

Understanding two-dimensional representations of human figure by people with congenital blindness in different cultural backgrounds

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DOI 10.52050/9788579177132-41

ABSTRACT

Drawings of human figures representations are especially challenging for people with congenital blindness. This study evaluated the use of Fleximan, an innovative pedagogical resource, with children with congenital blindness in Brazil, Poland, India and Nepal. The results showed significant improvements in spatial perception and drawing ability. It is concluded that Fleximan contributes to cognitive development, social inclusion and learning, facilitating the understanding of the relationship between body, movement and graphic representation. The experience highlights the relevance of assistive technologies in the education of people with visual impairments.

Keywords: congenital blindness, human figures drawing representations, Fleximan.

PORTUGUESE ABSTRACT

Desenhos de figuras humanas são especialmente desafiadores para pessoas com cegueira congênita. Este estudo avaliou o uso do Fleximan, recurso pedagógico inovador, com crianças com cegueira congênita no Brasil, Polônia, Índia e Nepal. Os resultados mostraram avanços significativos na percepção espacial e na capacidade de desenhar. Conclui-se que o Fleximan contribui para o desenvolvimento cognitivo, a inclusão social e a aprendizagem, facilitando a compreensão da relação entre corpo, movimento e representação gráfica. A experiência destaca a relevância das tecnologias assistivas na educação de pessoas com deficiência visual.

Palavras-chave: cegueira congênita, representações de desenhos de figuras humanas, Fleximan.

1. INTRODUCTION

It may seem that representation of the human body should be well understood by blind persons. However, a fundamental difference exists between how we experience our body and what it looks like in a given position. While awareness of one's own body may be related to kinaesthetic imagery, understanding what a person looks like in a particular posture requires using external imagery of “watching yourself from a third-person perspective” (CALLOW, WATERS, 2005; HALL, 2001). In other words, the first perspective has more to do with the egocentric reference frame, while the second involves the allocentric reference frame, which is often linked with using visual imagery (SZUBIELSKA et al., 2024). Consequently, people with blindness may need support with understanding how the appearance of the human figure changes when performing various movements and activities (for instance, when dancing or playing sports).

Although advanced technologies exist for producing and audio-describing tactile graphics, they do not aid comprehension of drawings. The Hungry Fingers Transfograph (MAREK, 2009; SZUBIELSKA et al., 2016) effectively explains the 3-D to 2-D transition for static objects. For introducing learners with congenital blindness to tactile drawings of people (objects, whose shape changes as a result of movement), Fleximan was developed – a magnetic stick figure with bendable joints, which makes it possible to show what people look like when they engage in various activities. Understanding such drawings is crucial for development and social inclusion of children and adults with a visual impairment¹. This report compiles observations from research in Brazil, Poland, India, and Nepal on how children with congenital blindness interpret and create drawings, fostering dialogue on the findings.

The main objectives of this report are to: investigate how people with congenital blindness understand two-dimensional representations of the human body, using the Fleximan pedagogical resource; to evaluate the effectiveness of the Fleximan in mediating the understanding of spatial and structural concepts, such as front/back and left/right, in multicultural educational contexts; to

1 Other drawing approaches for blind children, such as those by Duarte and Piekas (2013), emphasize tailored sequences and each child's graphic abilities. Duarte (2013) notes that while sighted children's human figure drawing develops in predictable stages (LUQUET, 1927; LOWENFELD, 1947), blind children require a distinct approach considering their unique perceptual modes

investigate whether cultural differences interfere with learning and results, with regard exclusively to the use of Fleximan.

2. DEVELOPMENT

Fleximan is a HUNGRY FINGERS² educational tool which supports the cognitive and perceptive development of children with visual impairment, especially in understanding body structure and representing human movement through tactile drawings. It serves as an intermediate link between the three-dimensional human body and its two-dimensional representation as a drawing (Figure 01).

Figure 01 - Hungry Fingers FLEXIMAN

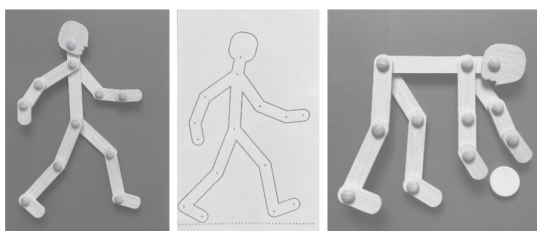


Photo: Bogusław Marek

Fleximan promotes body recognition and spatial concepts like laterality and orientation through posture imitation, spatial organization, and tactile overlays. It has three versions—front, back, and side views—offering varied perspectives. Originally plastic with magnets, the latest wooden model meets Norman's (2013) standards for tactile aids. Its effectiveness was validated in specialized educational settings and is supported by the 'Playing and Learning with Fleximan' series—three booklets with simplified tactile stick-figure illustrations (see Figure 04).

3. RESULTS

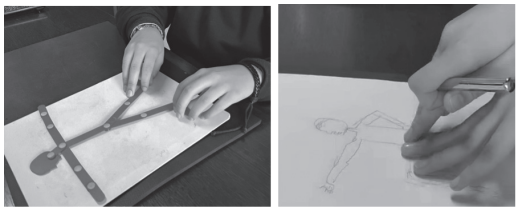
The reports below detail Fleximan's use as an accessible teaching tool for visually impaired learners in various countries and educational settings.

2 HUNGRY FINGERS. Teaching materials for blind children. <https://www.hungryfingers.com/index.html>.

3.1. Experience in Brazil

This qualitative report presents the use of the Fleximan (MAREK, 2009) teaching resource in drawing activities with a 16-year-old student with total visual impairment. Conducted over five years (2019–2025) in weekly Visual Arts workshops in Curitiba, the student was the only visually impaired participant in the class (Figure 02).

Figure 02 - A. C., 16 years old, using FLEXIMAN, 2025



Photos: Mari Ines Piekas

Alongside Fleximan, accessible materials and inclusive methods greatly improved the student’s drawing and painting skills (PIEKAS, 2017; MARCHI, 2019). Classes covered anatomy, landscapes, and creative drawing using tactile boards, pencils, crayons, and 3D objects to teach body proportions, movement, and spatial concepts. The student exhibited work in shows for visually impaired artists. Fleximan reinforced spatial and laterality learning, supporting inclusive art and socialization. Results appear in Table 01.

Table 01 - Human figure drawings by A. C., before and after using FLEXIMAN, with ages noted

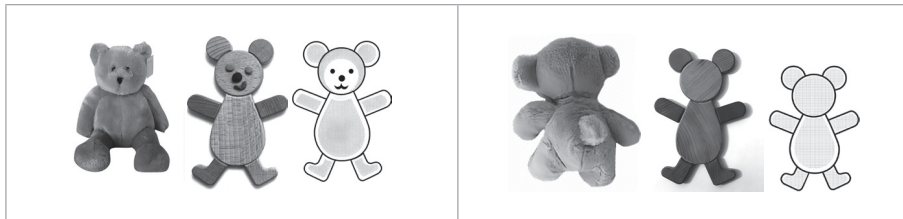
A. C. (10) before, 2019	A. C. (10) beginning to use Fleximan, 2019	A. C., (12) with Fleximan, 2021	A. C. (13) with Fleximan, 2022	A. C. (14) “Golfer” 2023	A. C. (15) “African native”, 2024	A. C. (16) “Dancer”, with Fleximan, 2025

Drawings: Collection of A. C., with her age in parentheses

3.2. Experience in Poland

In Poland, tactile diagrams are widely used from the age of seven. Introducing drawings of people starts with the Hungry Fingers Teddy Bear set. This includes a 3D teddy bear, flat magnetic puzzles, and a storybook where the teddy bear drawing emerges step by step. The puzzles bridge the 3D toy and 2D drawing, helping children grasp spatial concepts like “front”, “back”, “right” and “left” depending on the teddy bear’s orientation (Figure 03).

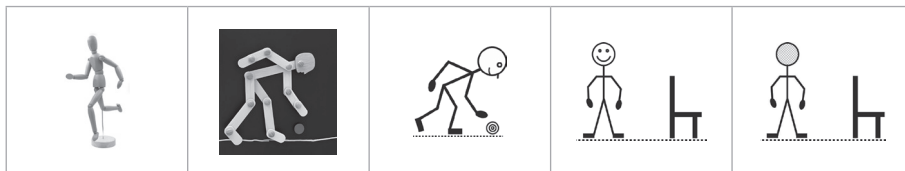
Figure 03 - The puzzles bridge the 3D toy and 2D drawing



Photos: Bogusław Marek

Stage two involves using 3D human models, Fleximan, and tactile drawings to explore spatial concepts. With practice, children understand drawings of various activities, engaging both egocentric and allocentric imagery (Figure 04).

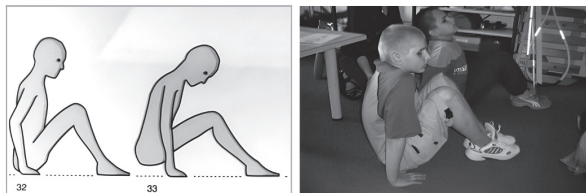
Figure 04 - 3D human models, Fleximan, and tactile drawings



Photos: Bogusław Marek

Imitating postures demonstrated by Fleximan and shown in the accompanying booklets with tactile drawings is an important part of the training (Figure 05).

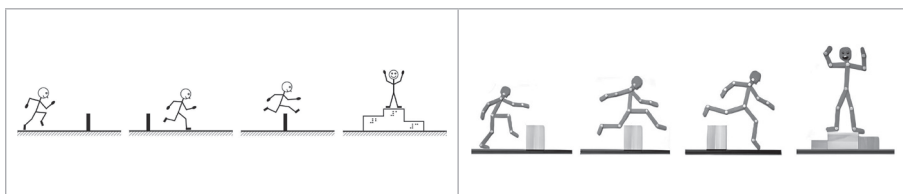
Figure 05 - Imitating postures



Photos: Bogusław Marek

Fleximan is also used to introduce children with total blindness to tactile comic strips which help understand 2-D representations of movement (Figure 06).

Figure 06 - Fleximan's Adventures



Photos: Bogusław Marek

To engage children in tactile drawing, the RNIB geometry mat and German film are used with a pen or Braille stylus. Aptitudes vary: some need help, while others, with Fleximan training, create recognizable drawings of practiced activities. Images B and C show an eight--year-old's drawing of a ski jumper (A); Image D shows the same child's (as an adult) drawing of a person walking a dog (Table 02).

Table 02 - Drawings of practiced activities

			
Image A	Image B	Image C	Image D

Photos: Bogusław Marek

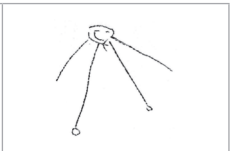
3.3. Experience in India and Nepal

In India and Nepal, unlike Poland, children had no experience with representational tactile drawings. At Jothi Seva schools (Bangalore, Nongbah) in India, basic tactile graphics like geometry and maps were available, but some children at Head Nepal (Simikot) did not even understand the concept of “drawing.”

This allowed testing resources for introducing congenitally blind children (ages 7–14) to graphics. Activities included work with the Transfograph, Teddy Bear set, and Fleximan. Additionally, training evaluated if drawings made during workshops reflected developmental stages observed in both blind and sighted individuals (MILLAR, 1975; KENNEDY, 1993; D'ANGIULLI, MAGGI, 2003).

No examples of Scribble stage were found. The early lines were made consciously to build confidence with drawing tools. Similarly, no Fortuitous Realism (LUQUET, 1927) instances appeared. Thus, under controlled workshop conditions, development of drawing skills began at Failed realism (poor resemblance) or Intellectual realism (based on the child’s knowledge). Drawings of teddy bears and people made in pr-test (before using the teddy bear set and Fleximan) showed Failed realism: images A – B: a person; Intellectual realism: image C – teddy bear, image D – person (Table 03).

Table 03 - Drawings of a teddy bear and a person before introducing the Teddy Bear and Fleximan sets

			
Image A	Image B	Image C	Image D

Photos: Bogusław Marek

It is worth noting down that both teddy bear and person were drawn as ‘toads’ by an 8-year-old congenitally blind child - just as sighted 3-4-year-olds draw people. After exercises with the Teddy Bear set and Fleximan and imitation (Fig. 07), drawings showed traces of Visual Realism (LUQUET, 1927) - more detail and better recognizability, though accuracy varied. (Figure 07 and Table 04).

Figure 07 - Use of FLEXIMAN. Left: India, Right: Nepal



Photos: Bogusław Marek

Table 04 - Drawings of a teddy bear and a person before and after training with teddy bear puzzle and Fleximan

Teddy bear - Drawing after examining toy	Person - drawing after examining human model	Teddy bear - drawing after story and puzzle	Person - drawing after training with Fleximan	Teddy bear - drawing after comparing drawing, puzzle, and toy	Attempt to show person walking

Photos: Bogusław Marek

With specialized aids and ample chances to explore tactile drawing, children with congenital blindness achieve remarkable results, as this example from Nepal showing spatial relations like on, under, above, off, and between, with easily recognizable drawings of furniture and teddy bear (Figure 08).

Figure 08 - Drawing showing a variety of spatial relations - static and movement

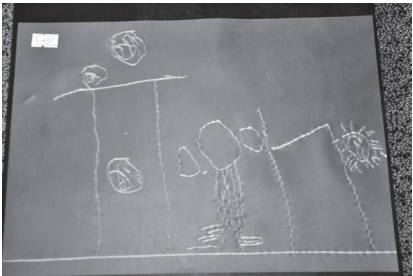


Photo: Bogusław Marek

These results reinforce the importance of inclusive pedagogical practices and provide valuable insights for the concluding reflections presented below.

4. CONCLUSION

This report examines how individuals with congenital blindness understand and create tactile drawings of people and evaluates the effectiveness of Fleximan across cultures. Fleximan, a low-tech tool, aids in linking 3D objects to 2D representations, complementing The Hungry Fingers Transfograph, which focuses only on static objects. Fleximan helps blind individuals understand body movement, fostering participation in sports, dance, and social interactions. It introduces children with congenital blindness to tactile books with collages and raised-line illustrations. The effectiveness of Fleximan was confirmed across cultures, revealing differences: Brazil and Poland emphasized its use for books with tactile illustrations and art, while India and Nepal focused on yoga and sports. The need for additional tools, like the Teddy Bear set, depended more on age and tactile experience than cultural factors.

Future efforts must focus on investigating affordable ways to promote the potential of Fleximan and accompanying tactile materials such as illustrated tactile instructions to various activities – increasing accessibility of sport, art and other social interactions of persons with a visual impairment. Fleximan can also be an inspiration to developing other assistive low-tech resources explaining difficult concepts and filling numerous gaps in blind persons knowledge and understanding of the invisible world.

ACKNOWLEDGMENTS

Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq-Brazil - Mari Ines Piekas - Postdoctoral Scholarship Holder - Process No. 153200/2024-3

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