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Chapter 6

New Flower Bed Design and Verification Supporting Horticultural Therapy Classes Based on Behavioral Observation

Meng-Cong Zheng

Additional information is available at the end of the chapter

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Abstract

Horticultural therapy improves the elderly's emotional and cognitive functions and also leads to their social participation and better overall health. We want to know about the problems of implementing horticultural therapy and how to improve it with the flower bed design. "House of Love" is a private nursing home in Taipei and had been the research base in this study. It was found that current horticultural classes heavily rely on teacher-centric and volunteer staff-assisted curricula, often not considering the specific physical and psychological needs the elderly usually face in classes. "Elderly Green" is a new design taking the requirements of horticultural classes in to consideration, providing for a maximum of flexibility under varying conditions by modulizing the flower bed. It allowed the elderly to do their gardening in a comfortable and less strenuous manner. "Elderly Green" is a centripetal flower bed design improved equally distributed care for each participant during class time and increased interaction among the elderly that reduces manpower needs.

Keywords: flower bed design, horticultural therapy, behavioral observation

1. Introduction

Taiwan has become an aging society. Even though many assisted living facilities are providing care services for the elderly, most of them do not want to move into nursing homes because the perceived lifestyle at these facilities is foreign to them. "Aging in place" is a concept that first originated from Northern Europe during the 1960s. The goal at the time was to care for the elderly with resources that are native to them so they could age in an environment that is familiar to their culture, which would give them the holistic care and independence that they

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deserve. On the contrary, some nursing homes limit the elderly's lifestyle choices and social functions, which may damage their mental health and self-respect resulting in deterioration of their body and mind [1]. The goal of "Aging in place" was to fulfill the native's needs with domestic goods and services, which would require community-like facilities to build a long-term care system. Most of the assisted living facilities today in Taiwan are based on community activities to promote interaction among the elderly. Healthcare-oriented facilities should be considered more when daily activities and movements become less convenient for the elders. Japanese welfare economist [2] proposed five basic measures to ensure that the elderly live a normal life: avoid taking quarantine measures; allow them to live in an environment with which they are familiar as much as possible; facilitate their social exchanges and mutual assistance; provide facilities and services to maintain quality of life when institutionalized care becomes necessary; and integrate social welfare, medical and health, and environmental maintenance policies to create a suitable living environment.

Sandberg indicated that 95% of the elderly in Hong Kong have one or more chronic diseases; however, only 5.5% require institutionalized care [3]. Although nursing homes can help the elderly who cannot live independently [1], institutionalized care entails a change in living environment, and consequently, disconnection from family and society as well as a reduction in physical activities and enhanced loneliness [4]. Another study found that the physical activity level of the nursing home-dwelling elderly is considerably lower than that of the community-dwelling elderly [5]. In addition to facing changes to their environment and mobility, the elderly who move into nursing homes must deal with changes in daily life routine, social network, and social support [6]. Moving into a nursing home means the discontinuation of a person's traditional lifestyle with which they are familiar. In addition, the elderly can sustain an enormous sense of loss caused by separation from families, neighbors, and friends [1, 7]. When the elderly face gradual decline in physical and mental status, what can be done to ensure they age stably is a question that requires an answer. The American Horticultural Therapy Association (AHTA) maintained that horticultural therapy can be applied to people of various ages, backgrounds, and abilities. It defined horticultural therapy as "engaging in gardening-related activities through the assistance of a trained therapist to complete a specific therapeutic goal." Horticultural therapy has four major types of benefits: intellectual, social, emotional, and physical [8–11].

Intellectual benefits: Through horticultural therapy, participants can acquire new skills and knowledge, increase their vocabulary and communication skills, have their curiosity aroused, improve observation, receive occupational and pre-occupational training, receive stimulation to their sensory organs [11–14], and obtain new learning opportunities [15].

Social benefits: A successful treatment should involve three types of interaction: between the therapist and the client, between clients, and between the client and nonclient [16]. Generally, these interactions mainly are aimed at socializing and collaborating; specifically, sharing gardening experiences facilitates creating meaningful interactions. Because group members have a common goal, interactions among them can be increased on the basis of mutual respect and support, as well as duty sharing. During the process of gardening, patients have the opportunity to connect with people other than their group members and share their own gardening results with external parties, thereby gaining the benefit of an enlarged interpersonal network [4, 11, 17].

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Emotional benefits: Lewis and Mattson maintained that through gardening activities, people can experience serene satisfaction in the world of plants where no threats or discriminations exist, thereby alleviating their mental stress and fear [2]. Furthermore, when patients discern that they can work independently and have their own gardens, a sense of identification and belonging to the gardens emerge in them, and their self-respect is enhanced. When patients' confidence is elevated, their belligerent tendencies can be tempered and adjusted to socially acceptable behavioral models; in addition, their interests and passion for future life are triggered to satisfy their creative instinct [11]. Moreover, gardening activities can help patients develop an ideal self-image and continually develop work skills [12]. Because numerous factors in the living environment can affect people's emotions, a designed and selected environment can indeed quicken patients' emotional recovery [18–21]. For example, a successful therapeutic garden can reduce people's stress, even generating a sense of encouragement [22].

Physical benefits: In addition to mental benefits, gardening activities help wounded or physically disabled individuals to improve their coordination and effectively control their motor neurons through tasks such as carrying plants, sowing seeds, applying fertilizer, and watering plants [11].

For the elderly, gardening enables them to improve physical and mental health through a leisure activity. Therefore, an increasing number of the retired elderly have devoted themselves to gardening activities, and numerous elderly nursing and home care centers have introduced horticultural therapy. Research has shown that horticultural therapy can improve the elderly's arthritis symptoms, and it exerts positive effects on blood pressure and diet control [2]. Furthermore, gardening activities can increase regular physical activities that require physical and mental stability as well as high-level functional activities [23]. Gardening practices have the clear effects of enhancing muscle strength, fine motor skills, and balance; in particular, transplanting requires grasping and releasing with the thumb and index finger as well as muscle flexibility [23, 24]. Gardening activities boost enthusiasm and senses of responsibility and achievement. From selecting plants to their growth and eventual flowering, plants continually create hope for people. Furthermore, learning gardening skills enhances the elderly's curiosity. Therapeutic use of activity can help the geriatric individuals to improve their independence in daily life, and cognitive and motor skills [13, 21, 23]. The activity that will be used as a therapeutic agent can be determined according to the interests, activity preference, and the skills of the geriatrics [19, 25, 26]. Gardening can expand people's social networks by providing opportunities to socialize [27]; thus, gardening activities have positive effects on the community-dwelling elderly.

Brown administered a 5-week horticultural therapy course to 66 older residents in nursing homes [28], and found that compared with the control group, residents in the test group exhibited significantly greater improvements before and after receiving the horticultural therapy in several items on the activities of daily living (ADL) scale, namely physical ambulation, feeding, and toilet. Austin applied a 5-week horticultural therapy course to eight elderly people who lived by themselves, the results of which revealed that their fitness, ADL scores, and 6-min walk test results all improved significantly after the intervention [29]. In addition, Son administered a 5-week horticultural therapy to five community-dwelling elderly people, and found that during vegetable-planting activities, they could use adapted tools and aids to teach the elderly to adjust to appropriate joint movement angles, balance using suitable postures, and train gross

and fine motor skills, eventually improving their physical activity and self-maintenance abilities [30]. Thelander introduced a 6-week outdoor gardening intervention to eight older residents with dementia at a frequency of three times a week, for 40–70 minutes per session [31]. The results indicated that landscape maintenance tasks such as watering, weeding, and fallen leaf picking significantly improved the residents' balance. Gigliotti and Jarrott compared the elderly participating in gardening activities with counterparts receiving conventional treatment, and found that those in the horticultural therapy group exhibited significantly higher levels of activity involvement and positive emotions [32]. Lee and Kim implemented a 4-week gardening intervention comprising selecting bean cultivars, sowing seeds, watering plants, touching the plants they had planted, cleaning and maintaining the planting environment, and harvesting, cutting, and washing the plants; their results indicated that these indoor gardening activities significantly reduced anxiety [33]. Austin determined that after receiving horticultural therapy, the elderly exhibited significantly lower levels of anxiety [29]. By touching the plants they had planted, cleaning and maintaining the planting environment, and harvesting, cutting, and cleaning the plants, the elderly were engaged in higher levels of physical activity, which in turn improved their cognitive functions [33]. In addition, Sempik, Aldridge, and Becker noted that gardening activities strengthened the elderly's sense of responsibility and increased the opportunities for decision-making, through which their degradation could be slowed and the group became consolidated because of sharpened social skills [34]. However, gardening activities remain inadequate in the elderly's nursing homes. Although lawns and gardens are common in nursing institutions, they are rarely designed according to user needs. SCUs in France conducted a survey from 1992 to 2007, determining that less than 82% of medical institutions had freely accessible outdoor space, and only 43% provided patients with access to this outdoor space; thus, gardens were not regarded as a part of health management. Nevertheless, compared with conventional treatments that require hospitalization, horticultural therapy is generally more accessible to patients and easier to adapt to; furthermore, the costs are cheaper than other types of therapy. Despite gardening activities being widely recognized as a positive therapy, substantial efforts are still required to popularize this therapy in public care systems. Engaging in gardening activities typically requires the elderly to bend or squat. When planting is conducted in a standing posture, people in a wheelchair have difficulty participating because square tables have limited availability. Therefore, defining design conditions that support the elderly's participation in gardening activities is paramount. Research has shown that the first condition to be considered in horticultural equipment design is to lower the participants' physical burden. When the elderly are allowed to engage in the activities by themselves, their opportunities for mutual communication increased; however, their exchanges and communications reduced when a facilitator joined [35]. Circle theory in the field of environmental psychology maintains that using a round table enables people to see each other. However, results of one experiment revealed that simple concentric tables could not satisfy the requirements of wheelchair users and others with diversified physical conditions [36]. Even so, designers may still experiment with other shapes that have the effect of a circle to determine which table shape facilitates the interaction of people with varying physical conditions in a variety of venues. Horticultural therapy courses stimulate emotions, boost activity levels, reduce stress and fear through human-to-plant interactions, increase muscle relaxation, and promote confidence and knowledge. These courses promote user's sense of responsibility and self-fulfillment through

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plant care, which also enhances cognitive capabilities. Group activities in planting and sharing experiences create community opportunities and respect among each other. There is a connection between social participation and environment recognition of the elderly [37, 38]. Besides, there is also a strong correlation between the elderly's ability to successfully interact with society and the quality of their facilities and surroundings. Their comfort with the surrounding environment and perception of the social interactions significantly aid their social ability [39]. Horticulture courses are crucial in planning regarding retirement and assisted-living facilities. Many studies showed mind-body health improvements among the elderly who partake in horticulture classes. However, implementing horticulture courses through assisted care and planning in these facilities are not enough. We need to consider an elder's activity level, physical ability, and health condition in gardening classes to implement communication and activity in their curriculum.

This study investigates facilities that have implemented horticulture classes in their treatment. Through interviews and behavioral observation to find out the problems and conditions associated with horticulture classes, also understand the different types of gardening, facility deployment, and gardening treatment details and execution. This study also focuses on the duration of these classes to understand the effectiveness of horticulture classes that will be helpful for future class design and planning.

2. Method

"House of Love" is a private nursing home and a research base established in 1923, for the elderly, people with no assistance, the sick, and the homeless. "House of Love" is also awarded for excellence by the Ministry of Home Affairs and Taipei City Hall. "House of Love" is the best long-term care center in Taipei that focuses on treatment of the body and mind (**Figure 1**). This study implemented records of long-term behavioral observation in "House of Love" with a focus on cases who participated in these horticulture classes, the



Figure 1. Private nursing home "House of Love".



Figure 2. Observation one, class one (control group).

interaction between them, their problems in grading, and studies of these classes. Behavioral observation and post-occupancy evaluation were used in this study. Behavioral observation is referred to as sequential action marking; this method is a type of continuous observation-recording, and its objective is to record the relationship between time and actions. This study adopted behavioral observation to record the process of the elderly's engagement in gardening activities. Post-occupancy evaluation was adopted to evaluate user evaluations after experiencing the design. Weaknesses in the proposed design could be determined from users' behaviors and reactions, and corresponding design strategies could be developed.

This study was carried out in three sections. The first section focuses on observation of elders who participated in horticulture classes. We implemented behavioral observations in the three classes as below:

1. Observation of class one (control group) (**Figure 2**)

   Class location: flower beds with sitting areas.

   Elder group: the elderly with dementia and ambulatory.

   Class participation: nine elders, one teacher, one social worker, and three volunteers

2. Observation one, class two (control group) (**Figure 3**)

   Class location: operating area.

   Elder group: the elderly in wheelchair and ambulatory.

   Class participation: total of 13 elders. Nine in wheelchair and four ambulatory, one teacher, one social worker, and seven volunteers

3. Observation one, class three (control group) (**Figure 4**)

   Class location: low floral display area in the back of the garden.

   Elder group: the elderly on lower treatment.

   Class participation: total of eight elders, one teacher, one social worker, and 10 volunteers.

The investigation was conducted using behavioral observation. The gardening course was implemented in the Garden of Fragrance in the House of Love. Classes for the control group were documented faithfully in their entirety with videos and photographs. The collected files

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Figure 3. Observation one, class two (control group).



Figure 4. Observation one, class three (control group).

were coded and divided into four categories: class-related objects, classroom interactions, the elderly's upper extremity activities, and the elderly's lower extremity activities.

Section 2 focuses on how we make a design proposal of gardening tools and then new design proposal will put into section three which uses behavioral observation again in another horticultural therapy class to see its effect.

4. Observation of new class (test group)

Class location: side exit of the main building in the plaza.

Elder group: currently in wheelchair.

Class participation: five elders, one teacher, no social workers, and no volunteer.

This study is based on behavioral observation and post-occupancy evaluation. We hope the result would combine gardening therapy and class design in an amicable environment for elders.

3. Results

The observation results indicated that classes two and three involved longer durations of activities conducted in a sitting posture. Compared with a standing posture, engaging the elderly during the classes in a sitting posture led to more satisfactory evaluations from the teacher in the postclass interviews. Both the teacher and social workers expressed that adopting a sitting posture effectively prevented the elderly from developing exhaustion or muscle pain, whereas

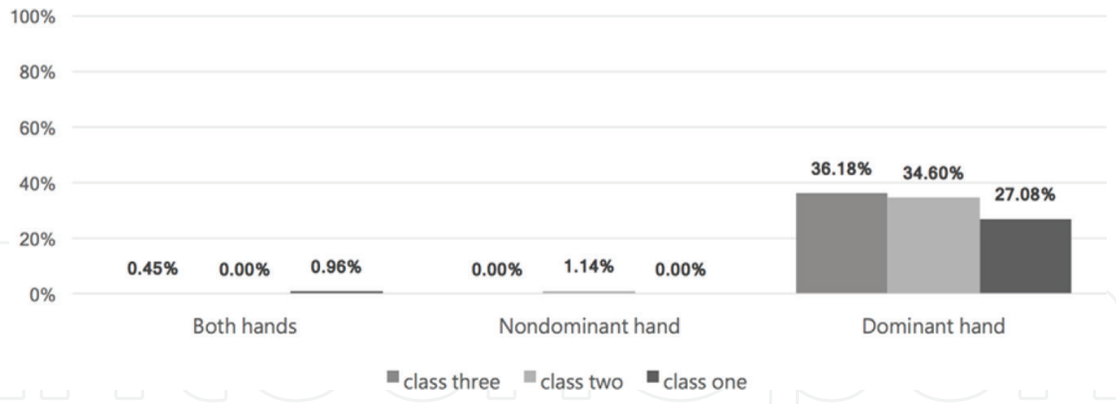


Figure 5. Behavior of tool use.

adopting a standing posture could result in these symptoms. In addition, **Figure 5** reveals considerable difference between the dominant and nondominant hand in the rate of tool use, indicating that the elderly did not use their two hands in turn for equal lengths of time. Even when engaged in bare hand operations, the elderly spent significantly longer on average operating with their dominant hand than with their nondominant hand or both hands.

There are more elders staring into space and resting behavior in class two. Even though class two has a longer duration, there is no increase in time between the interaction of plants and elders. Furthermore, elders in class two have at the highest, a 39.47% increase in time duration to observe others (**Figure 6**). The observation reveals that the unequal attention from instructors causes the unattended elders to look around at other elders in boredom.

The instructor in three horticulture classes pointed out that sedentary positions are more suitable for elders in gardening activities that prevent fatigue from stooping or repetitive movements. Only class two has three gardening platforms, providing more assistance during gardening. The operating platforms make it easier for elders to reach, which makes it a more suitable platform for elders to use. On the contrary, there is a high discrepancy between dominant and nondominant hand users in gardening work in class two. Moreover, observations of the three classes reveal that elders who use tools use their dominant hand 32.62% of the time more than their nondominant hand. Elders who use their bare hands use their dominant hand 17.31% of the time more than their nondominant hand. It is one point where the platform design can improve. We also know that elders more frequently use tools than bare hands to work with soil



Figure 6. Intensity of elder interaction in horticulture class.

and plants based on observation. This study also focuses on the design proposals of how users place gardening tools, to give an effect of horticulture activities.

Moreover, staring into space and resting behavior are the highest in class two. When instructors are unavailable to attend to an elder, this elder ends up staring into space because he/she is confused about next steps. Observations in class two also reveal that instructors, volunteers, and social workers on average spend the most time assisting elders. The purpose of these horticulture classes is for elders to achieve therapeutic effect through finishing class experiments on their own. Over-guidance from instructors or volunteers could decrease the opportunity for elders to work on their own. One of the 13 elders in class two had less attendance. Finally, the flower platform from class two with nine elders in the wheelchair, compared to the fixed flower beds at the center of the plaza, is associated with higher mobility which can easily accompany with other classes. Therefore, we should consider the different physical condition of elders and use the mobile floral platform as a base, as a template for future gardening design.

3.1. Horticultural flower bed design concerns and conditions

Three most common problems occurred in gardening work among the elders during the first observation:

1. Bad posture: inadequate tools encourage poor posture in elders, which offsets the therapeutic benefits of the classes. The tools they used affected many postures in classes.
2. Lack of interaction of classes: horticulture classes stimulate interactions between the elderly and also reduce the aging of body function. Staring-into-space and resting behaviors take up a large percentage of class interaction based on our observations. Sharing and helping interactions among elders should be a critical design criterion for a flower bed.
3. Uneven care among elders: many staff, other than the instructor, need to focus on the situation of all elders also, which increases the burden on them. Therefore, most of these horticultural classes arrange volunteers to help. However, an oversupply of volunteers will cause uneven care among the elders, and reduce their independence to work in gardening activities. A goal of flower bed design should be taken into account the volunteer-to-elder ratio and save manpower.

3.2. Concept drafts

Horticultural therapy courses were conducted in groups. Most flower beds available on the market could be used by multiple users. However, this study aimed to develop a flower bed featuring sufficient personal space and the ability to support multiple users, thereby enhancing a sense of exclusiveness in the users. From the starting point of user space, modularized separable designs were developed to meet the aforementioned requirements (**Figure 7**).

Eventually, a hexagonal design was adopted. A set of flower beds comprising six pieces was created and modularized. The advantage of hexagon-based modularization was that the comprising pieces could be assembled into various shapes in response to varying class requirements. During the design process, the researchers considered the possibility of future production and designed the flower beds to be self-assembly pieces for the convenience of those purchasing and using the products. Hence, all components were made from planks and

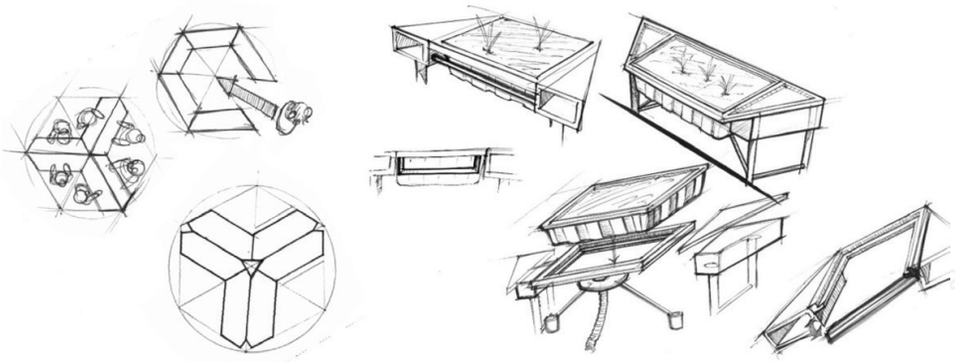


Figure 7. Development of design concepts.

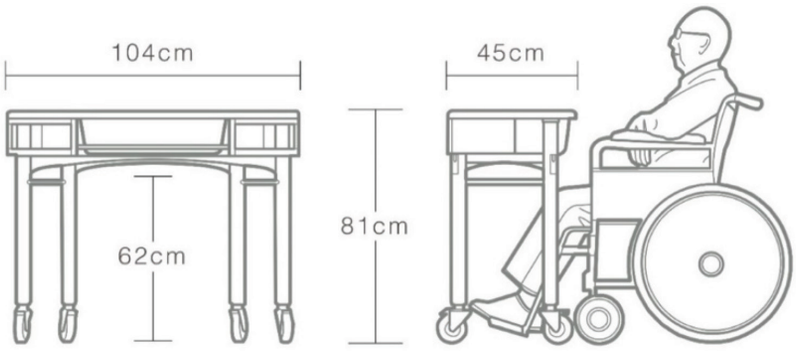


Figure 8. Flower bed dimensions.

tubes. To meet the requirements of various older users, the use of height of an ordinary elderly in the sitting and standing postures as well as that of the elderly in wheelchairs were considered. A 1:1 model was produced by measuring available wheelchairs on the market to obtain the most appropriate dimensions (**Figure 8**): 104 cm (l) × 45 cm (w) × 81 cm (h). Furthermore, the height under the table was set to 62 cm, to be compatible with the knee height of most the elderly in a sitting posture, and to allow wheelchairs to enter and exit easily.

In a satisfactory drainage system, flower bed design should be considered. The drainage system was first placed at the center of the table; however, experimental results indicated that the drainage effect was poor. Subsequently, a pipeless drainage system was designed, in which table beams were used as water channels to guide water to be discharged through table legs. With a pipeless design, water pipes or water pot damage caused by prolonged use could be prevented, and the space under the table could be effectively minimized to allow the elderly to enter and exit more easily. The soil pot that was readily available was Model-600 sealed pot, which could be used once it was pierced along the directions of the water channels, and furthermore, it could be replaced conveniently. Previous observations have suggested that approximately 15 items should be used in each gardening course session, including hoes, shovels, potted plants, and the elderly's personal belongings. Considering users' need for storage, operating platforms and drawers were added to both sides of the newly designed flower bed. The operating platforms were designed to be inclined surfaces with water drainage holes to facilitate water discharge. In

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addition, a round hole was designed on the top to place 5–7″ potted plants or hoes and shovels. Moreover, most of the elderly would hold on to the chair or the flower bed when standing or sitting. Therefore, iron bars were installed to surround the operating platform with raised edges for the elderly to hold on to. Multiple methods of flower bed arrangement were simulated to ensure the design was compatible with multiple course requirements. In addition to facilitating teaching, the operating platform served as a display platform after class to enhance the elderly's sense of connection with the plants they had planted. We have designed a new wooden flower bed based on all of the conditions and concerns on the sizing and interaction design factors. The flower bed is a trapezoidal desk, which allows everyone to gather around in a circle. We hope it is more convenient for the instructor to communicate with the elderly than before.

In addition, top pulleys were adopted for the casters, which featured a stamp-and-press switch to stop slippage, enable the flower beds to be arranged in class, and prevent flower bed movement when the elderly hold them for support. Because horticultural therapy classes are often implemented outdoors, all flower beds were finished with wood oils that were extracted from plants and exhibited UV-resistant and water-proof features. Subsequently, simple loading and drainage tests were conducted. A sealed pot containing approximately 30 liters of water was used in the loading test, and the results indicated that the flower bed remains stable both under normal use conditions and violent shaking. Furthermore, the drainage system was proved to be effective in leading the water to drain through the framework-turned-channels under the sealed pot to the sides of table legs to be discharged.

4. Discussions

This discussion takes the new design of the flower desk into the curriculum. The test group has a total of five participants, including four women, one man, where three of them are in wheelchairs. They sit equidistant from the teacher in a circle. The five new flower desks are arranged radially, with an opening for the instructor to freely walk in and out of it.

In the test group during the horticulture class, the elderly used the dominant hand 26.30% of the time, nondominant hand 17.58% and both hands 12.32% of the time (**Figure 9**). The test group has a much higher usage of hands in all three categories compared to the control group, especially in the nondominant hand category. The test group uses bare hands 56.21% of the class, which is much higher than the control group of 25.28%. Previous observations revealed that inappropriate flower bed dimensions can lead to a forward-leaning sitting posture. When the table top was too low, or when the elderly could not approach the flower bed with ease from their chair, they could not make effective use of the work table. However, the newly designed flower bed "Elder Green" may effectively prevent bad posture in its users. As a result, this new flower bed design stimulates both hand usage and balance in the elderly. From flipping soil to digging a hole to placing a seed to burying soil, all elders fulfilled the hand movement goals. It could be the design of "Elder Green" that allow elders to feel more intimate toward the product.

The total time that the test group spent using their dominant hands was 26.32% for tool use and 26.30% for bare hand operations. In contrast, time spent in the control group was 34.60%

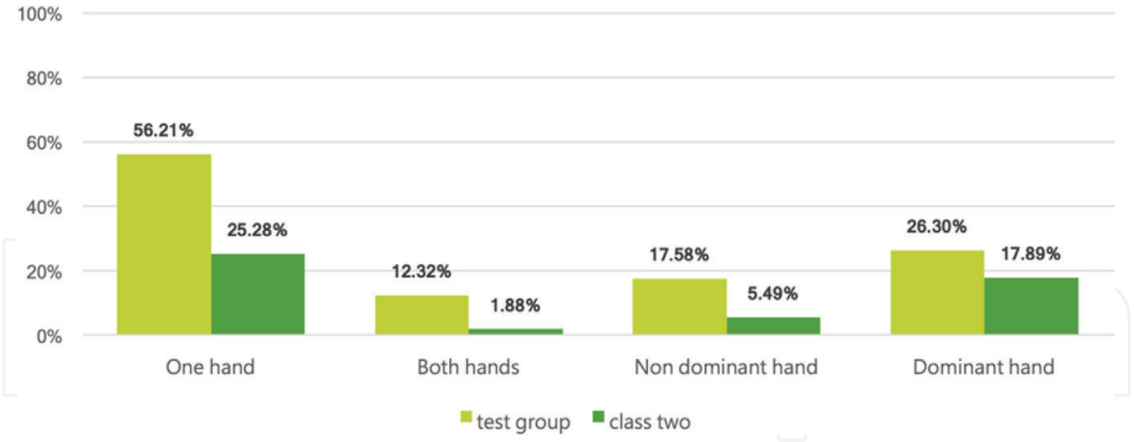


Figure 9. Average percentage of time working with bare hands.

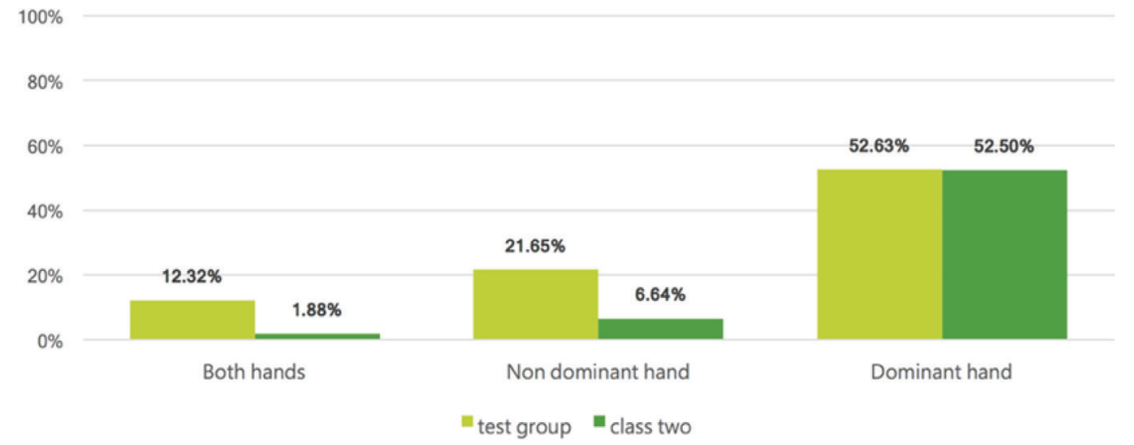


Figure 10. Average percentage of time working with tool-assisted and bare hands.

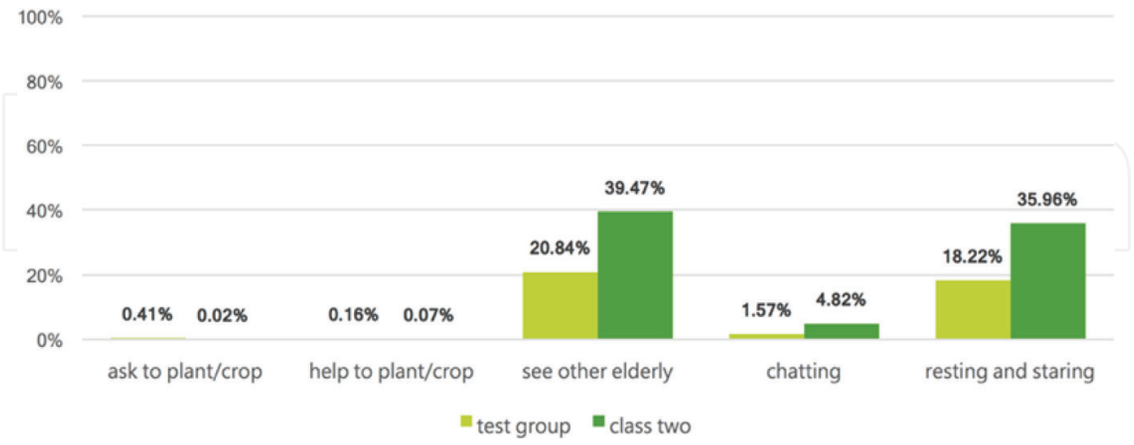


Figure 11. Interaction of the elders in class in percentage.

for tool use and 17.89% for bare hand operations (**Figure 10**). The results indicated that the elderly in the test group were involved in tool-assisted and bare hand operations more evenly. In addition, compared with the control group, the elderly in the test group had considerably higher percentages of dominant hand use and both hand use in terms of total time. Therefore, the newly designed flower bed was proved effective at enhancing the elderly's willingness to

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use the nondominant hand and both hands, thereby encouraging balanced exercise in both hands and enhancing the positive effects of horticultural therapy.

The percentage of time in the test group where the elderly spent staring into space or resting is 18.22%. It is significantly lower than that of the control group at 35.96% (**Figure 11**). The elders in the test group spent a lot more time on planting activities and less time being idle. We also observed that the elderly immersed in their tasks that were under only one instructor's supervision. This means that "Elder Green" causes participants to be more interested in the whole class.

4.1. A comparison between pre- and post-design behavior, factoring in the number of elders

The control group of class two has a total of 13 participants, accompanied by nine volunteers and one teacher (**Figure 12**). Based on the new and unique design function of the flower bed with professional garden therapist advisory, the user base of "Elder Green" is set at five, accompanied by one instructor.

4.2. A comparison of caregiving to elders between the pre- and post-design

The percentage of time where an elder gets verbal instruction in class is 7.19%, physical instruction is 6.46%, and the average time where instructor demonstrates for an elder is 57.4 s, 1.97% of class time (**Figure 13**). Compared to class two, volunteer demonstrations have decreased.



Figure 12. The relationship between the number of instructors and elders.

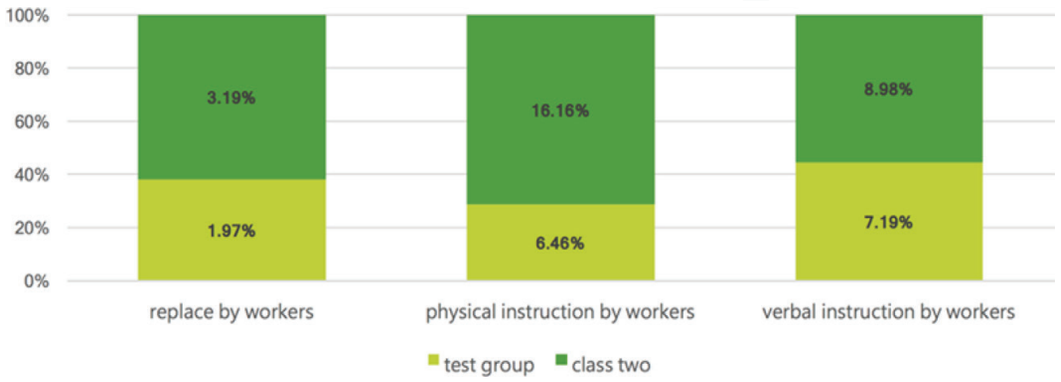


Figure 13. The percentage of time when an elder receives care.

Also, the elderly in the test group are much more enthusiastic about the curriculum, which reduces any distraction from other volunteers. The new design makes the elderly to get the therapeutic effect when working independently as same as the goal of horticultural classes. Implementation of "Elder Green" in the new curriculum will have positive effect on horticultural activities.

4.3. Comparison of pre- and post-design, factoring workers to elder interaction

The attention on all the elderly residents was unequal even though there were 13 elders and 9 volunteers in the control group of class two (**Figure 14**). On the contrary, there is only one instructor for every five elders, the elders of test group have more even guidance and care from one instructor (**Figure 15**). The test group had a much better experience than the control group in increased mental stimulation and physical exercise. This reveals how the instructor-centric class mode of "Elder Green" works. "Elder Green" helps the elders with fewer instructors and volunteers, conducting a quality fulfilling class more than creating a balance of instruction to each student.

In the test group, the elderly achieved higher amounts of exercise in a more balanced manner. The percentage of time involved in bare hand operations was higher than that spent on tool use. During the classes, the horticultural therapist encouraged the elderly to touch the soil often with their hands, and even smell the soil to increase tactile and olfactory sensory stimulation. Because

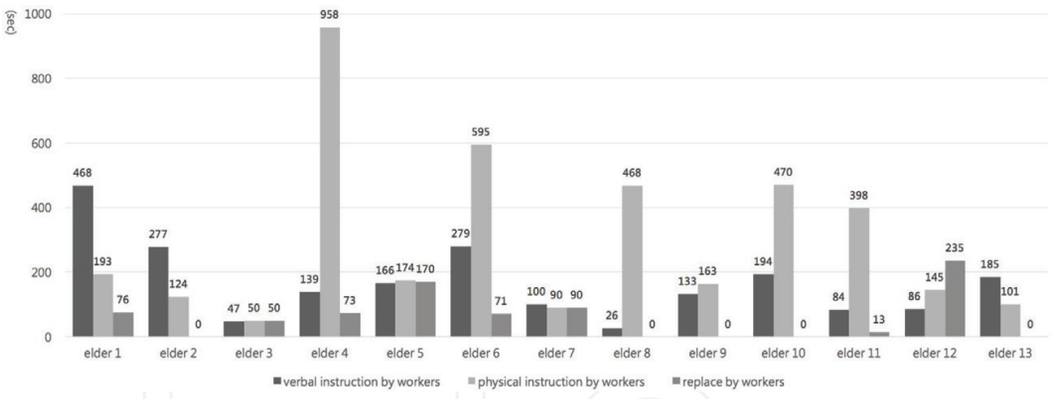


Figure 14. Relationship of class two (control group) between workers and elders.



Figure 15. Relationship of the test group between workers and elders.

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the dimensions of Elder Green were more suitable for the elderly, and because it featured individual operating platforms, the elderly could engage in planting more easily, which enhanced their willingness to use bare hands. In addition to encouraging the elderly to use both hands evenly, Elder Green enabled the horticultural therapist to provide equal attention to each older adult because of its radial arrangement when in teaching mode. Moreover, the arrangement elevated the elderly's perceived respect from others during the activities. The results indicated that idle time for the elderly in the test group decreased and mutual assistance increased. Again, this showed that higher enthusiasm in the elderly promotes the effects of horticultural therapy. Overall, this teaching style can enable institutions to provide quality gardening courses with less manpower.

5. Conclusions

The horticultural therapist can stand at the center of the radial flower beds to interact with the elderly during gardening courses. This study adopted universal design; both the elderly who were wheelchair users and nonwheelchair users could sit by the side of the flower bed. The flower bed was primarily made of wood, the pattern and color of which conveyed comfort and warmth to the elderly. After completing the gardening course, the flower bed naturally became a display shelf showcasing the planting results (**Figure 16**). The Elder Green flower bed helped every older adult focus on the course contents. It mitigated the problem of forward-leaning sitting postures commonly observed in users of existing products by improving flower bed dimensions; moreover, even the elderly in wheelchairs could approach the flower bed at a proper distance to effectively use the work table and reach the depth of the flower bed at ease, rendering gardening activities easier. In previous observations, marked differences were observed between the percentage of time the elderly spent using their dominant hand and using their nondominant hand. However, with the Elder Green flower bed, the elderly' physical activity conducted with both hands holding objects was substantially elevated, and they used their nondominant hand more frequently to accomplish the movements required in the class instead of simply using the same hand repetitively. Therefore, the Elder Green flower bed created more opportunities for physical activity among the elderly by effectively guiding them in spreading their strength to both hands (**Figure 17**).



Figure 16. Different type of "Elder Green" arrangements.



Figure 17. Actual situations of the elderly holding objects, using tools, and interactions between them and the teacher.

Observations on the bare hand operations of the elderly using Elder Green revealed notable increases in the average time of dominant hand, nondominant hand, and both hand usage compared with those observed with conventional methods. This finding indicated that the elderly became more active in bare hand operations, which enabled them to receive more comprehensive hand motor training. The individual seat attached to each Elder Green flower bed provided each participating older adult with an exclusive operating platform, enhancing their subsequent willingness to care for the plant and generating a sense of connection with the plant. In addition, this study noted that after Elder Green was introduced, the elderly were more enthusiastically involved in the tasks assigned by the teacher in class, which reduced distraction caused by boredom. Overall, the combination of a tight class tempo and concentrated movements rendered the gardening course fruitful; moreover, after Elder Green was adopted, the elderly spent more time helping each other. This indicated that the new teaching method inspired by Elder Green encourages mutual assistance and collaboration in a group of the elderly, and can adequately achieve the effects that horticultural therapy is expected to exert on the elderly. Using this method, the elderly have greater opportunities to complete gardening operations independently during horticultural therapy. Although the five elderly participants in the test group were only cared for by a horticulture teacher, the course proceeded successfully and they received relatively equal attention. This method allows organizing a quality horticultural therapy course with less manpower, and is likely to promote the willingness of related institutions to organize such courses. The flower bed of "Elder Green" allows soil depth of at least 15 cm. The height of the space under the desk is set at 62 cm which is a one-size-fits-all for elders of different heights and wheelchair users. The specification for the different basin choices are available in the market which makes future replacements easier (**Figure 13**). Users can arrange "Elder Green" in different forms according to the number of participants and the purpose of the horticulture class. Users also arrange flower beds in different shapes as the number of desks increase. "Elder Green" desks are mostly made out of wood. The protective wooden oil creates a warm and moist feeling when touching the wooden desk. Users can place the tools such as a hoe, shovel, plant, etc. on top of the desk or in the built-in drawer, which allows an elder to work seamlessly. Besides, an elder can use the desk of "Elder Green" as a hand-holder when sitting down or standing up for class. The installed wheel can make moving arrangements easier on the desk, and wheel lock also prevents the flower basin from shifting around.

The "Elder Green" flower beds have the potential to improve in many aspects. Studies support that individuals with cancer and chronic disease also benefit from therapeutic use of activities such as gardening, which helps the individual in terms of strengthening his/her bonds with life [19, 21]. Thus, different types of wooden patterns and the color of the flower basin are examples of customization which can meet the different requirements by design. Also, how different horticultural class curriculums combined with different medical aids are worthy of investigation for the future.

Author details

Meng-Cong Zheng

Address all correspondence to: zmcdesign@gmail.com

Department of Industrial Design, National Taipei University of Technology, Taiwan

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