities that help and attract patients to explore the outdoor environment and interact with the surroundings through passive and active engagements.

The garden offers an accessible looped pathway that starts at the building door and ends at the same place. this pathway passes through different spaces in the garden, these spaces provide meaningful activities, physical engagement opportunities, elements and activities that stimulate the senses, a secure and safe environment, private seating areas, gardening and horticultural activities, wildlife attraction elements, elements that promote reminiscence [20].

2.2.2. Second Case Study: Magnolia House for the Elderly, United Kingdom

Starrett Lodge on the NSW Central Coast conducted a comprehensive literature assessment in 2009 and used the findings to design a therapeutic, interactive, sensory wandering garden and an accompanying atrium/sunroom. The atrium has a view of the rest of the garden and may

be partially opened to let in fresh air, fragrances, and sunlight. Features for reminiscence, a mural of the nearby land, an old vehicle, an observation platform overlooking the wildlife, a finch aviary, a woodpile, a quiet place with a water element, and raised planting beds where people may dig and harvest vegetables are all included in the garden's design. The garden environment was created to improve the quality of life for people in the dementia units in Magnolia House, in addition to improving the staff members' outdoor experience [21] as shown in Fig. 4.

The garden's design aimed to fulfill the following qualities: provide a safe and secure environment, promote independence in using the garden, provide a sensory stimulating environment, elements, and features that support orientation, attract wildlife, provide walking paths, provide seating choices, supports teamwork, provides, give the opportunities for meaningful activities, provides maintenance and gardening activities, supports social interaction between residents and staff members and family visitors [21].



Figure 4. Magnolia House Garden plan [21]

2.2.3. Third Case Study: Fontenuovo Elderly Care Facility and Residence, Italy

The Fontenuovo Residence opened a ten-bed unit for dementia patients with moderate to severe behavior issues in January 2016. Patients take part in a particular therapy program that makes use of sensory rehabilitation methods, such as group or individual healing activities in the healing garden, where the combination of lights, colors, scents, essences, noises, objects, and pictures aids in the reduction of abnormal behavior and the stimulation of memory recall as shown in Fig. 5. This aims to enhance patients' behavior as well as their overall mental and physical health.

The Fontenuovo Healing Garden is easily accessible from the activity hall, allowing a seamless transition between indoors and out to minimize confusion [22].

There are various rest places along the main walk, each with chairs surrounded by fragrant plant varieties to make the halt even more pleasant and stimulating. There are also solitary seats available, which provide a personal, private place, as well as a tiny wooden gazebo to stimulate social interaction [22].

2.2.4. The Design Qualities of Landscape Elements in Dementia Gardens

As a result of the previous analysis of the three cases studies of dementia gardens, the most important design qualities of dementia gardens were determined in an intend to find the interrelationship between these qualities and dementia therapeutic goals in the third phase of the research methodology, and these qualities are promoting independence, sensory stimulation, decision making, familiar characters, mental mapping, personal identity, communication, address memory, privacy, ownership, sense of belonging, self-confidence, promote reminiscence, safe and secure environment, support mobility, relaxation, microclimate adaptation, promoting physical exercise, provide walkable walking paths, shelter and shade, sustainability, promoting physical activities, accessibility, support range of abilities, improve mood, pleasant activities, support hobbies, spatial orientation, horticultural activity, meaningful activity, familiar tasks, integrate indoor and outdoor, wildlife attraction, participation and interaction, support activities, support socialization, seating choices, and encourage team work.



Figure 5. Fontenuovo Elderly Care Facility Garden plan [22]

2.3. Third Phase: Evaluate and Analyze the Interrelationship between the Design Qualities of Sensory Gardens and the Therapeutic Goals of Dementia

This part of the research presents the interrelationship between the design qualities of therapeutic sensory gardens found in each case study and the dementia therapeutic goals that were previously set and their impact on the landscape elements this relationship was done by two methods and these methods were as follows:

2.3.1. Data collection

In this part, data were collected through the past two phases and set in an interview form which determines a set of relationships between therapeutic goals and design qualities according to different design aspects. The interviews were conducted and accomplished by the researcher and the participants through institutional visits and online interviews which were previously determined. The interview participants were a sample of 20 dementia specialists and 30 caregivers in different dementia daycare institutions to determine the relationship between design qualities and therapeutic goals.

The interviews questions categorized the design qualities according to the main therapeutic goals through five topics; 5% of questions about gender, age, garden visiting rate, and user group if a dementia specialist, provider, or a family caregiver, 30% for the qualities that enhance cognitive functioning and psychological

therapeutic goals and, 30% for qualities that supports Physical health and manage Behavioral therapeutic goals, 20% for qualities that enhance communication and interaction therapeutic goals, 15% about designing the outdoor spaces for dementia patients. The interview questions were on a rating scale on how relevant are the design qualities to the therapeutic goals and participants were asked to rate the relationship between Dementia therapeutic goals (Cognitive functioning, psychological, physical, behavioral, and interaction) and garden design qualities.

2.3.2. Data Analysis

The interview data were analyzed and evaluated by the researcher, and the data analysis is presented in five categories of design qualities in the shown bar charts in Fig. 6. The final results of the interrelationship between design qualities and therapeutic goals are shown in Fig. 7.

2.3.3. Comparative Analysis of the Design Qualities of the International Case Studies Related to Different Therapeutic Goals

This part of the research presents a comparative analysis of the design qualities achieved in the selected case studies concerning therapeutic goals, and the degree of achievement of these qualities that vary from good (●), average (■), poor (○), and not applicable as shown in **Table 1**.

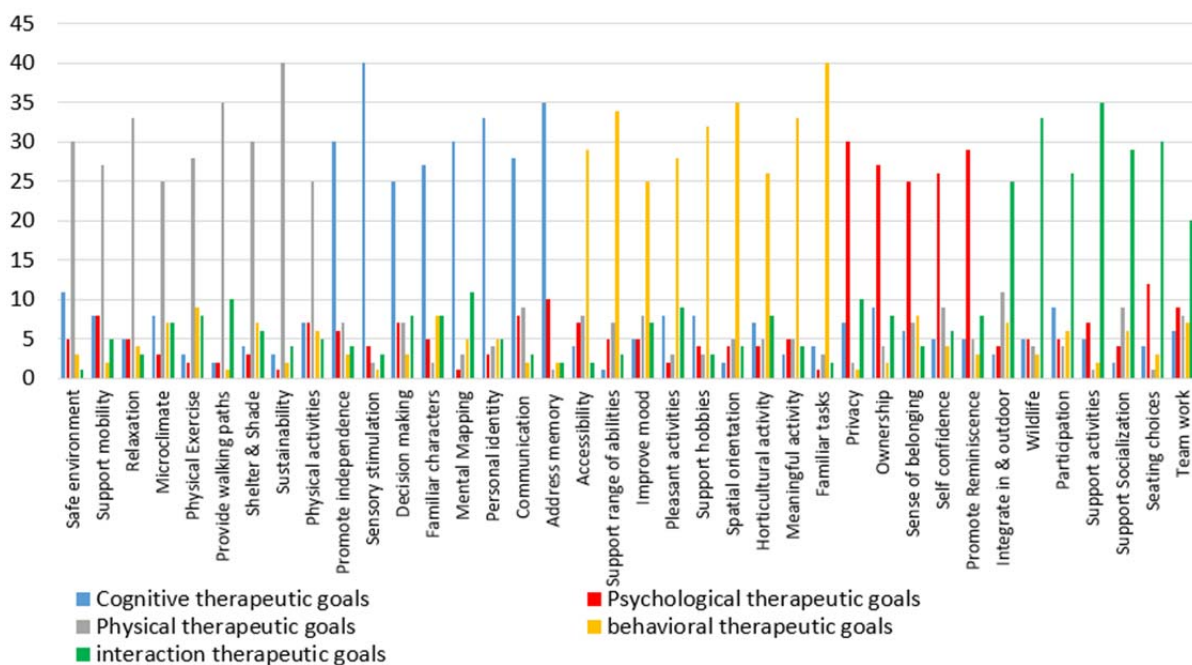


Figure 6. Data analysis of the interview results of the design qualities related to therapeutic goals [The Researcher]

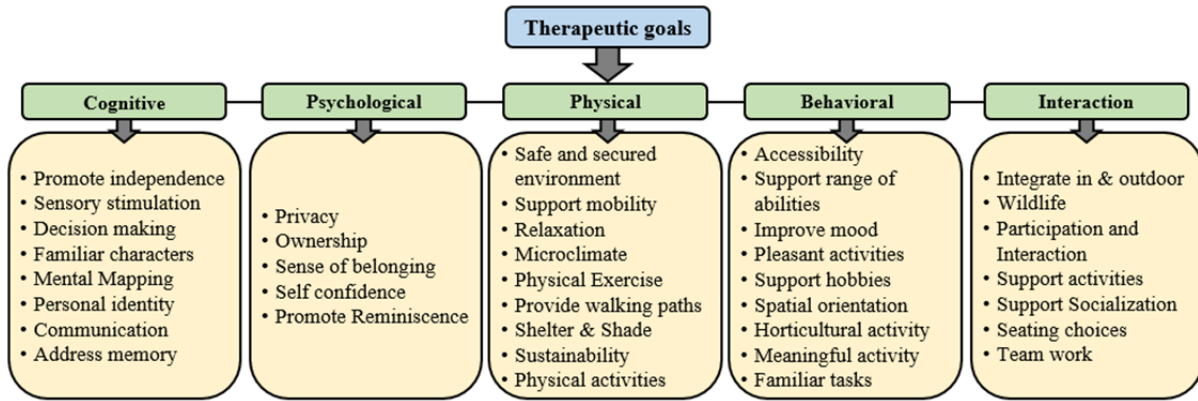


Figure 7. Design qualities related to different therapeutic goals [The Researcher]

Table 1. A comparative analysis of the design qualities of the selected case studies related to therapeutic goals

Design Qualities	Resthaven, Australia	Magnolia House, UK.	Fontenuovo, Italy
Cognitive functioning	Promote independence	N.A	There are fixed seats with arms to promote independence
	Sensory stimulation	There are a sensory green wall and a water fountain	There is a multi-sensory stimulating environment
	Decision making	Looped pathways with a non-confusing starting point	N.A
	Familiar characters	A rotunda with heritage style, bird bath, and fountain	An aviary and a fountain along the pathway
	Mental Mapping	The use of small landmarks along the garden	N.A
	Personal identity	N.A	Surrounding elements enhance personal identity
	Communication	Enhances communication with the surrounding environment	N.A
	Address memory	N.A	Sunroom that overlooks the garden
Psychological	Privacy	Provides private spaces for relaxation	Provides private zones for relaxation
	Ownership	N.A	N.A
	Sense of belonging	There is a rotunda with heritage style	A memory box and an observation platform and an old car
	Self-confidence	N.A	Provides a looped pathway
	Promote Reminiscence	Provides a heritage-style rotunda	Provides memory boxes, an old car, and a mural of nearby land

Table 1 continued

Physical Health	Safe and secure environment	Provides a safe environment by using paved with non-slip, material	■ Provides a safe environment by using paved with non-slip, material	■ Pathway with no sharp angles or junctions and paved with non-slip, anti-freeze, non-glare material	●
	Support mobility	Supports mobility through the garden	○ N.A	Support mobility by providing pathways paved with non-slip, anti-freeze, non-glare material	●
	Relaxation	A rotunda for relaxation	● Private zones for relaxation	● Rest area surrounded by stimulating features	●
	Microclimate	Shaded seating area for multi-use activities	N.A	An old big tree in the seating area for shade	●
	Encourage Physical Exercise	Encourage Physical Exercise	○ N.A	Encourage Physical Exercise	■
	Provide walking paths	Looped pathways throughout the garden	● Provides looped walking paths	● Provides circular walking paths	●
	Shelter and Shade	A shaded seating area and sheltered seats are located on the pathway	■ Provides Shelter and Shade	■ Provides Shelter and Shade	●
	Sustainability	N.A	Uses sustainable garden elements that need low maintenance	■ N.A	
	Physical activities	Provides physical engagement opportunities	■ N.A	Supports Physical activities	○
Behavioral Management	Accessibility	The garden is accessible through the dementia building	● The Garden is accessible through the dementia building	■ The Garden is accessible from the activity hall	●
	Support a range of abilities	Regards and Supports the Range of abilities	○ N.A	Regards and Supports the Range of abilities	■
	Improve mood	N.A	The Birds' aviary in the garden helps to improve the mood	■ There are multi features that Improve mood	
	Pleasant activities	N.A	The garden provides places for pleasant activities	■ The garden provides places for pleasant activities	■
	Support hobbies	N.A	There is a woodpile to support hobbies	○ N.A	
	Spatial orientation	Supports orientation by providing a looped pathway	■ Supports orientation by providing a looped pathway	■ Supports orientation by providing a circular pathway	■
	Horticultural activity	Raised beds for the horticultural activity zone	● provides Maintenance and Gardening Activities	● Raised beds for horticultural activity	■
	Meaningful activity	Provides Meaningful activity	● Provides Meaningful activity	○ Provides Meaningful activity	■
	Familiar tasks	Provides Familiar tasks	○ N.A	Provides Familiar tasks	■
Interaction and communication	Integrate indoor and outdoor	Integrates indoor spaces with outdoor through wide building openings	■ Provides an observation platform and an accompanying sunroom	■ There is a seamless transition between indoors and outdoors	●
	Wildlife	Provides elements that attract wildlife	● There is an aviary with birds in it	● Provides an aviary and a small fountain to attract birds	■
	Participation and Interaction	Supports Interaction through a rotunda located near the bird bath and water fountain	■ Gathering spaces for interaction with others	■ Supports Interaction with the surroundings	●
	Support activities	N.A	Support activities in the garden	○ N.A	
	Support Socialization	Supports social interaction	■ Supports social interaction	■ Supports social interaction	■
	Seating choices	Provides Seating choices along the pathway	■ Provides Seating choices along the pathway	● Provides Seating choices along the pathway	■
	Teamwork	N.A	○ Provides spaces that support teamwork	○ Provides spaces that support teamwork	○

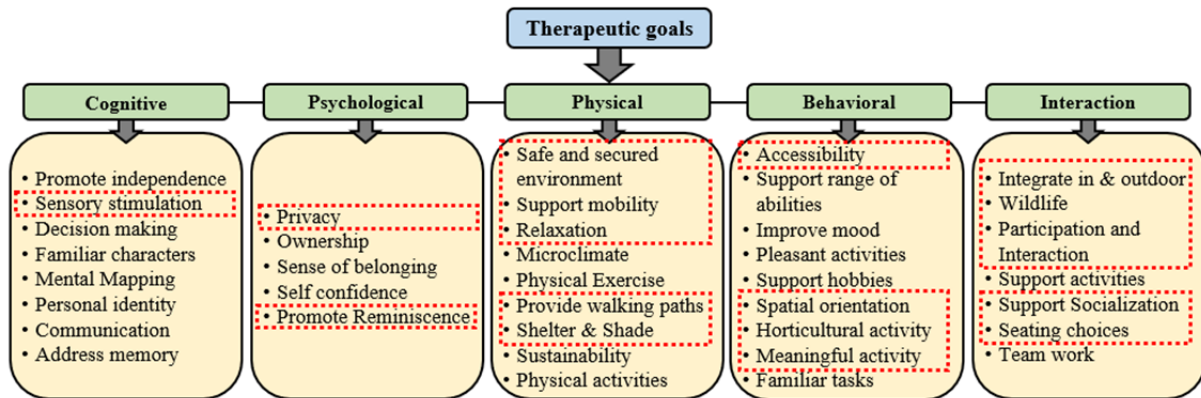


Figure 8. The most effective design qualities related to different therapeutic goals as a result of comparative analysis of case studies [The Researcher]

3. Results

Based on the previous analytical review of the therapeutic goals of dementia and the design qualities of sensory gardens, it has been clear that there is a reciprocal relationship between these goals and the design qualities of dementia gardens based on sensory challenges.

The most effective design qualities of each therapeutic goal in each case study have been determined as shown in Fig. 8.

These design qualities are related to therapeutic goals and characterize the garden elements and realize the different needs of dementia users and they should be realized in the garden design process considering the different therapeutic goals of dementia patients.

3.1. Design Qualities and Considerations of Landscape Elements for Dementia Sensory Garden

Gardens should provide certain qualities to enhance the quality of life for people with dementia and assist in the therapeutic process. Therefore, garden should fulfill the following qualities:

1. Provide a controlled and balanced stimulating environment

Effective and qualified sensory gardens for dementia people should provide an environment that includes controlled and balanced stimulating features, so as not to over-stimulate users or give a feeling of boredom. This can be achieved by:

- Noise reduction, as it acts as a negative stimulant and has the greatest and most harmful effect on people with dementia, noise is produced by the surrounding people, traffic, urban noise, entertainment tools, and operational equipment used for work. Noise can be reduced by the selection of a quiet site location for the garden, and the use of materials and elements that absorb or eliminate noise.
- Take into account the effect of landscape features and their morphological characteristics that stimulate

sight and touch senses like colors, light, texture, contrast, movement, size, and form and other characteristics that stimulate hearing, smell, and taste senses like sound and aroma, to improve the interaction of all five senses with the surrounding environment.

2. Provide non-annoying safety and security

Mobility and moving around are very important for a person with dementia, as they need to move freely and easily in a balanced, safe, and secure environment that is not restrictive or controlling the user, with fewer threatening and unobtrusive obstacles. These needs can be achieved through Innovative design approaches.

This feeling can be achieved through:

- The use of suitable lighting features that do not hinder the movement and are suitable for its function.
- The use of shrubs or planted walls with suitable height or vines' screens to define pathways and zones, which give a sense of control and freedom at the same time instead of high fences that impose obtrusive control.
- The use of non-restricting technology that fulfills safety for the user like detecting and monitoring tools.

3. Use elements and features that support orientation

People with dementia experience their surrounding environment with a great feeling of disorientation that they need to be assisted to be safely oriented in their living spaces and outdoor areas: this supported orientation can be achieved through:

- By using colors, contrast, and texture in the garden's design features to support the identification of elements, pathways, and floors.
- Use garden features that indicate the function of the used space.
- Avoid the use of shiny floors and features that can cause glare and be mistaken by users or misidentified and use features and treatments that reduce glare.

- Use garden signages and signs to support orientation and ensure entrances and exits to garden spaces and indoor spaces
- Use features and characteristics that are familiar to the user.

4. Support participation and involvement in daily activities

A person with dementia needs to practice his daily activities at his level of abilities garden design can be designed to encourage utilizing a person's interests and skills

- Design spaces that encourage and support outdoor therapeutic activities such as horticultural therapy, reminiscence therapy, pet therapy, and gardening.
- Design space for music activities with a controlled noise level.
- Design gathering spaces with familiar and domestic characteristics and elements, supported with certain sounds or odors.
- Encourage the practice of outdoor physical activities by designing safe and accessible spaces and non-slippery pathways for secured walking and strolling.

5. Promote and enhance self-confidence and self-esteem

A person with dementia needs to reach an optimum level of self-confidence in his daily tasks and activities and support his skills and therefore reaches his self-esteem and respect; gardens can maximize this feeling by providing appropriate landscape design of:

- Clear paths and routes between the indoor and outdoor nodes.
- Avoid unclear pathways and unsafe spaces or elements.
- Supporting social interaction with others and encouraging activities and skills.

6. Support social interaction and relation with family and caregivers

A person with Dementia needs to keep regularly communicated and connected to considerable family members and caregivers, so gardens must provide:

- Proper spaces for private family visits with suitable features
- A wider space is prepared for a larger group of family members to easily communicate
- Provide an intimate personal space to be used by the person with dementia easily alone
- Provide a workable space or activity space to encourage interaction with family members in a safe way.
- To maximize the quality of life of a person with dementia, his cultural background must be experienced and enclosed in the design considerations

4. Discussion and Conclusion

This research addresses the interrelationship between the therapeutic goals of dementia and the qualities of different design aspects. The research first reviewed the definitions, symptoms, and types of dementia and the impact of the sensory disorder on the behavior of people with dementia in their physical environment. It elaborated on the therapeutic goals of dementia from the perspective of dementia experts and caregivers to be used in the second part of the research, which presented the design qualities of dementia sensory gardens concerning different design aspects. Finally, the research presents a set of design qualities and considerations for each type of sensory challenge as a therapeutic sensory design approach for gardens used by people with dementia to enable users to overcome their sensory challenges and achieve therapeutic goals.

Declarations

Ethics Approval and Consent to Participate

The research included an interview-based survey. All respondents are professional dementia specialists and dementia caregivers (above 20 years old) and agreed to participate in the interview as a part of this research. This survey has no participation of any dementia patient and there were no medical trials set on patients and no medical or human data was shared in this survey. The researcher provided the participants with all the data they need to know about the study to make an "informed" decision about participating in this research and they all gave their permission to be part of the study and they make an "informed" consent to participate.

Consent for Publication

The manuscript does not contain any personal data in any form (including individual details, images, or videos). Further, all participants are professional dementia specialists and dementia caregivers (above 20 years old) and agree to publish the results of the interview.

Availability of Data and Material

All data generated or analyzed during this study are included in this manuscript.

Competing Interests

The authors declare that there are no competing interests.

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This study received no funding from any resource.

Authors' Contributions

All authors contributed to the manuscript and have read and approved the final version. All authors put the outline of the study idea, completed the literature review, planned the methodology, conducted the interview form and its analysis, and are responsible for writing the manuscript details, figures, and revisions.

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