

Title: IRIS: Encouraging self-learning of tactiles among blind and visually impaired students

Abstract Brief: Blind and visually impaired students across India face challenges learning complex scientific diagrams. While teacher assistance is essential, the high student-teacher ratio makes it difficult to provide an engaging learning experience at scale. In this pilot study, we introduce IRIS, a novel TV remote-sized product designed for visually impaired children to explain the tactiles in audio format. Results show that IRIS helped students learn about scientific processes in regional languages and provided for a more comprehensive, holistic grasp of the concepts presented in the tactile diagram when compared to other methods. We propose IRIS as an assistive technology geared to make students self-reliant in learning tactiles with minimum assistance from teachers, thereby reducing their workload

Abstract

India is home to about 9.3 million children with visual impairment [1]. Education opportunities for the blind and visually impaired (BVI) students are scarce, especially in Science, Technology, Engineering and Mathematics (STEM), which involve subjects that rely on visual means such as diagrams and equations [2]. As a result, the state of education infrastructure for BVI students is abysmal, marked by the lack of infrastructure, overwhelmed teachers, and rigid curriculum [3]. This has serious repercussions with regard to the staggering disparity between sighted and BVI STEM graduates and, consequently, their employment prospects.

In recent years, several assistive technologies have offered promising solutions to address the challenge of accessible STEM learning. Notably, the use of tactile has significantly enhanced BVI students' understanding of scientific diagrams and figures. Made with technologies such as thermoforming and DIY plastics, tactiles have raised lines that help a BVI student trace them and learn about the concept. Learning tactile involves a special teacher spending significant time with each student to explain parts of tactile.



Fig 1: A typical tactile

While such a setup allows BVI students to comprehend scientific diagrams, the learning process necessitates the teacher to conduct separate sessions with each student individually. Given the paucity of trained teachers and the high student-teacher ratio, such a configuration is not scalable.

To address this, Vembi has developed IRIS, a novel TV remote-sized product designed for visually impaired children to explain the tactiles in audio format. IRIS has 12 Braille embossed keys (0-9 number keys, Enter and Clear keys) and a speaker/headphone. IRIS operates on a battery and gets charged with a USB-C cable.



Fig 2: IRIS device

A typical learning session with IRIS involves students opening a tactile book that has a corresponding unique tactile number on the top right corner of the tactile. When a student enters the tactile number in IRIS, the audio information of the tactile is loaded. The student then spends time exploring the tactile. Upon entering the number corresponding to the braille embossed label, IRIS plays the name of the label (for instance, "Stem" in a "Parts of a tree" tactile). In order to learn more about the label, the student can long press the number. Thus, through the IRIS device, the student can independently explore and learn a tactile without extensive assistance from the teacher.

Teachers can easily integrate IRIS into their lesson plans. When they introduce new tactiles for teaching specific concepts, they seamlessly load the audio descriptions to IRIS through cloud software called "Antara". Antara converts text descriptions to audio using Azure, thereby creating audio descriptions for the tactile.

To evaluate the efficiency of IRIS in classroom contexts, we conducted a pilot study with 28 BVI students from Grades 6 and Grade 7 at a boys' school in West Bengal, India. Vision Empower [4], a non-profit organization working towards making STEM subjects accessible to BVI students, partnered in conducting the study. Their rapport with the schools helped in running the pilot study. A team of six facilitators collaborated to conduct the pilot study. The objective of the pilot study was to evaluate IRIS for its potential integration into the classroom for specific lesson plans.

The student sample comprised 15 from Grade 6 and 13 from Grade 7. Based on the curriculum and lesson plans, the tactile diagrams selected for the study included a) the Germination of Seed, b) Parts of

the Plant, c) the Water cycle, and d) the Respiratory system. We used a total of 5 IRIS sets loaded with tactile numbers corresponding to each diagram and a headphone to listen to the audio output.

Facilitators noted their observations and the time taken for the students to grasp the concepts from the tactile diagram. The study involved a gradual context setting for the students. Initially, the teachers gave the students tactile diagrams with English labels. The teachers asked the students to read the labels and explain their understanding of the diagram. In the next phase, the teachers provided the students with instructions on how to navigate the tactile diagram. The tactile diagram was taught to them using tactile cues, and the students were encouraged to explain their understanding of the diagram. Finally, the teachers introduce the IRIS device to the students, providing them with a tutorial on how to navigate the buttons on the device and listen to the audio descriptions. This time, numbers were used instead of labels in English. After the students listened to the audio descriptions, the teachers asked them to explain the diagram based on their understanding. Students took anywhere between six to 10 minutes to listen to audio descriptions and form a solid understanding of the process underlying the tactile diagram.

Through the pilot study, the facilitators observed that the IRIS device helped the students comprehend and articulate multi-step, dynamic processes such as germination, water cycle and respiration in their regional language (Bangla). The device matched the pace of learning for individual students as some of them chose to repeat the audio descriptions. Conversations with the teachers indicated that IRIS could ease some parts of their workload as self-learning tactile was now possible.

We conclude by highlighting the scope of IRIS in the context of STEM education for BVI students. The device can empower students to self-learn tactile diagrams in their regional languages and ease the workload of teachers.

Collaborators and Support for IRIS:

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