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Development of an Orientation and Mobility Simulation Room for Visually Impaired Children to Prepare for Mobility in Real-World Environments

Lynca Mutiara Sukamto, Anane Nasticta D. I , Dewi Iftitah Sari, Fiki Luthfatunnisa, Wiwik Dwi Hastuti*, Muya Barida

State University of Malang, Jl. Semarang No. 5 Malang, East Java, Indonesia

*Author of correspondence, Email: wiwik.dwi.fip@um.ac.id

Abstract

Conventional orientation and mobility (OM) training for visually impaired children often takes place directly in high-risk public areas, whereas existing aids—such as static tactile maps or VR simulators—fail to integrate the kinesthetic and haptic feedback derived from cane tapping and foot contact. This study aims to synthesize concepts regarding adaptive OM simulation spaces, identify effective physical replication components, and formulate theoretical recommendations for special education practitioners. A systematic literature review design adhering to PRISMA protocols was employed. Literature searches were conducted across Scopus, SINTA, Google Scholar, and Portal Garuda databases covering the period from 2016 to 2026. Data analysis utilized Braun & Clarke's six-phase thematic analysis method. The findings indicate that OM simulation spaces must integrate three key components: haptic elements (tactile paving, texture variations, inclines, and declines), auditory elements (environmental sound sources and sound reflections), and kinesthetic elements (elevation changes and path width variations). The study concludes that adaptive OM simulation spaces serve as an effective intermediary environment between classroom instruction and high-risk real-world settings. Recommendations encompass minimum simulation space components, phased usage procedures, and integrated evaluation methods.

Keywords: Orientation; Mobility; Visually Impaired; Simulation Room

1. Introduction

Orientation and mobility (OM) skills are crucial for visually impaired children to live independently and integrate successfully into society. However, field experience shows that conventional OM training in Special Education Schools (SLB) is often conducted directly in high-risk public areas, which can trigger psychological anxiety in children due to unexpected stimuli such as traffic flow or drastic changes in road contours (Pradipta et al., 2023; Sari & Handayani, 2022). In contrast, previous research has only addressed the reinforcement of small-scale cognitive maps using static tactile models (Nugroho, 2021) or the development of spatial-audio-based VR simulators. Unfortunately, the kinesthetic and haptic feedback from tapping a cane and feeling the ground with one's feet have been overlooked (Wibowo & Lestari, 2024). Due to the functional limitations of these various media, comprehensive research is needed on the concept of a controlled physical simulation space as an intermediate environment that sensorially mimics the real-world school environment. This article aims to synthesize ideas regarding the creation of an adaptive OM simulation space, identify effective physical replication components, and provide theoretical recommendations for special education practitioners (PLB) in establishing a safe mobility laboratory before visually impaired children are transitioned to complex real-world environments.

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2. Method

The approach used in this study was qualitative, employing a systematic literature review design. The data collection procedure followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol developed by Page et al. (2021). This protocol outlines four stages: identification, screening, eligibility assessment, and inclusion. The literature search was conducted in the Scopus, SINTA, Google Scholar, and Portal Garuda databases using the following keywords: "orientation and mobility for the visually impaired," "simulation room," "OM learning media," "multisensory approach," and their English equivalents. The publication range was limited to 2016–2026. Inclusion criteria included: (1) addressing orientation and mobility for visually impaired children, (2) addressing at least one component of physical replication (haptic, auditory, or kinesthetic), (3) availability of the full text, and (4) clear research methods.

Data analysis employed the six-stage thematic analysis framework by Braun & Clarke (2021), comprising: data familiarization, initial coding, theme identification, theme review, theme definition, and report writing (Rahmawati & Kurniawan, 2022). Data reduction was conducted through categorization and data extraction into a form containing the literature's identity, methods, level, measured variables, and research results. Data validity was ensured through source triangulation, an audit trail of the process documentation, and the presentation of direct quotations from the literature (Moleong, 2017; Sugiyono, 2019). The final stage of the research involved an integrative synthesis to produce a conceptual framework for an adaptive OM simulation space and theoretical recommendations for special education practitioners.

3. Results and Discussion

3.1 Result

An analysis of 10 articles describing the development of orientation and mobility simulation spaces for visually impaired children to prepare them for mobility in real-world environments is presented in Table 1.

Table 1. Synthesis Analysis of Literature Search

No	Researcher and Year	Study Title	Research Method	Level	Variables Measured	Research Findings
1.	Heryati, E., Rochyadi, E., Aprilia, I. D., Homdijah, O. S.,	Improving Orientation and Mobility Skills in Visually	This study employed a quantitative approach using a one-group	The study subjects were 7 young children with visual	Orientation and mobility (O&M) skills, which include sensory skills, conceptual	Research shows that a modified game of hide-and-seek has a positive effect on improving the orientation and

	Tarsidi, I., & Handayani, R. (2023). DOI : https://doi.org/10.31004/obsesi.v7i2.4172	Impaired Early Childhood Children through a Modified Game of Hide-and-Seek. Jurnal Obsesi: Journal of Early Childhood Education, 7(2), 2361–2372	pretest-posttest design. Data were collected through pretest and posttest assessments of orientation and mobility (O&M) skills before and after the intervention, which consisted of six sessions of a modified game of hide-and-seek . Data analysis utilized the Wilcoxon matched-pairs test.	impairments (ages 5–6 years), consisting of 3 girls and 4 boys at the Bandung Integrated Low Vision and MDVI Service Center	development, and mobility skills, such as sound discrimination, spatial orientation, trailing, and landmarks.	mobility skills of visually impaired children. The average score increased from 59.26 (pretest) to 75.09 (posttest). These findings indicate that game-based activities can help improve spatial orientation, confidence in movement, sensory skills, and mobility in visually impaired children.
2.	Herlambang, E. P., & Suteja, M. S. (2023). DOI : https://doi.org/10.249	Design of Training and Recreational Facilities for the Visually Impaired Using a Sensory Approach. STUPA	Behavioral and narrative methods; data collection techniques through documents and direct	Visually impaired children aged 0–17 years, their families, and the general public Visually	The spatial and mobility needs of the visually impaired; the use of the senses of touch, hearing, smell, and	The development of inclusive programs and activities enables visually impaired individuals, their families, and the community to interact in a single activity. The application of empathetic architecture

	12/stupa.v5i2.24315	Journal, 5(2), 1765–1778	observation of the visually impaired	impaired children aged 0–17 years, their families, and the general public	residual vision (low vision); as well as factors influencing children's social attitudes.	through sensory design (lighting, textures, scents, and spatial layout) helps visually impaired individuals recognize their environment and facilitates their mobility. These facilities also support the development of interests and talents, socialization, and provide care assistance for families.
3.	Rachman, M., Kasmawati, & Zulfitrah (2024) DOI : https://doi.org/10.70217/jmp.v2i3.202	Improving Landmark Mastery through Orientation and Mobility Training for Third-Grade Visually Impaired Students at SLB A YAPTI. Journal of Metafora Pendidikan, 2(3), 16–29	Descriptive qualitative study using a case study approach; data collection techniques: participant observation unstructured interviews, and documentation.	Third-grade visually impaired students (aged approximately 8–9 years) at SLB A YAPTI In Makassar	Mastery of landmarks (environmental objects/features used as reference points) as well as orientation and mobility training (walking techniques with a companion , independent walking, and long-cane techniques).	Consistent orientation and mobility training (covering environmental familiarization, navigation techniques, the use of assistive devices such as canes, and the use of the senses of hearing, touch, and smell) has been shown to improve the ability to master landmarks among third-grade visually impaired students. Students become more independent, confident, and able to move around safely and recognize spaces within the school environment.
4.	Rena, M. M., Zara, M., & Maulida, A.	POMATE: A Mobility Orientation	Literature review; data collection	Young children who are	Development of a mobility orientation	POMATE can be used as a physical and motor learning tool for

	(2021) DOI : https://jurnalstitmaa.org/index.php/alasma/article/view/52	Game for Visually Impaired Children. Alasma: Journal of Scientific Information and Communication Media, 3(1), 47–55	through various relevant literature and research	visually impaired (ages 5–8, with a focus on 5–6-year-olds).	game (POMATE) to support the physical and motor skills of visually impaired children.	visually impaired children. This game requires only a minimal amount of space (3x4 meters), is economical, safe, and easy to make from recycled materials. This tool can also foster various aspects of early childhood development and can be implemented in inclusive educational institutions or special education schools (SLB).
5.	Isnan, J., & Benardi, A. I. (2024) DOI: https://doi.org/10.15294/a8vttz06	Improving Readiness Among Visually Impaired Students Using the EVAROM-NET Medium at State Special Education School 1 Sleman	Research and Development (R&D) with a Qualitative Approach	Visually Impaired Students at State Special School No. 1 Sleman	Spatial Awareness & Evacuation Preparedness	EVAROM-NET effectively improves spatial awareness, but is not sufficient as the sole medium
6.	Prastika, H. D., Sadiya, H. I., Sholehah, F. L., Rahmawati, N., Safitri, S., & Rofiki, I. (2025).	The “Build Your World” Program: Improving Spatial Skills of Visually Impaired Students	(Plan, Do, Check, Act) Using a Quantitative Approach	Visually impaired students at the Kedungkandang State Special Education School (SLB ABD)	Spatial understanding and basic mobility orientation skills through map-based learning materials	Spatial understanding improved from 4% to 64% through Deko Edu; spatial skills improved from 15% to 70% through Deko Action. Positive impacts include mastery of routes, locations, distances, and

	https://doi.org/10.18860/jrce.v6i2.31691	Through the PDCA (Plan, Do, Check, Act) Map-Based Learning Medium				mobility independence.
7.	Praditya, N. K. (2024). https://doi.org/10.51169/ideguru.v10i1.1594	"Si Mama" as an Interactive Learning Medium for Social Mobility and Communication Orientation (OMSK) to Enhance the Independence of Visually Impaired Students	R&D (development of interactive media)	Five visually impaired ninth-grade students at State Special Education School (SLB) 1 Bantul. All students are totally blind and have varying levels of independence.	Independence through the OMSK interactive learning medium	The “Si Mama” (Let’s Map the Direction) media was developed for teaching orientation, mobility, and social communication to the visually impaired
8.	Khalaila, A., Everette, G., Kim, S., & Roy, I. (2025). DOI: https://doi.org/10.1145/3706599.3719897	StreetScape: Gamified Tactile Interactions for Collaborative Learning and Play	Iterative Design and Prototyping (ACM CHI 2025)	Visually impaired children aged 6–10	Development of a modular 3D tactile map for collaborative spatial learning	StreetScape is a tactile street puzzle featuring 3D-printed modular tiles, textured paths, and decorative elements. No existing tool integrates gamification and collaboration into the “ ” for visually impaired children. Existing tools focus solely on individual navigation

9.	Façanha, A. R., Júnior, J. M. L. de M., Araújo, M. da C. C., dos Santos, J., Sánchez, J., & Viana, W. (2024). (Vol. 14750, pp. 436–443) https://doi.org/10.1007/978-3-031-62846-7_52	Empowering Orientation and Mobility Instructors: Digital Tools for Enhancing Navigation Skills in People Who Are Blind. In Computers Helping People with Special Needs (ICCHP 2024)	Mixed-method (quantitative & qualitative evaluation)	10 people who are blind (PWB). Age range not specified	Map editor and audio-haptic OM training environment for mobile devices	The audio-haptic OM training environment allows instructors to create custom maps. It significantly helps people who are blind create mental maps. The audio-haptic feedback still needs improvement
10.	Kaplan, H., & Pyayt, A. (2024). , 4(1), 64-78. https://doi.org/10.3390/disabilities4010005	Fully Digital Audio Haptic Maps for Individuals with Blindness	*User testing (quantitative)*	13 people with blindness; specific ages not specified	Audio-haptic map creator application using an Xbox gamepad as a controller	Easy to use, efficiently conveys route information and landmarks that are easily understood by people with blindness.

The literature we reviewed focuses entirely on assistive devices or simple games, rather than on physical simulation spaces that replicate real-world environments. No research has yet developed the concept of a controlled physical simulation space whose configuration can be reconfigured to mimic various real-world environmental conditions. Thus, this study is novel because it seeks to fill this gap through a systematic literature review that yields a conceptual framework and theoretical recommendations.

The Concept of Orientation and Mobility Simulation Spaces for Visually Impaired Children The results of the literature review indicate that orientation and mobility are essential skills for visually impaired children to recognize their environment, determine direction, and

move safely and independently. Orientation and mobility programs focus not only on walking skills but also on the ability to understand spatial concepts, identify obstacles, and use sensory cues such as hearing, touch, and spatial memory. Visually impaired children require structured learning experiences to adapt more effectively to real-world environments.

Various studies confirm that orientation and mobility training provided through hands-on practice in real-world environments often faces limitations, particularly regarding safety and the child's readiness. Therefore, a simulation space is needed as an initial training environment that allows visually impaired children to learn to recognize environmental patterns under more controlled conditions. Simulation spaces can be designed to resemble real-world conditions, such as sidewalks, entrances, stairs, different floor surfaces, and specific obstacles commonly encountered in everyday environments.

A literature review indicates that the use of simulation spaces can help improve environmental adaptation skills in visually impaired children. A systematically arranged environment allows children to gain exploratory experiences without high risk. In the context of special education, simulation also provides teachers with the opportunity to conduct step-by-step learning, ranging from directional awareness and object orientation to independent mobility training.

3.2 Discussion

3.2.1 Components of Orientation and Mobility Simulation Space Development

A review of various sources indicates that the development of orientation and mobility simulation spaces must consider several key components: safety, accessibility, environmental realism, and sensory stimulation. Safety is the top priority, as visually impaired children require a space free from the risk of injury during training. The use of safe materials, clearly defined space boundaries, and varied floor textures are essential elements in supporting the learning process.

In addition to safety, accessibility is also a critical factor. The simulation space must allow children to move independently with the aid of mobility aids such as a white cane. Training paths should be designed to mimic real-world conditions, such as curves, changes in road texture, narrow areas, and even simple crossing simulations. This is intended to ensure that the skills acquired during simulation can be transferred to everyday life situations.

From the perspective of sensory stimulation, the literature indicates that visually impaired children rely more on their senses of hearing and touch to perceive their environment. Therefore, the simulation room should provide auditory and tactile stimuli, such as specific sound sources to indicate direction or different floor textures to indicate position. Such multisensory stimulation has been shown to aid in the formation of mental maps of the environment in visually impaired children.

3.2.2 The Role of Simulation Rooms in Preparing for Mobility in Real-World Environments

Based on a review of the literature, simulation rooms serve an important function as a bridge between learning in school and the application of mobility skills in real-world environments. Visually impaired children who receive training in a simulated environment tend to be better prepared to handle actual situations because they have previously gained experience in recognizing spatial patterns and potential obstacles.

Simulation rooms also contribute to boosting children's self-confidence. Psychological readiness is a key factor in independent mobility, as fear of environmental obstacles often leads visually impaired children to rely on others. Through repeated practice in simulation rooms, children can develop courage, decision-making skills, and problem-solving strategies when encountering obstacles.

Findings from various studies indicate that simulation-based orientation and mobility learning approaches are effective in enhancing the independence of visually impaired children. This aligns with the goals of inclusive education, which emphasizes the development of independent living skills as a foundation for social participation in the community. Therefore, the development of orientation and mobility simulation spaces can serve as an innovative alternative that supports the readiness of visually impaired children before they encounter real-world environmental conditions.

3.2.3 Implications of Developing Simulation Spaces for the Education of Visually Impaired Children

The results of this study indicate that the development of orientation and mobility simulation spaces can serve as a strategic tool in the education of visually impaired children. Special education schools and inclusive educational institutions should consider providing such facilities as part of life skills instruction. The presence of simulation spaces not only supports the learning process but also assists teachers in conducting ongoing assessments of students' mobility skill development.

Furthermore, the development of simulation rooms can serve as a form of adapting the learning environment to be more responsive to the needs of visually impaired children. Collaboration among special education teachers, orientation and mobility therapists, and educational facility developers is essential to ensure that the designed simulation rooms truly align with the specific needs of students. The Concept of Orientation and Mobility Simulation Rooms for Visually Impaired Children.

A review of the literature indicates that orientation and mobility are essential skills for visually impaired children to recognize their environment, determine direction, and move safely and independently. Orientation and mobility programs do not focus solely on

walking skills but also encompass the ability to understand spatial concepts, identify obstacles, and use sensory cues such as hearing, touch, and spatial memory. Visually impaired children require structured learning experiences to adapt more effectively to real-world environments.

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A literature review indicates that the use of simulation spaces can help improve environmental adaptation skills in visually impaired children. A systematically arranged environment allows children to gain exploratory experiences without high risk. In the context of special education, simulation also provides teachers with the opportunity to conduct step-by-step learning, ranging from directional awareness and object positioning to independent mobility training.

3.2.4 Components of Orientation and Mobility Simulation Space Development

A review of various sources indicates that the development of orientation and mobility simulation spaces must consider several key components: safety, accessibility, environmental realism, and sensory stimulation. Safety is the top priority, as visually impaired children require a space free from the risk of injury during training. The use of safe materials, clearly defined space boundaries, and varied floor textures are essential for supporting the learning process.

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From the perspective of sensory stimulation, the literature indicates that visually impaired children rely more on their senses of hearing and touch to perceive their environment. Therefore, simulation rooms need to provide auditory and tactile stimuli, such as specific sound sources to indicate direction or different floor textures to indicate position. Enhancing this multisensory stimulation has been shown to aid in the formation of mental maps of the environment in visually impaired children.

3.2.5 The Role of Simulation Rooms in Preparing for Mobility in Real-World Environments

Based on a review of the literature, simulation rooms serve an important function as a bridge between learning in school and the application of mobility skills in real-world environments. Visually impaired children who receive training in a simulated environment tend to be better prepared to handle actual situations because they have previously gained experience in recognizing spatial patterns and potential obstacles.

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Findings from various studies indicate that simulation-based orientation and mobility learning approaches are effective in enhancing the independence of visually impaired children. This aligns with the goals of inclusive education, which emphasizes the development of independent living skills as a foundation for social participation in the community. Therefore, the development of orientation and mobility simulation rooms can serve as an innovative alternative that supports the readiness of visually impaired children before they encounter real-world environmental conditions.

3.2.6 Implications of Developing Simulation Spaces for the Education of Visually Impaired Children

The results of this study indicate that the development of orientation and mobility simulation spaces can serve as a strategic tool in the education of visually impaired children. Special education schools and inclusive educational institutions should consider providing such facilities as part of life skills instruction. The presence of simulation spaces not only supports the learning process but also assists teachers in conducting ongoing assessments of students' mobility skill development.

Furthermore, the development of simulation rooms can serve as a form of adapting the learning environment to be more accommodating of the needs of visually impaired children. Collaboration among special education teachers, orientation and mobility therapists, and educational facility developers is essential to ensure that the designed simulation rooms truly align with the specific needs of the students.

4. Conclusion

Based on the findings of the above study, it is evident that orientation and mobility simulation rooms are an effective tool for helping visually impaired children develop skills in recognizing their surroundings and can serve as an appropriate medium for their education. Simulation rooms not only function as a supportive tool for learning but also facilitate teachers'

ability to evaluate the progress of visually impaired students' orientation and mobility skills. It is recommended that special education schools or inclusive schools provide orientation and mobility simulation rooms as learning tools for visually impaired students. These simulation rooms should be designed with safety, accessibility, and student needs in mind, support gradual mobility training, and assist teachers in evaluating students' progress.

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