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Eyeful garden bell - garden structure developed to stimulate auditory senses in visually impaired

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Abstract
The aim of the study is to develop a garden structure to stimulate the audio and tactile senses for visually impaired children. The study was conducted in three phases, a preliminary study was conducted in order to develop the structure planning and designing of the structure was carried out based on the preliminary design. The structure named eyeful Garden Bell was designed and developed based on the audio and tactile elements. The feasibility and acceptability of the developed product was carried out in a sample of 20 visually impaired children of the age group 10 to 15 years. Questionnaire cum interview schedule method was used to assess the feasibility of the structure. It was reported that the structures stimulated their audio and tactile senses, which in turn contributes to a sense of peacefulness experienced by the participants. Therefore, the developed garden structure is recommended for installation in horticulture therapy garden.

Keywords: Visually impaired, horticultural therapy, garden structure, sensory garden, auditory stimuli, tactile sense, disabilities, nature, well-being

1. Introduction
Sensory activities can improve well-being by engaging our senses. Visually impaired individuals rely on auditory and tactile stimuli for spatial orientation. Tactile stimulation is essential for emotional experiences and stress reduction. Auditory stimulation can also improve mood, and combining both senses can be more effective. Sensory gardens are designed to stimulate all senses and are beneficial for children and adults with sensory processing issues. Gardens should be tailored to the intended audience and feature elements such as color, sound, scent, taste, and texture. Sound is a feature of sensory garden that creates calming environment. Manmade additions such as wind chimes, water fountains add sounds to the garden which helps to explore their senses. A study was conducted to develop a garden structure that stimulates the auditory and tactile senses of visually impaired children and assess its feasibility and acceptability.

2. Literature Survey
Research suggests that sound, including music, can have a significant impact on our body and senses, going beyond just auditory pleasure (Eidsheim, 2015; Basner et al., 2014; Juslin and Vastfjall, 2008) [3, 2, 6]. Blind individuals, who rely heavily on auditory stimuli for spatial orientation, develop impressive hearing skills and haptic perceptual representations (Al-Saif et al., 2017; Sabourin et al., 2022) [1, 9]. Additionally, sensory gardens designed with safety standards, environment, access, activities, and color in mind can provide benefits to visually impaired individuals (Winterbottom and Wagenfeld, 2015) [11]. Devices such as shishi-odoshi and suikinkutsu can provide unique auditory experiences (Fowler, 2015; Cerwen, 2020) [7, 4] while tactile toys can improve sensory exploration and therapy (Hong, 2018) [5].

3. Methodology
The study aimed to develop and assess the feasibility and acceptability of a garden structure called "Eyeful Garden Bell" designed for visually impaired children. The study consisted of three phases: preliminary study, planning and designing of the structure, and feasibility and acceptability study. A preliminary study was conducted with 20 visually impaired children from a government school for the visually impaired to gather their opinions on horticulture therapy and their requirements. Based on the findings, a garden structure was planned and

designed to incorporate audio and tactile elements. The prototype of the structure was tested and refined based on feedback from visually impaired children and experts. The feasibility and acceptability study were conducted with a sample of 20 visually impaired children aged between 10-15 years. The children were allowed to use the structure for 5-10 minutes, and their feedback was gathered through a questionnaire. The data analysis process involved transcribing the data into written form, organizing it into manageable chunks, and studying each response in a detailed manner to understand the feasibility of the structure by the visually impaired children.

4. Results and Discussions

The result of the study entitled ‘Feasibility and acceptability study of Developed Garden structure for the visually impaired children’ is presented in this chapter under the following headings.

4.1 Developed Eyeful Garden bell structure

The Eyeful Garden Bell is a structure designed for visually impaired individuals to provide both audio and tactile stimulation. The design resembles a see-saw and produces tinkle sounds with back-and-forth movement. Plants for a vertical garden are added to the sides. Similarly, Tangible Music Programming Blocks for Visually Impaired Children teach programming concepts through music creation, providing sensory stimulation through touch and sound (Sabuncuoglu, 2020) [10]. Both tools offer a hands-on approach for visually impaired students to develop their audio and tactile senses. The Eyeful Garden Bell promotes horticultural therapy, making sensory stimulation accessible in a unique and affordable way (Figure 4)

4.2 Feasibility of the garden structure by the visually impaired children

The results of the feasibility study showed that out of the 20 visually impaired students, 13 preferred the colliding sound of the garden bell, 2 preferred the sliding sound, and 5 liked both sounds. Among the partially visually impaired students, 6 preferred the colliding sound, 1 preferred the sliding sound, and 5 preferred both sounds. Among the fully visually impaired students, 7 preferred the colliding sound and 1 preferred the sliding sound. No fully visually impaired student preferred both sounds (Figure 1).

When asked to predict the material inside the garden bell based on the sound, 7 students answered coins, 7 answered stones, 3 answered bangles, 1 answered steel, 1 answered either coins or stones, and 1 couldn't predict. Among the partially visually impaired students, 5 answered coins, 4 answered stones, 1 answered steel, 1 answered either coins or stones, and 1 couldn't predict. Among the fully visually impaired students, 3 answered bangles, 3 answered stones, and 2 answered coins (Figure 2).

Out of the 20 visually impaired students who participated, all reported feeling happy while listening to the sound, indicating a uniformly positive response. No reports of negative or neutral emotions were recorded, suggesting that the sound of eyeful garden bell was well received by the students.

The touch experiment involved visually impaired students touching the outer part of a garden bell coated with coconut fiber rope, and then were asked to identify the material they were touching. The findings revealed that partially visually impaired students were more accurate in their identification of the material, with 8 out of 12 students correctly identifying it as coconut fiber rope. Among fully blind students, 2 out of 8 were able to correctly identify the material, while others misidentified it as wood or thorn (Figure 3).

The findings of this study highlighted the importance of sound in shaping the experience of visually impaired individuals. The preference for colliding sounds over sliding sounds among both partially and fully visually impaired students suggested that the sensation of sound played a significant role in their perception of the environment. The results also showed that there was a diverse range of responses when it came to predicting the material inside the garden bell based on the sound. The variety of answers suggested that the interpretation of sound was subjective and influenced by a range of factors such as prior experiences, personal preferences, and individual differences.

The higher number of partially visually impaired students who preferred both colliding and sliding sounds, compared to fully visually impaired students, suggested that partial vision affected the interpretation of sound. It is possible that the partial vision of these students allows them to better perceive the source of the sound and therefore differentiate between the colliding and sliding sounds. On the other hand, the fully visually impaired students, who rely solely on their sense of hearing, may have a more limited understanding of the source of the sound and therefore preferred a single type of sound. The differences in the answers given by fully visually impaired students when predicting the material inside the garden bell is interesting. The presence of the unique answer "bangles" only among fully visually impaired students suggested that they had a different perception of sound and were able to distinguish between sounds in a different way than partially visually impaired students. This could be due to their reliance on sound as their primary means of experiencing the environment, which leads to a heightened sensitivity to sound. The fewer number of fully visually impaired students who answered "coins" compared to partially visually impaired students may have indicated that fully visually impaired individuals have a different interpretation of the sound of coins compared to partially visually impaired individuals.

The additional findings of the touch experiment suggest that visually impaired individuals rely on their sense of touch to identify and understand the properties of objects in their environment. The ability of some partially and fully visually impaired students to accurately identify the material of the garden bell outer coating as coconut fiber rope through touch alone is noteworthy. It highlighted the enhanced sensitivity and discrimination of tactile information among some visually impaired individuals.

The difference in the responses of partially and fully visually impaired students regarding the identification of the material through touch may have been due to their varying degrees of tactile acuity. Partially visually impaired students may have retained some degree of tactile sensitivity due to their residual vision, allowing them to make more precise judgments about the material. On the other hand, fully visually impaired individuals may rely solely on their sense of touch, leading to a greater reliance on haptic exploration and a more exploratory approach to understanding the properties of objects.

The fact that some fully visually impaired students in the study misidentified the material as wood or thorn suggested that some fully visually impaired individuals may have a more limited understanding of the properties of objects through touch alone. This may be due to a range of factors, such as the complexity of the object, lack of prior exposure to the material, or the individual's degree of tactile sensitivity.

The role of sound and touch in shaping the experiences of visually impaired individuals is crucial. However, various factors like individual differences, past experiences, and subjective factors may influence the interpretation of sensory information. Enhancing the sensory experiences of visually impaired individuals and understanding the factors that impact touch and sound interpretation requires continued investigation.

Overall, the combined findings of the sound and touch experiments highlighted the importance of sensory experience in shaping the experiences of blind individuals and suggested the need for greater understanding and attention to sensory modalities in the design of environments and products for the blind.

The feasibility and acceptability of the Eyeful Garden Bell were evaluated using a questionnaire and interview schedule method. The findings were consistent with the tangible math game that also utilized audio and tactile elements to stimulate sensory learning in visually impaired students. Similar to the Eyeful Garden Bell, the tangible math game was designed to provide a multisensory learning experience to visually impaired students. The game utilized audio and tactile elements to enable visually impaired children to differentiate between shapes and enhance their problem-solving skills (Pires *et al.*, 2019) [8].

Overall, the findings of the Eyeful Garden Bell study are consistent with the findings of the tangible math game study. Both studies demonstrated that utilizing multisensory learning tools can be effective in stimulating the audio and tactile senses of visually impaired students, and improving their learning experience. Therefore, the Eyeful Garden Bell can be recommended for installation in horticulture therapy gardens to promote multisensory learning and enhance the sensory experience of visually impaired students.

Sound liked in the Garden Bell	Number of Students
Colliding	13
Sliding	2
Both Colliding and Sliding	5

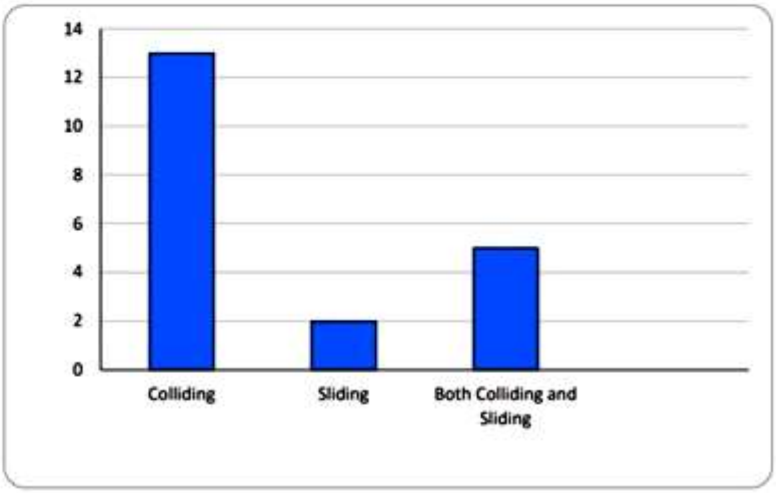

Fig 1: Response by the visually impaired children in the sounds of the garden bell

Prediction of material used Inside Garden Bell	Number of Students
Bangles	3
Coins	7
Couldn't predict	1
Steel	1
Stones	7
Stones/Coins	1

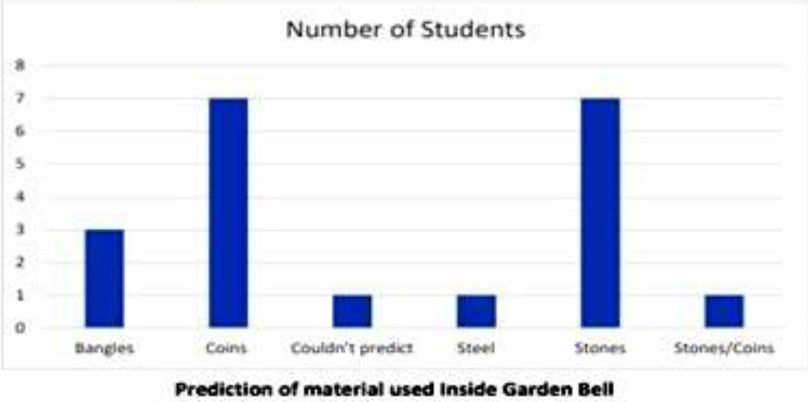

Fig 2: Prediction of material used inside the garden bell by the visually impaired children

Tactile Predicted Material	Number of Students
Rope	4
Wood	2
Thorn	4
Coconut Fibre Rope	10

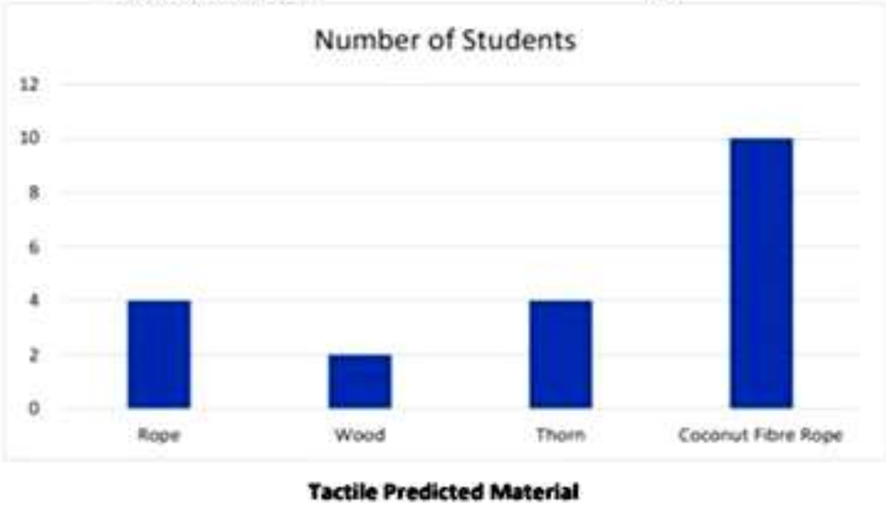

Fig 3: Tactile prediction material used around the garden bell by the visually impaired children

Fig 4: Eyeful garden bell

5. Conclusion

The study developed a garden structure named the Eyeful Garden Bell to stimulate auditory and tactile senses of visually impaired children. The structure resembles a see-saw producing tinkle sounds, covered with coconut fiber rope for touch sensing. Colliding sound was more prominent in stimulating auditory senses of visually impaired and partial visually impaired students demonstrating greater accuracy in identifying the material through touch. The study highlights the significance of sensory experiences in promoting inclusivity and engagement for visually impaired children.

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