Teaching beyond Vision: Academic Challenges of Visually Impaired Students and Teachers in India

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ABSTRACT
This study explores the educational challenges of visually impaired students and their teachers at Taramati Bafna School in Maharashtra, India. Despite advancements in inclusive education, rural areas face persistent issues like limited Braille resources, untrained educators, and stark gender disparities. Based on interviews with 61 students, 3 teachers, and a principal, the study reveals barriers in teaching complex subjects, inadequate assistive technology, and socioeconomic constraints. It emphasizes the need for early Braille exposure and innovative tools like the Talking Tactile Tablet. The research calls for targeted policy reforms, resource investment, and inclusive pedagogy to ensure equitable education for visually impaired learners in line with India's NEP 2020 and SDG 4 goals.

General Terms
Education, Accessibility, Assistive Technology, Human-Computer Interaction, Inclusive Design

Keywords
Inclusive Education, Visually Impaired Students, Braille Accessibility, NEP 2020, Educational Equity

1. INTRODUCTION
Braille is a tactile writing system that enables visually impaired individuals to read and write through touch. Invented by Louis Braille in the early 19th century, it revolutionized literacy for the visually impaired by using raised dots to represent letters, numbers and symbols. The system first published in 1829, gained widespread adoption, starting with the Missouri School for the Blind in 1860. Braille characters are based on a six-dot cell arranged in two columns and three rows, allowing 63 unique combinations including a null cell [2]. These combinations encode letters, punctuation, numbers and specialized symbols. Braille exists in two main forms:

1) *Uncontracted (Grade 1) Braille*: Represents each letter and punctuation mark individually, aiding beginners or precise transcription.
2) *Contracted (Grade 2) Braille:* Incorporates approximately 180 contractions and abbreviations, improving reading speed and conserving space [3].

India, home to an estimated 9.2 million visually impaired individuals [4], Braille literacy is vital for education, employment and independence. Braille offers a tactile system for reading and writing, enabling access to information and opportunities comparable to those of sighted individuals. Despite advancements in digital aids, Braille remains indispensable, especially for tactile learners. However, challenges in accessibility persist, particularly in rural and underserved areas. Early exposure to Braille is crucial for literacy and academic success, but access to textbooks, materials and trained teachers varies widely. While initiatives like the Right to Education Act, Sarva Shiksha Abhiyan (SSA) and NIEPVD aim to enhance Braille integration; many rural schools lack adequate resources and skilled instructors. Bridging this gap is essential to provide equitable educational opportunities for visually impaired students across India. The introduction of Braille can significantly enhance education and literacy for visually impaired individuals in India. Its history dates back to the late 19th and early 20th centuries, during British colonial rule, when educational resources for the visually impaired were scarce [5]. Christian missionaries, including Miss Annie Sharp, played a key role in adapting Braille to Indian languages starting with Hindi. This paved the way for its expansion to other regional languages, marking a major step toward accessible education. In 1897, Lal Behari Shah established the Calcutta Blind School, India's first dedicated institution for visually impaired students [6]. While this was a milestone, still had limited access to Braille materials and a societal focus on vocational training over academics restricted broader educational opportunities? This early emphasis on practical skills shaped the trajectory of education for visually impaired individuals in India for years to come.

India's linguistic diversity poses challenges for adapting Braille to its multilingual population, with hundreds of languages featuring unique scripts and phonetic structures. Indian languages primarily use abugida scripts, where consonants have inherent vowel sounds modified by diacritics, necessitating Braille code modifications [7]. The National Institute for the Empowerment of Persons with Visual Disabilities (NIEPVD) has standardized Braille for major languages, including Hindi, Tamil, Bengali and more enhancing accessibility for visually impaired individuals. Bharati Braille a standardized system tailored for Indian languages promotes uniformity across similar scripts like Hindi and Marathi, facilitating cross-linguistic learning and literacy. The Indian government has made significant progress in promoting Braille literacy and supporting individuals with visual impairments through partnerships with NGOs and legislative measures. A key milestone was the establishment of the Central Braille Press in Dehradun in 1951, later evolving into the National Institute for the Empowerment of Persons with Visual Disabilities (NIEPVD) [8]. The NIEPVD now provides Braille resources across educational levels, producing textbooks and materials in various languages to enhance accessibility. The 2016 Rights of Persons with Disabilities (RPWD) Act further bolstered these efforts by recognizing accessible education as a fundamental right, driving initiatives such as expanded Braille textbook production, assistive tools distribution and specialized teacher training [9]. These measures have significantly improved educational

opportunities for visually impaired students, empowering them to achieve greater independence.

Advances in technology, inclusive policies and advocacy campaigns have enhanced global awareness of Braille as a vital reading tool for visually impaired individuals. Schools especially in urban areas, increasingly integrate Braille into curricula, enabling visually impaired children to achieve literacy levels comparable to their sighted peers [10]. Braille education fosters academic success, independence and self-confidence while ensuring fair access to information and life skills. It is also critical for job readiness offering broader career opportunities and self-sufficiency in tasks like reading and writing. Inclusive classrooms further promote social inclusion by fostering empathy between sighted and visually impaired students [11]. Educators support this effort with tools like tactile aids and Braille displays, though access remains limited in rural areas highlighting the need for targeted funding and campaigns. Braille has revolutionized literacy and education for visually impaired individuals, offering a tactile reading and writing system crucial for independence and inclusion. Despite advancements in digital aids Braille remains indispensable, particularly in India, where initiatives like Bharati Braille and the RPWD Act aim to bridge accessibility gaps. This research paper focuses on the persistent challenges in rural areas, emphasizing the critical need for equitable resources and trained educators to achieve widespread Braille literacy and empower visually impaired individuals.

2. LITERATURE SURVEY

TABLE 1 : How the Researcher's Focus Areas Along with Key Details

Topics	Key Points
Independent Text Access for Visually Impaired Students [12]	- Accountability in school districts via assistive technology assessments. - Lack of standardized models for evaluation. - Reading assessment lags behind writing and mathematics.
Inclusion of Sighted Peers [13]	- Sighted peers' role in fostering an inclusive learning environment. - Teachers should facilitate interactions for academic and social support. - Enhances collaboration, autonomy, and empathy.
Talking Tactile Tablet (TTT) for Mathematics [14]	- Evaluated impact on visually impaired students. - Improved performance in 5 out of 8 test items. - Normalized test difficulty for equitable evaluation.
Braille vs. Print Reading Strategies [15]	- Study with 47 participants (24 prints, 23 braille readers). - Print readers generally read faster. - Both groups used similar cognitive strategies for reading tasks.
Challenges in Advanced Mathematics for Blind Students [16]	- Difficulty due to lack of visual perception. - High-tech tools available, but print output still needed. - Teachers of the Visually Impaired (TVIs) play a critical role.
Technology in Advanced Mathematics [17]	- Integration of graphing calculators, algebra systems, and software. - Essential for real-world applications in various fields. - Technological proficiency is crucial for modern problem-solving.
Assistive Technology (AT) Outcome Measures [18]	- Review of 50 studies identified 53 instruments. - Only 17 (32%) were AT-specific. - Calls for standardization to improve global accessibility.
Graduated Manipulative Sequence (VRAEa) Study [19]	- Examined mathematical problem-solving in students with autism and intellectual disabilities. - Extended Abstract phase added for skill maintenance. - Mixed results on skill retention suggest need for further research.
Virtual Manipulatives (VMs) in Special Education [20]	- Enhance conceptual understanding in arithmetic, fractions, and algebra. - Advantages: Accessibility, customization, instant feedback. - Challenges: Navigation difficulties, limited long-term research.
Inclusive Education in Indonesia [21]	- Examines the integration of students with disabilities into mainstream education. - Focuses on a 12-year-old autistic student, highlighting the need for guided support in an integrated school. - Inclusive education requires systemic change, resource allocation, and a shift in educational policies to be effective.

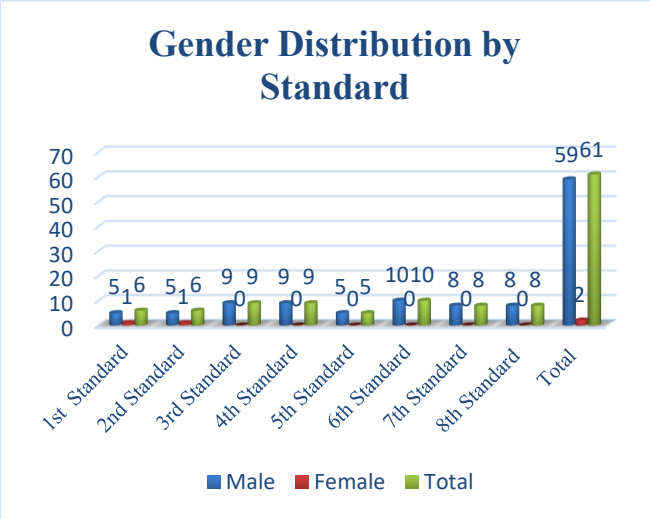
3. RESEARCH DESIGN & METHODOLOGY

3.1 School Scenario

The Taramati Bafna School in Chh. Sambhajinagar, Maharashtra, is a free residential institution empowering visually impaired and underprivileged children. For over 40 years, it has provided free education, lodging, and boarding for standards 1–10, integrating academics, life skills, and vocational training. Taramati Bafna School empowers visually impaired students through Braille, audio tools, and adaptive technology, fostering education and independence. Vocational training and social support prepare them for careers and community integration in Chh. Sambhajinagar. The stark gender imbalance (59 male vs. 2 female students) may reflect cultural norms prioritizing male education, safety concerns for girls in rural areas, or lack of awareness about inclusive schooling. UNESCO reports a 12% rural-urban literacy gap among visually impaired girls in India, contextualizing these disparities. The graph below illustrates the school's gender

distribution. Future studies should interview families to explore barriers to female enrollment.

Graph 1: show the gender-wise total number of students in the school



Male students dominate enrollment from 1st to 8th standards, with only 1 female student each in 1st and 2nd grades and none in 3rd–8th. The 6th standard has the highest enrollment (10 males), while the 5th has the lowest (5 males), underscoring the urgent need to address gender imbalance and promote female participation.

Snapshot 1: show the group photo of students in their school

The school fosters inclusion by providing equal opportunities for academic and personal growth, nurturing intellectual, emotional, and social development through a curriculum integrating academics, life skills, and vocational training.

Snapshot 2: show the visual impaired student with their parents

Taramati Bafna Blind School promotes inclusivity by integrating visually impaired and underprivileged sighted children, fostering empathy. Fully funded, it supports families and expands outreach to serve more children. Its 18 staff members including specialized educators, art/music teachers, and administrative roles ensure holistic education. Non-teaching staff maintain daily operations, creating a blended environment of academics, arts, and care to meet students' diverse needs.

3.2 Data Collection Tools & Procedure

Multiple qualitative tools were used for triangulation:

Semi-structured interviews: Conducted in Marathi to ensure linguistic comfort. Students and teachers were asked about academic challenges, use of assistive technology, access to Braille resources, emotional well-being, and future aspirations.

Observation: Field notes were taken during classroom observations to assess the teaching environment, available resources, and instructional methods.

Document analysis: School records, attendance logs, teacher training modules, and academic performance data were analyzed for contextual understanding.

Visual documentation: Snapshots and graphs were used to illustrate participant demographics and resource distribution.

3.3 Ethical Considerations

Ethical approval was obtained from the institutional research ethics committee. Informed consent was taken from all adult participants and guardians of students. Participation was voluntary and data confidentiality was strictly maintained.

3.4 Research Validity & Reliability

To enhance validity:

- Triangulation was applied through interviews, observations, and documentation.

- Member checking was conducted by sharing summaries with participants for accuracy.

- Peer debriefing with academic colleagues ensured the interpretations were grounded.

3.5 Comprehensive Evaluations

To enhance the robustness of findings, comprehensive evaluations were integrated throughout the research process.

These included cross-validation of participant narratives, inter-rater reliability checks during thematic coding, and incorporation of expert review feedback. A pre- and post-interview reflective assessment was conducted to measure changes in students' self-perception and confidence levels. Moreover, comparisons were made across sub-groups (e.g., completely blind vs. low-vision students; primary vs. secondary level students) to identify trends and disparities in academic experience.

Quantitative proxies such as attendance rates, academic scores, and usage frequency of assistive devices were reviewed to supplement qualitative insights. These metrics enabled triangulation and pattern recognition in access, adaptation, and achievement levels across diverse learners. Educator feedback was also benchmarked against training curricula and institutional standards to highlight gaps and improvement areas.

To ensure generalizability, the study's findings were compared with literature on inclusive education in similar Indian contexts. Findings from this comprehensive evaluation are intended to inform policy recommendations and curriculum interventions that can be scaled and adapted across other visually impaired educational institutions in India.

4. ANALYSIS

A total number of 61 students participated in the interviews for this survey, along with 3 teachers and 1 principal.

Snapshot 5,6 Show Teachers & Students in the school

Snapshot 6,7 Show the Taylor frame & 5th Standard English Book

Snapshot 8,9 Show the Braille Writing Slate & Learning Frame

Snapshot 10,11 Show the Teachers and Student & Tactile Geometry kit

5. DISCUSSION

5.1 Academic & Instrumental Challenges

Tables 2 and 3 delineate the academic and instrumental challenges encountered by visually impaired students and educators. A notable trend is the deceleration in academic progression during grade transitions, attributable to (i) increased curriculum complexity, (ii) gaps in foundational knowledge retention, and (iii) adaptive difficulties to elevated academic expectations.

5.2 Cognitive Skill Variability

Analysis of cognitive skills revealed heterogeneity among students. While some exhibited marked improvement in problem-solving and abstract reasoning, others struggled with critical thinking tasks, underscoring the necessity for differentiated pedagogical strategies to address diverse learning trajectories.

5.3 Socioeconomic and Familial Influences

Family background variables parental education levels, socioeconomic status, and financial constraints were identified as compounding factors. These variables correlate with limited access to assistive technologies, heightened psychosocial stress, and reduced temporal and cognitive investment in academic pursuits, further exacerbating educational inequities.

5.4 Extracurricular Engagement and Aspirations

Extracurricular profiling highlighted students' multifaceted talents, including proficiency in cricket, mastery of musical instruments (e.g., Tabla, harmonium), and vocal performance. Longitudinal aspirations spanned professions such as computer engineering, medicine, education, and competitive

examinations, reflecting resilience and ambition despite systemic barriers.

5.5 Implications for Policy and Practice

This study underscores the importance of:

- *Customized Instructional Frameworks:* Aligning pedagogy with individual cognitive profiles.
- *Resource Equity Initiatives:* Mitigating socioeconomic barriers through subsidized assistive technologies.
- *Holistic Support Systems:* Integrating academic, psychosocial, and extracurricular support to foster resilience and aspirational achievement.

This synthesis underscores the imperative for multidimensional interventions to bridge accessibility gaps and empower visually impaired students in achieving equitable educational outcomes.

Table 2. Academic Challenges for Students & Teachers

Scholarly Activity	Challenges	Explanation	Cause
Reading	Difficulty reading the printed material	Reading the printed material was challenging and took a lot of time.	Complete Blindness for students
Writing	Unable to take notes during class	Using pen and paper was not an option	Partial Blindness, Lack of Braille proficiency
Learning Marathi	Marathi's complicated Devanagari script adds challenges to its Braille adaptation.	Limited Access to Braille Materials, Marathi Braille Books not available	Limited resources and trained educators.
Learning Mathematics	Difficulty solving math problems involving calculation, Drawing Geometry Concepts etc.	The complexity of translating mathematical notation into Braille or audio formats	Requires innovative teaching methods, accessible resources, and adaptive technology
Learning Geography	Traditional tools like maps and globes are rarely adapted for visually impaired learners, restricting their exploration of geographic concepts.	Making them inaccessible to visually impaired students and limiting their understanding of geography.	Traditional tools are visually designed, neglecting the needs of visually impaired students.
Sports Activity	Several challenges, primarily related to mobility, safety, and accessibility	Blind students face difficulty navigating sports environments, which may be unfamiliar or lack proper orientation	Lack of awareness, inadequate training, insufficient specialized equipment, and limited resources

Table 3. Instrumental Challenges in the institute

Scholarly Activity	Challenges	Explanation	Cause
Stylus	Fragility and high cost	Styluses are not durable enough for daily use, leading to frustration and difficulty in progress.	Lack of awareness of the specific needs of blind students.
Talkback	Difficulty mastering gestures	Gesture-based system is hard for first-time users and those with limited tech experience.	Lack of training in Talkback gestures and dependence on auditory cues, which are ineffective in noisy environments.
Tailor Frame	Lack of tactile guides	Blind students struggle with using the tailor frame due to the absence of tactile aids.	Lack of safety features like tactile markings or audio signals.
Dots Book	Limited availability and high cost	Braille books are costly and difficult to produce, leading to limited access and slow production.	Funding shortages, lack of focus on Braille, and limited technology.
Software	High cost and lack of training	Expensive software requires significant training,	High development and licensing costs.

		making it difficult for students to use effectively.	
Slates	Durability and alignment issues	Wooden slates are fragile, and interposing slates require precise alignment, leading to errors.	Traditional designs, lack of innovation, limited user-friendly features, and insufficient training.

5.6 Supporting Key Obstacles Faces for Blind Students:

5.6.1 Funding Limitations: Securing consistent funding through donations and grants is a challenge, affecting service quality and availability.

5.6.2 *Access to Resources and Technology:* High costs and limited availability of assistive technologies hinder students' learning experiences.

5.6.3 *Qualified Staff Shortage:* There's a lack of trained educators skilled in Braille, adaptive methods and mobility, affecting quality teaching.

5.6.4 *Social Stigmas and Low Awareness:* Negative stereotypes and limited awareness reduce community support and impact students' confidence.

5.6.5 *Parental and Family Support:* Families may lack resources or knowledge to fully support their child, affecting progress outside school.

5.6.6 *Employment Opportunities:* Limited job opportunities and lack of awareness in the workforce hinder post-school employment for visually impaired students.

5.6.7 *Infrastructural Challenges:* Creating and maintaining accessible infrastructure is costly and difficult without adequate funding.

6. CONCLUSION

This study underscores the pivotal role of Braille literacy and adaptive technologies in empowering visually impaired students to overcome barriers to equitable education. The case of Taramati Bafna School for the Blind exemplifies progress in resource provision, yet persistent challenges such as gender disparities, resource shortages, and insufficient trained educators remain entrenched, particularly in rural areas with inadequate Braille materials and assistive technologies. Innovations like the Talking Tactile Tablet demonstrate efficacy in enhancing learning outcomes in mathematics and geography, though scalability is hindered by high costs and training gaps.

To address these systemic inequities, targeted interventions must align with global and national frameworks. First, allocating 2% of state education budgets to Braille material production would mitigate resource limitations. Second, partnerships with NGOs like Sight Savers to certify educators in adaptive technologies could bridge pedagogical skill gaps, ensuring high-quality instruction. These measures align with SDG 4 (Quality Education) and India's National Education Policy 2020, both of which prioritize inclusive education and accessibility.

Furthermore, fostering an inclusive ecosystem requires addressing socioeconomic barriers and societal stigmas while nurturing students' diverse talents from cricket and music to aspirations in STEM fields and competitive careers. By integrating these strategies, schools can empower visually impaired students to achieve academic success, social inclusion, and professional contributions, ultimately advancing equitable societal participation.

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