

EXPERIENTIAL ARTICLES

Use of Tactile Diagrams in Teaching Science to Visually Impaired Learners at the Upper Primary Level

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ABSTRACT

Inclusive classrooms are a must in today's education system so that all the students are given equal opportunities, irrespective of their abilities. Understanding science without diagrams and illustrations can be a challenging task for learners. Although Braille books are available for visually impaired students, they lack diagrams and illustrations. To address this issue, the Department of Education in Science and Mathematics (DESM), National Council of Educational Research and Training (NCERT), New Delhi, has brought out a tactile science book for upper primary level students. This paper aims to convey the importance of the tactile science book for students of class VI. The tactile science books were distributed to students from different inclusive schools as well as students in special schools. The students with visual impairments felt that they were able to understand science concepts easily with the aid of the tactile diagrams. The tactile science book can promote comprehensive classrooms in inclusive set-ups and, through diagrams and illustrations, can help students with visual impairments to increase the efficacy of their learning.

INTRODUCTION

According to The Rights of Person With Disabilities Act(2016) of the Government of India, inclusive education is considered to be a system where students with and without disability learn together, and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities. Inclusion means accommodation of normal and special needs children under the same roof to promote co-learning and also to maintain a sense of equilibrium among the students. Inclusion in mainstream education is very important as every child has the right to education, irrespective of one's

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socioeconomic status and disabilities. It has been observed that a lot of students are reluctant to opt for the science stream at higher secondary level due to unavailability of resources which can help them to learn science concepts.

Tactile Science Book Developed by NCERT for Class VI

Tactile books are embossed diagram books for visually impaired students and children with multiple disabilities. They contain pictures to be touched and embossed pictures help the students with visual impairment to understand the diagrams. Different materials used for the books stimulate the senses of touch, hearing and smell. Ordinary letters and Braille can also be used in the books. Tactile books play a pivotal role in teaching science concepts to visually impaired students in the early stage of schooling. The main objective of preparing tactile books for visually impaired students by the NCERT's Department of Education in Science and Mathematics (DESM) is to develop their interest in learning science concepts and also to provide accessible versions of instructional materials, illustrations and diagrams. Tactile illustrations and diagrams connect the visually impaired students to real life experiences – to what they can hold and explore using their hands and feet. This in turn helps them to make symbolic representations of the experience.

"A picture is worth a thousand words" (Schroeder,1968); on the basis of this idea, tactile books for science were introduced at the upper primary stage to depict the textual information given in Braille textbooks. The objective was to provide books which included tactile diagrams so that children with visual impairments would have the same learning experiences as sighted students. Diagrams that can be perceived by touch help visually impaired students to understand scientific concepts.

Preparation of the Tactile Book

Illustrations and diagrams in NCERT's Science textbook (2006) for class VI were converted into tactile format to ensure better learning among the visually impaired students. The design of the tactile book was based on the International Guidelines for tactile graphics by BANA (Ostby,2012). The diagrams and illustrations were made using CorelDraw (<https://www.coreldraw.com/en/>). Production of diagrams in tactile format, using 3-D technology, was done by IIT-Delhi. After the preparation of the tactile diagrams, there was a trial at a workshop for visually impaired students and teachers. The final trial was done at the National Blind

Association centre, Delhi. It was seen that the tactile book and illustrations in it created a link between the concrete and tactile experiences of a student's world with a symbolic representation of that experience.

Tactile Diagrams

A tactile graphic is not automatically meaningful to students with visual impairments. The tactile diagrams in the book include tactile representations of pictures, lines and diagrams, etc., and a visually impaired student can feel these raised lines or diagrams to obtain information. Tactile illustrations mainly depend on the texture, size and sequence of the concept. The texture of the illustrations focusses and reflects the qualities of the content. Tactile diagrams in the NCERT book are not an exact replica of a visual image of a raised diagram. Some examples are given below.

Example 1

Figure 1: Image in PDF format from NCERT textbook

Looking through Opaque Material



Figure 2: Image in CorelDraw Format

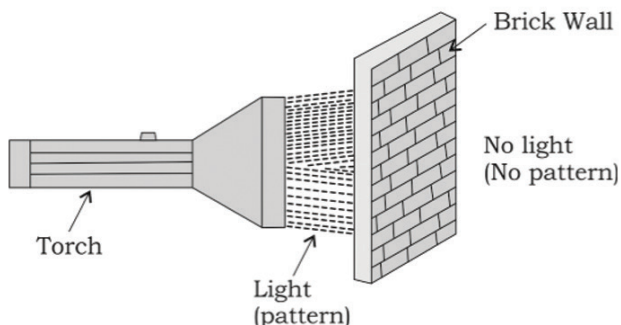


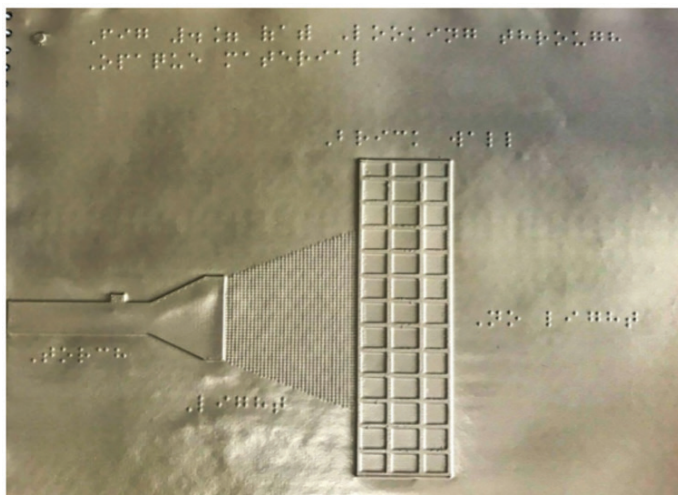
Figure 3: Image in Tactile Format

Figure 1 is the picture given in the Class VI science textbook developed by NCERT. It is converted into Corel format in Figure 2, and finally converted into tactile format in Figure 3.

The same pattern is followed in the second example.

Example 2

Figure 4: Image in PDF format from NCERT textbook

Evaporation and Condensation



Figure 5: Image in CorelDraw Format

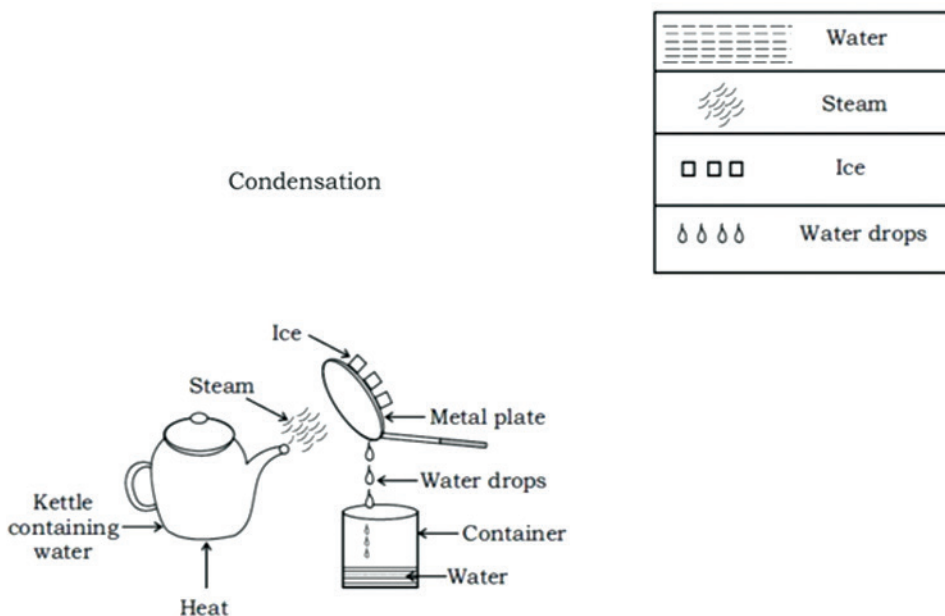


Figure 6: Image in Tactile Format



Tactile diagrams can be easily created on thermoforming sheets, making this procedure cost-effective. The 3-D technology is used to emboss the required diagrams and pictures. The main purpose in making embossed diagrams is to enable students with visual impairments to feel and understand concepts without difficulty.

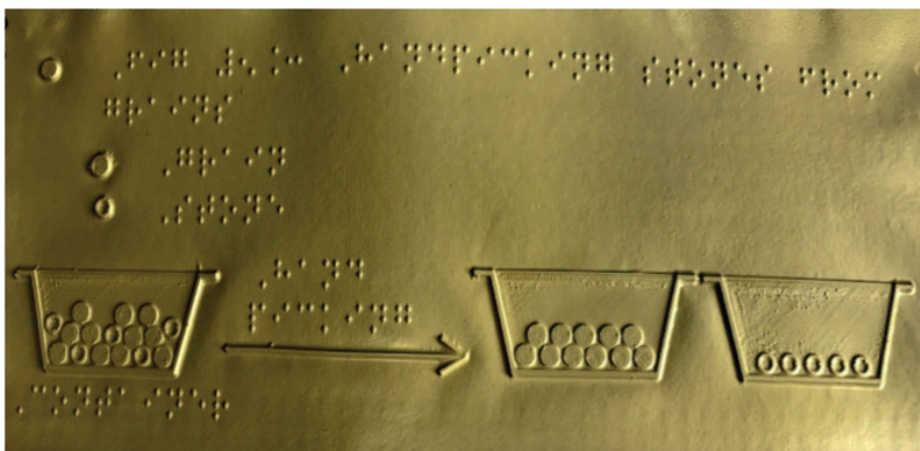
Examples of Tactile Representations

Figure 7: Separating Peas from Pods by Handpicking



The tactile diagram helps the visually impaired students to perceive, by touch, the concept of separating peas from pods by handpicking.

Figure 8: Separating Stones from Grains by Handpicking



The tactile diagram helps the visually impaired students to touch and understand the concept of separating stones from grains by handpicking.

Advantages of the Tactile Books developed by NCERT

- The main objective of tactile books is to promote equality in education for visually impaired students.

- These books are designed to help visually impaired students attain the same level of academic achievement in science as their peers without disability.
- Tactile books overcome the drawbacks of textbooks available in Braille format. The latter did not have diagrammatic information which caused difficulty in linking the concepts.
- Tactile books come with the transcriber's note to make it easy for the teachers and students to understand the science concepts.

Evaluation of tactile books

The evaluation and effectiveness of the NCERT book was assessed in a trial session at the National Association for Blind (NAB), conducted to study the potency, needs, as well as the difficulty faced by students and teachers in working with tactile diagrams. Initially they had difficulty in understanding due to their limited exposure to tactile diagrams. Once they familiarised themselves with the format, they found it easy to link theory with the diagrams. The tactile book developed by NCERT was able to create a meaningful link between concrete tactile experiences of science concepts and symbolic representations. It resulted in better learning of science concepts. The students were able to point out some conceptual as well as designing errors in the diagrams; these were noted for corrections and improvement.

The majority of teachers recommended that tactile books should be made available to students at a very early stage to be more effective and helpful in facilitating their scientific concept-building. The teachers appreciated the transcribers' notes and expressed a need for resources of this type to be available in inclusive classrooms. Teachers of inclusive schools are already using handmade 3-D diagrams for students to gain a better understanding of the subject. The availability of tactile books would provide them an opportunity to combine their hands-on experience with diagrams and illustrations in the books.

CONCLUSION

It is often seen that children with visual impairment are rather reluctant to pursue science at higher levels. The reason is their poor conceptual understanding due to unavailability of proper tactile books at the primary level. With very limited access to tactile diagrams, these students find it difficult to grasp a concept easily. The tactile book provides visually impaired students with learning experiences in science that are similar to those of sighted students.

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