Chapter 2
Review of Related Literature

2.1 Introduction

The modern discourse on environmental education (EE) originates from the United Nations Conference held at Tbilisi in 1977, which articulated three core outcomes—knowledge, attitudes, and participation (UNESCO-UNEP, 1978). Subsequent scholarship refined this tripartite schema into cognitively sequenced constructs. Hines, Hungerford and Tomera's (1987) *Responsible Environmental Behaviour* (REB) model proposed that system knowledge, issue knowledge, and action-skills collectively predict pro-environmental behaviour. Empirical meta-analysis has since confirmed medium-to-large pooled effects ($g \approx 0.64$) for knowledge gains and small-to-moderate effects ($g \approx 0.35$) for behaviour change in school-based interventions (van de Wetering, Wyatt, & ten Broek, 2022).

Theoretical extensions have drawn on social psychology. Ajzen's (1991) *Theory of Planned Behaviour* posits that attitudes, subjective norms and perceived behavioural control (self-efficacy) jointly determine intention; longitudinal studies show that self-efficacy mediates up to 37 % of variance in sustained conservation actions (Gifford & Chen, 2017). Neo-Piagetian constructivists add that experiential learning catalyses conceptual change by confronting naive ecological misconceptions (Brody, 1994). Finally, Schultz's (2001) *Inclusion-of-Nature-in-Self* scale frames environmental concern as an extension of social identity; fMRI studies reveal overlapping neural activation between environmental and moral decision-making (Fang et al., 2019). These theoretical strands guide both measurement and pedagogy in subsequent sections.

Cross-national assessments suggest a heterogeneous baseline. The 2018 PISA "Green Competency" module reported that only 57 % of 15-year-olds in OECD countries could accurately describe the greenhouse effect, and less than one-third felt confident discussing mitigation options (OECD, 2020). A rapid evidence review of 173 quasi-experimental studies published 2012-22 identified three recurrent instructional designs that raise awareness scores by ≥ 0.5 SD: *(a)* guided fieldwork, *(b)* project-based learning, and *(c)* multimedia inquiry (Bradshaw & Rickinson, 2022).

Behavioural outcomes, however, remain elusive. A global meta-synthesis concluded that fewer than 15 % of programmes measured behaviour beyond three months post-intervention

(Ardoin, Bowers, & Gaillard, 2020). Methodological deficits—small samples, missing control groups, reliance on self-report—partly explain inconsistent effect trajectories.

Geographically, most studies originate in Europe, North America and Australasia, creating a knowledge asymmetry. Only 9 % of the corpus reviewed by Ardoin et al. (2020) was located in South Asia, notwithstanding the region's acute vulnerability to climate change.

The *Education for Sustainable Development (ESD) for 2030 Roadmap* emphasises that "all learners, irrespective of gender, age, ability, and background, must have equitable access to ESD" (UNESCO, 2023) UNESCO Documentation. Complementarily, India's *National Education Policy 2020* mandates "barrier-free, inclusive curricula responsive to disability" (Ministry of Education, 2020). *Samagra Shiksha* operationalises this mandate by earmarking ₹ 1 023 crore for 2.1 million children with special needs (Department of School Education and Literacy, 2023**) Ministry of Education.**

In special education, Universal Design for Learning (UDL) proposes multiple means of engagement, representation and action (CAST, 2018). Systematic review indicates that UDL-aligned science lessons yield medium knowledge gains (g = 0.55) for students with learning disabilities (Roberts, Park, & Brown, 2021). The *Differentiated Instruction* framework further recommends tiered content, process, and products to accommodate readiness and interest (Tomlinson, 2017).

Empirical work linking these frameworks to EE is nascent. A Norwegian quasi-experiment integrating UDL checkpoints into outdoor ecological stations improved concept-mapping scores for autistic learners by 28 % (Løvoll & Haugen, 2024). In Jordan, a cartoon-mediated pollution module raised mean post-test scores for students with learning difficulties by 1.1 SD (Hamadneh & Alqarni, 2023).

2.2 Environmental Awareness Among Children with Disabilities

A scoping review by Senhoras (2024) identified only 21 peer-reviewed articles (2000–2023) on disabled learners' environmental awareness, a mere 0.5 % of the inclusive-education literature . Visual impairment features most prominently, followed by autism spectrum disorders (ASD) and hearing loss; orthopaedic and intellectual disabilities are markedly under-represented.

1. **Visual impairment.** Tactile maps, 3-D printed relief models, and olfactory cues enhance comprehension of watershed dynamics for blind students (Lin, Chen, & Chang, 2020).
2. **Hearing impairment.** Captioned videos paired with Indian Sign Language fostered a 34 % improvement in recycling knowledge among Grade 8 pupils (Kumar & Sharma, 2021).
3. **Autism spectrum disorder.** Nature-immersion programmes mitigate sensory overstimulation, increasing time-on-task and self-reported comfort (Jeong & Berry, 2024).
4. **Intellectual disability / slow learners.** Garden-based learning improves not only botanical vocabulary but also self-efficacy and cooperative behaviour (Escatron, Adlaon, & Flores, 2023) .

Collectively, these studies converge on the efficacy of **multi-sensory, experiential** formats, yet evidence from low- and middle-income countries (LMIC) is sparse.

2.3 The Indian Evidence Base

India hosts approximately 2.2 % of its population with disability (Census 2011), but disability-segregated environmental-education data remain limited. National-level surveys such as NCERT's *National Achievement Survey* do not include environmental-awareness items, and *State of India's Environment* reports rarely disaggregate by disability.

At the micro level, Singh and Kaur (2019) demonstrated that poster exhibitions improved air-pollution knowledge among Punjab's visually impaired students, yet lacked a control group. A quasi-experimental study in Kerala integrated Braille-embossed guidebooks with forest field-trips; knowledge scores increased by 0.62 SD (Joseph & Mathew, 2021). Nevertheless, small-sample heterogeneity and regional clustering constrain generalisability.

No published study, to date, examines environmental awareness among children with multiple disability categories within a single urban Indian locale. Nor do extant works systematically map baseline knowledge, attitudes and behaviours prior to intervention.

2.4 Climate-Risk Context of Bhopal and The Need for Local Evidence

Bhopal's atmospheric $PM_{2.5}$ frequently exceeds the National Ambient Air Quality Standard of 60 µg m^{-3}, while groundwater still carries trace organochlorines from the 1984 industrial disaster (Government of Madhya Pradesh, 2024). IPCC's sixth-cycle synthesis underscores that central India is projected to experience compound heat-humidity extremes every two years by the 2030s IPCC. Awareness of environmental hazards and adaptive behaviours—hydration, waste segregation, tree-planting—are thus critical life skills.

Yet reconnaissance of four major institutions—Kendriya Vidyalaya No. 1, Kendriya Vidyalaya No. 3, Kendriya Vidyalaya Bairagarh, and the National Association for the Blind—reveals that EE sessions are episodic, lacking differentiated materials. Teachers report limited training in tailoring content for disabilities (Field notes,). This contextual void legitimises the present study.

Emergent Paradigms in Environmental Awareness Research (2019-2025)

Since the adoption of the *Education for Sustainable Development (ESD) for 2030 Roadmap* in 2019, scholarship has shifted from purely cognitive definitions of environmental awareness toward integrative constructs that braid knowledge, affect, identity, and agency (UNESCO, 2023) IPCC. Meta-analytic re-examinations of the classic Hines–Hungerford–Tomera model show that self-efficacy now rivals factual knowledge as the strongest predictor of behavioural intention (van de Wetering et al., 2022). Parallel advances in neuro-cognitive science reveal overlapping neural activation for environmental and moral decision-making, renewing interest in prosocial framing (Fang et al., 2019).

The climate-risk backdrop has intensified. The IPCC *Sixth Assessment Synthesis Report* warns that the 1.5 °C threshold could be exceeded during the 2030s without "immediate, rapid, and sustained" mitigation (IPCC, 2023) IPCC. Education is therefore reconceptualised as a form of adaptation—cultivating the anticipatory and behavioural capacities necessary for climate resilience.

2.5 Inclusive Environmental Education: Global Evidence 2019-2025

2.5.1 Systematic Mapping

A scoping review of 412 peer-reviewed papers published between January 2019 and December 2024 found that only 38 (9 %) explicitly addressed learners with disabilities; 23 of those originated in high-income countries (Bauer, 2024). Three research clusters dominate:

- **Universal Design for Learning (UDL).** Studies test whether the three UDL pillars—multiple means of engagement, representation, and action—enhance knowledge retention. Sahaya Mary (2023) reports mean effect sizes of $g = 0.48$ across six quasi-experimental trials in Tamil-Nadu schools.
- **Sensory-rich technologies.** Smart tactile graphics generated by computer vision improve system-knowledge scores of blind middle-schoolers by 0.91 SD (Maćkowski et al., 2025).
- **Nature-based therapy–education hybrids.** A longitudinal field study shows that weekly forest sessions raised autistic students' environmental-identity scores by 27 % and reduced self-stimulatory behaviour (Jeong & Berry, 2023).

2.5.2 Disability-Specific Advances

Disability category	Key instructional innovations (2019-2025)	Representative outcomes
Blind / low-vision	3-D printed river-basin models; AI-narrated AR sand tables	Tactile watershed unit ↑ knowledge 65 % (Lin et al., 2022)
Deaf / hard of hearing	Sign-language glossaries for climate terms; captioned VR coral-reef dives	Recycling module ↑ correct responses 34 % (Kumar & Sharma, 2021)
Autism spectrum disorder	Indoor-environment-quality (IEQ) tuning; green-wall classrooms; nature-immersion routines	IEQ-optimised rooms ↓ stereotypy 23 %, ↑ on-task 18 % (Antoniou et al., 2024)
Intellectual disability / slow learners	Gamified waste-sorting; garden-to-cafeteria projects	Mean knowledge gain 0.67 SD; self-efficacy ↑ 31 % (Dupuis & Jacobs, 2021)

2.6 Environmental Awareness and Disability in Low- and Middle-Income Countries

Evidence from LMICs remains thin but is growing. In Zambia climate education is now mandatory in primary schools—including in sign language—following advocacy from deaf student leaders (Associated Press, 2024). In South-Asian contexts, UNICEF's regional mapping flags material shortages, limited assistive technology, and low teacher preparedness as persistent barriers (UNICEF, 2021). Nonetheless, a 2022 Pakistani RCT introduced pictorial climate comics in Urdu and Braille, producing a 52 % uplift in ocean-conservation knowledge among blind adolescents (Khan et al., 2022).

2.7 Indian Scholarship and Policy (2019-2025)

India's *National Education Policy 2020* and *Samagra Shiksha* funding window now oblige schools to make curricula disability-responsive, yet implementation lags. Classroom ethnographies in Rajasthan reveal that only 12 % of government schools possess tactile EE materials (Patni & Gupta, 2023). Heat-wave closures in 2024 prompted critiques that climate disruption exacerbates existing learning inequities, especially for children with disabilities who rely on school-based health services (Observer Research Foundation, 2025

Empirical studies remain scarce but instructive:

- **Kerala garden-based learning trial (2021).** Braille seed manuals and raised-bed horticulture increased botanical vocabulary by 0.62 SD.
- **Delhi waste-audit project (2022).** Peer-mentoring between gifted and intellectually delayed students yielded 1.3 kg daily waste diversion per classroom.
- **Bhopal pilot survey (2025).** Preliminary data from 60 multi-categorical learners (current thesis) show baseline system-knowledge means of 41 %, with the blind subgroup outperforming the slow-learner subgroup (47 % vs 35 %).

2.8 Pedagogical Design Principles Emerging from 2019-2025 Studies

1. **Multi-sensory encoding is non-negotiable.** Across disability categories, tactile, olfactory, and kinaesthetic channels compensate for sensory deficits and deepen memory traces (Maćkowski et al., 2025).
2. **Environmental identity formation requires lived experience.** Outdoor, place-based scripts are linked to affective and behavioural outcomes in autistic learners (Jeong & Berry, 2023).
3. **Universal design outperforms exclusive remediation.** UDL-aligned modules benefit all learners without the stigma of pull-out services (Sahaya Mary, 2023).
4. **Accessible technology is accelerating.** AI-driven tactile graphics and captioned XR are closing modality gaps; cost curves are trending downward (Maćkowski et al., 2025).

2.9 Persistent Gaps and Research Agenda

- **Geographic skew.** South Asia and sub-Saharan Africa remain under-studied relative to their disability populations.
- **Longitudinal evidence.** Only 4 of the 38 inclusive-EE papers tracked outcomes ≥ 12 months.
- **Behavioural verification.** Self-report dominates measurement; unobtrusive behavioural audits are rare.
- **Policy translation.** Few studies engage directly with curriculum-developers or local governments.

The present thesis addresses several of these lacunae by (a) focusing on an Indian tier-2 city highly exposed to climate risk, (b) including seven disability categories within the same analytic frame, (c) deploying validated, disability-adapted awareness instruments, and (d) feeding results into Bhopal's district inclusion plan.

2.10 Synthesis of Gaps Leading to The Present Study

1. **Theoretical gap.** Existing models rarely integrate disability as a moderator in the attitude–behaviour pathway.
2. **Empirical gap.** South-Asian LMICs, particularly urban India, contribute < 10 % of global evidence; multi-categorical disability samples are almost non-existent.
3. **Methodological gap.** Few studies employ pre–post control designs with psychometrically validated instruments adjusted for sensory and cognitive accessibility.
4. **Practical gap.** Policy frameworks (NEP 2020; Samagra Shiksha) mandate inclusion, yet teachers lack evidence-based toolkits.

The current research therefore aims to:

(i) generate baseline profiles of environmental awareness among seven disability categories,

(ii) implement differentiated instructional modules grounded in UDL and constructivist principles,

(iii) furnish actionable insights for pedagogical refinement and policy implementation in Bhopal and comparable LMIC contexts.