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From Empathy To Cognition: A Behaviourally – Informed Pedagogical Frameworks For Sustainable UX Design Education

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Abstract– *This study presents a pedagogical framework designed to enhance cognitive flexibility and empathy, and contextual understanding in undergraduate user experience (UX) design education through immersive community-based learning. Conducted over a longitudinal period of three years, the research engaged students at the institute in contextual inquiry, ethnographic fieldwork, and user-centred participatory immersion across diverse regions in India - including rural, semi-urban and urban settings. These settings offered rich, distinct socio-cultural diversity and terrain-specific challenges. This pedagogical research integrates environmental immersion into UX education, enabling students to understand socio-ecological systems through design ethnography.*

Using a mixed-methods approach, including the observations, student surveys, select in-depth interviews, and systematic performance-based analysis of design artefacts, the study observed measurable improvements in students' metacognitive awareness, empathetic reasoning, and need-finding skills- core constructs in UX problem-space framing and user-centred design.

Two original pedagogical tools emerged: The C.E.R.C.L.E. rubric (Cognition, Empathy, Reflection, Context, Learning, Engagement) to assess cognitive and behavioural outcomes, and the I.D.E.A.L. model (Immerse, Design, Engage, Assess, Loop) to guide cyclical curriculum integration. These frameworks foreground actionable strategies for embedding immersive learning into UX pedagogy.

The findings highlight how experiential learning, when aligned with behavioural insights and reflective practice, cultivates socially responsive, cognitively agile, and ethically grounded designers. This work contributes a replicable model for design education, aligned with growing demands for inclusive, adaptive and context-aware UX practice.

Keywords– *Experiential Learning, Behavioural Science, Cognitive Development, Pedagogical Innovation, User Experience (UX) Education, Environmental Immersion, Sustainable Design Thinking*

I. INTRODUCTION

In environmentally diverse nation like India, user behaviours and community needs are deeply tied to ecological constraints, making sustainability a core design challenge.

As user experience (UX) design evolves into a socio-technological discipline, it is increasingly clear that mastering tools and aesthetics alone is insufficient. Contemporary UX education must also cultivate cognition, empathy, reflection, and contextual intelligence in learners [1], [2], especially in culturally diverse regions like India, where user behaviours vary significantly across social and regional lines.

While traditional studio instruction supports technical growth, it often cannot prepare students for real-world ambiguity, ethical complexity, and deep user engagement [3]. Skills such as critical reflection, perspective-taking, contextual awareness, and iterative learning - Core 2 effective UX - are rarely developed in isolation.

In response, global design pedagogy has shifted toward experiential learning through community immersion and ethnographic inquiry [4]. However, most such efforts remain short–term and poorly integrated into formal curricula, lacking tools to evaluate internal transformation.

To bridge this gap, I launched a longitudinal initiative integrating immersive field work into courses like user research, ethnography, and social psychology in the UX program at MIT Academy of Engineering's School of Design. Students engaged with diverse communities across India – tribal villages in Uttarakhand, coastal Goa, rural Alandi, and urban Pune, and many more- navigating complex terrains, cultures, and design challenges. The settings provoked not just observation but engagement, assessment, and iterative reflection, forming the basis of an organic cyclic learning model.

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Qualitative data from reflections, artefacts and critics revealed shifts in how students framed problems, co-created with users and acknowledged bias and ethical nuance. Themes such as context sensitivity, user engagement, and metacognitive insight emerged repeatedly, prompting two key questions:

1. How can such internal growth be assessed meaningfully across contexts?
2. How can immersive learning be systematically integrated into design curricula?

In response, two pedagogical tools were developed:

- The C.E.R.C.L.E. rubric: To assess behavioural and cognitive shifts across six dimensions – Cognition, Empathy, Reflection, Context, Learning, Engagement.
- The I.D.E.A.L. model: five-phase curriculum integration cycle - Immerse, Design, Engage, Assist, Loop.

These frameworks evolved organically through faculty-student interactions, studio feedback, and thematic coding, not from theory alone. Reflections from 57 students pre and post immersion frequently cited "perspective inversion", "moral responsibility", and "challenged assumptions", echoing findings in effective neuroscience [5], social learning theory [6], and empathy research [7].

Fig. 1 Students interacting with locals during immersion

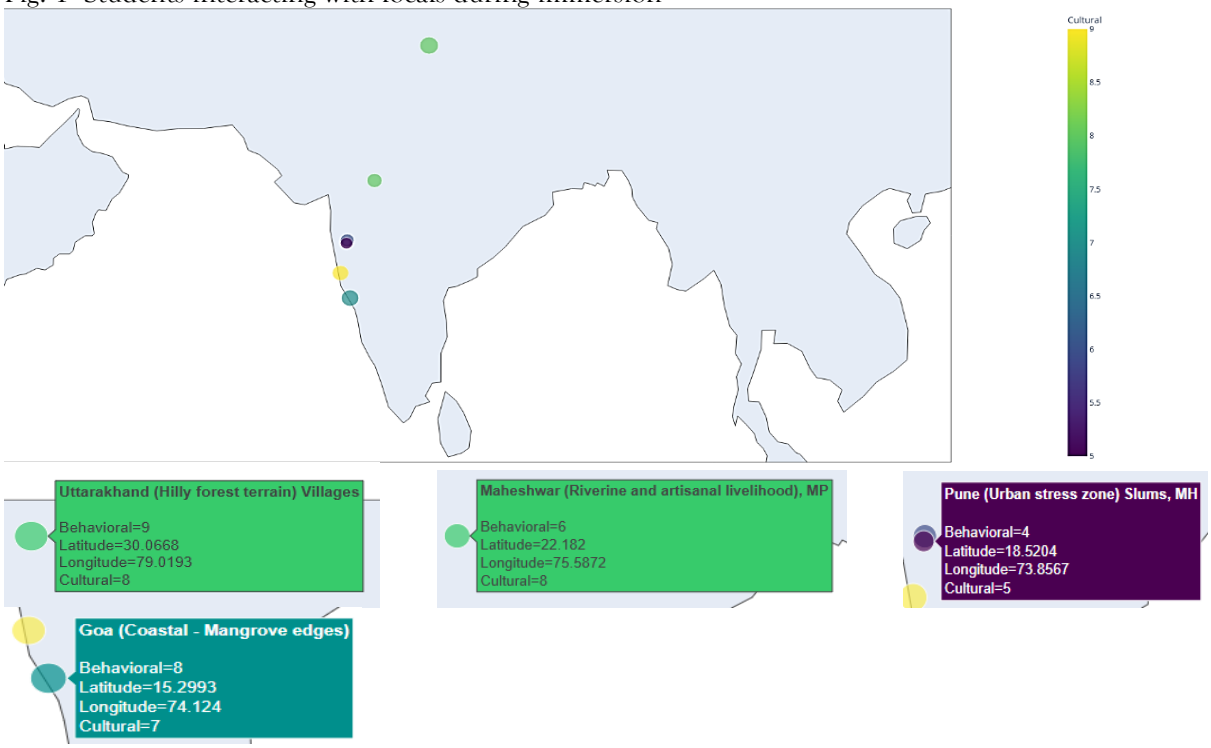

Fig. 2 Snapshots of geographical locations of immersion sites across India, overlaid with behavioural learning

Each site presented not only cultural, but also ecological challenges – such as water scarcity, environmental degradation, or sustainable livelihood – requiring students to design with environmental sensitivity.

Table. 1 Mapping of Immersion Sites to Socio-Ecological Features

Site	Ecological Zone	Environmental Challenges	Key Learning
Uttarakhand	Hilly / Forested	Accessibility, tribal ecological knowledge	Empathy for traditional resource systems
Goa	Coastal (Mangrove edges)	Tidal patterns, sustainable fishing practices	Sustainable co- creation, respect for local ecosystems
Pune	Urban / Low- income	Pollution, water scarcity, mobility stress	Ethical navigation, design for constrained infrastructure
Maheshwar	Riverine / Artisanal zone	River use, generational craft, digital divide	Cultural preservation, inclusive design

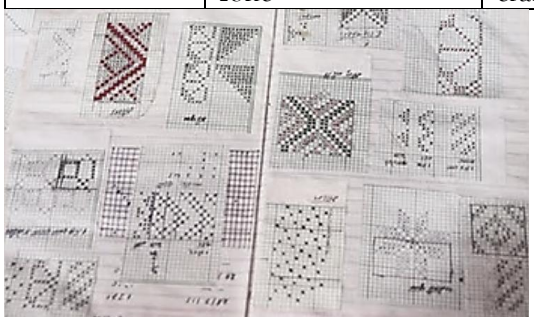

Fig. 3 Snapshot of student notes

II. LITERATURE REVIEW

A. Experiential Learning and Reflective Practice in Design Education

These immersive experiences not only promote empathy but also deepen ecological consciousness and sustainable thinking in future designers.

Kolb's theory of **experiential learning** [4] emphasises a cycle of **doing, observing, reflecting,** and **re-applying** - Especially relevant to UX, where learners engage real users in iterative design. Dewey [10] further highlights the **moral and reflective value** of learning through authentic social experience, such as field immersion. These Encounters often prompt **cognitive dissonance**, challenging student assumptions and cultural biases [1], [3].

Despite this, Gray et al. [2] note that most design programs still **lack tools to assess internal growth**, like empty or ethical reasoning, focusing instead on external outputs such as wireframes and prototypes. This gap points to the need for structured rubrics that evaluate how students **think, feel,** and **reflect** throughout the design process.

B. Behavioural and Cognitive Foundations of UX Learning

Bandura's Social Learning Theory [6] explains how students learn by observing users within real-world systems – absorbing not just behaviours but values and cooking strategies. These insights directly inform students' design ethics and framing.

Neuroscience further suggests this: Immordino-Yang and Damasio [5] found that **emotionally charged experiences** activate neural pathways tied to empathy and moral reasoning. Empathy, as Decety and Lamm [7] argue, is not innate but developed through repeated, scaffolded exposure to diverse user perspectives, making structured immersion central to cognitive-emotional growth.

C. Pedagogical Gaps in Ux Education Models

Popular models like the Double Diamond, IDEO's Human-Centred Design Process, or Stanford's d.school Framework Guide process stages but rarely track how students **evolve as designers** [1], [8]. They overlook behavioural development, long-term growth, or ethical reflexivity.

Razzouk and Shute [9] propose reframing design education as a cognitive ecosystem, emphasising ambiguity and reflection, yet they offer no scalable tool for measuring transformation. In India, Joshi and Sharma [3] observed positive shifts in student empathy during immersion projects, but no Framework

existed to evaluate or embed this growth across curricula.
This study addresses that gap with the structured models- **C.E.R.C.L.E.** and **I.D.E.A.L.**- Design to capture and guide behavioural development in UX learners.

III. Rationale For Framework Centred Methodology

This study is grounded in the belief, supported by experiential, affective, and social learning research [4], [5], [6] - The **behavioural transformation in design learners must be both observed and scaffolded**. As mentioned earlier, conventional UX models for short in addressing how students internalise empathy, reframe assumptions, or navigate ethical complexity [2], [9].
To address this, the study introduces two inductively developed frameworks - **C.E.R.C.L.E.** and **I.D.E.A.L.** - used both as evaluation tools and curricular guides. These frameworks emerged from empirical classroom data, including student reflection, studio critiques, and artefact analysis over six semesters.
The **C.E.R.C.L.E. rubric** captures six recurring dimensions of transformative learning:

- **Cognition** (problem reframing)
- **Empathy** (emotional Insight
- **Reflection** self-awareness
- **Context** (cultural/environmental sensitivity)
- **Learning** (adaptive thinking)
- **Engagement** (user collaboration)

By making these internal shifts measurable C.R.C.L.E. answers call in UX and neuroscience for reflective behavioural evaluation tools [5], [7].

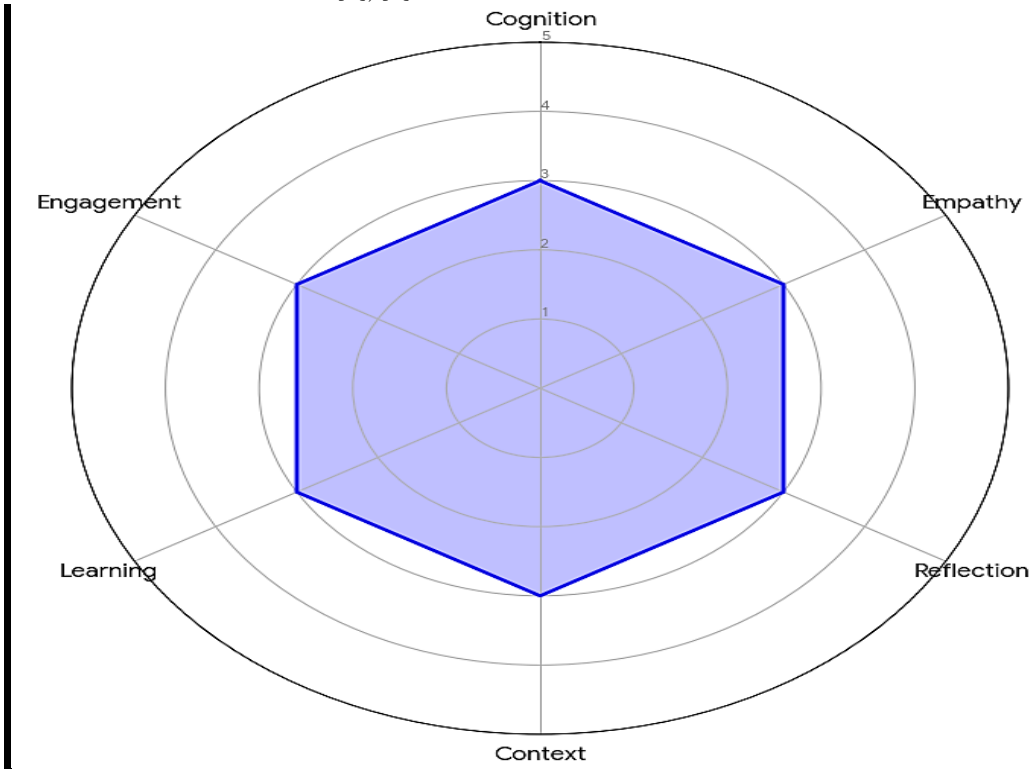

Fig. 4 Radar chart plotting student growth across C.E.R.C.L.E. dimensions

In parallel, analysis of student timelines revealed in natural five-stage cycle:

- **Immerse**- observe unfamiliar contexts
- **Design** - generate grounded solutions
- **Engage** - co-create with users
- **Assess** – evaluate critically
- **Loop** – iterate and re-immerse

This model became the **I.D.E.A.L. cycle**, aligned with **Kolb's learning loop** and **Bandura's social modelling** principles.

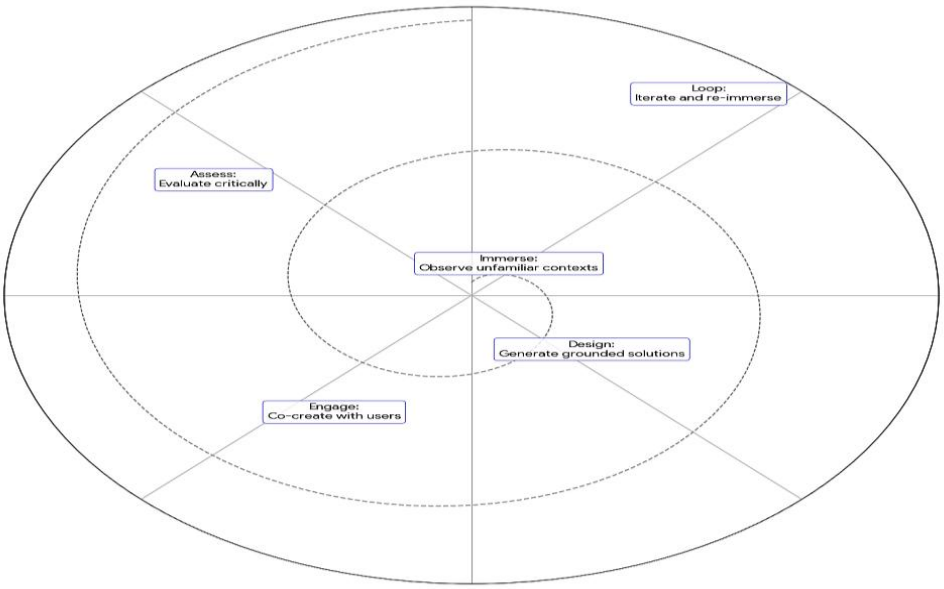

Fig. 5 Spiral diagram of the I.D.E.A.L. cycle annotated with student behaviours.

Together, these frameworks can help design institutions:
- Go beyond tool-based instruction
- Measure internal growth
- Integrate real-world learning across cultures and semesters.

They form the foundation for the mixed-methods evaluation that follows in the study.

IV. METHODOLOGY

A. Research Design and Purpose

This longitudinal mixed-methods study (2022-2025), grounded in experiential social and cognitive empathy learning theories, aimed to:

- Examine how field immersion affects **cognition, empathy, reflection, context awareness, learning, and engagement**.
- Develop and validate two pedagogical frameworks - **C.E.R.C.L.E.** and **I.D.E.A.L.** - Drawn from Student experiences.
- Address gaps in UX education by proposing a replicable immersion-centred curriculum model.

B. Participants and immersion sites

This study involved **57 UX undergraduates and 6 in-depth interviewees,** enrolled in courses like ethnographic research, user Research, social psychology and studio projects.

The sites were chosen to reflect not only cultural but also ecological diversity – offering exposure to environmental challenges such as water access, coastal degradation, and tribal land- use practices.

Students engaged with the diverse Communities across India, including:

- **Rural/Tribal**: Maheshwar, Uttarakhand villages.
- **Coastal**: Morjim (Goa), Savantwadi (Konkan)
- **Urban/Low-income**: Artisans and other communities in Pune
- **Transitional towns**: Alandi

and other sites explored by students for their studio projects.

These sites offered varied **linguistic, ecological,** and **behavioural complexities** that required students to design iteratively and ethically.

C. Data Collection Tools

1. Pre-immersion Survey (Quantitative)

Administered before fieldwork, this Google form survey established a baseline in:

- **Problem framing**: What problem did you initially plan to solve?
- **Assumptions**: What assumptions did you hold about the users, systems, and environment?
- **Context Confidence**: How confident were you in your understanding of the context before immersion?
- **Exposure history**: Describe any previous exposure you had to this community/domain.

These questions aligned with the **Cognition, Context,** and **Learning** dimensions of **C.E.R.C.L.E.** while capturing the initial Immerse and Design stages of **I.D.E.A.L.**

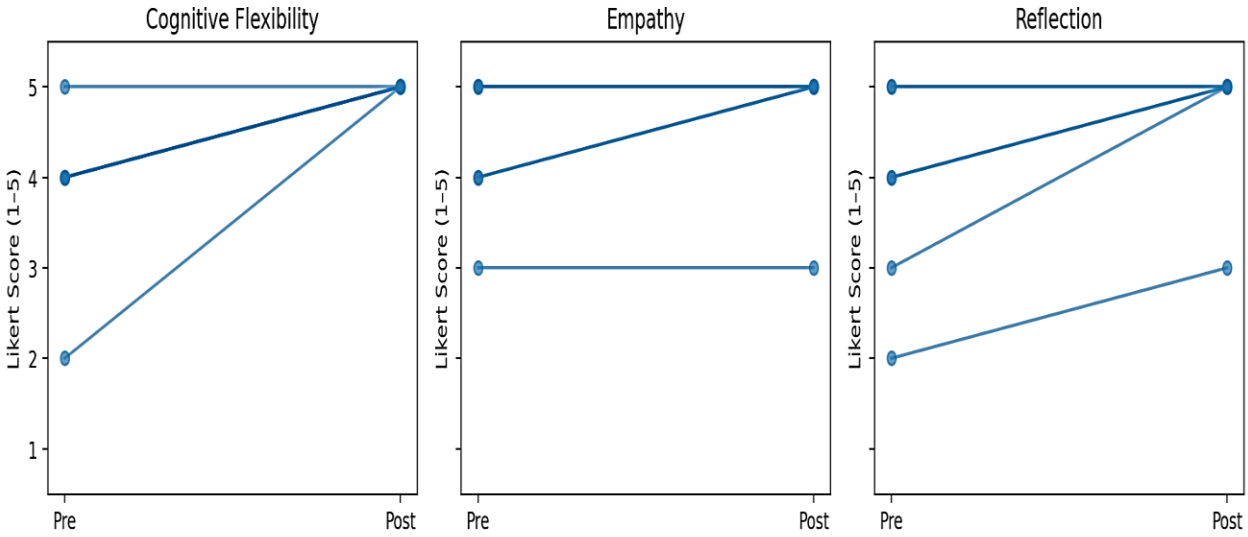

Fig. 6 Mean comparison of self-rated empathy, reflection, and cognitive flexibility before and after immersion (n = 57)

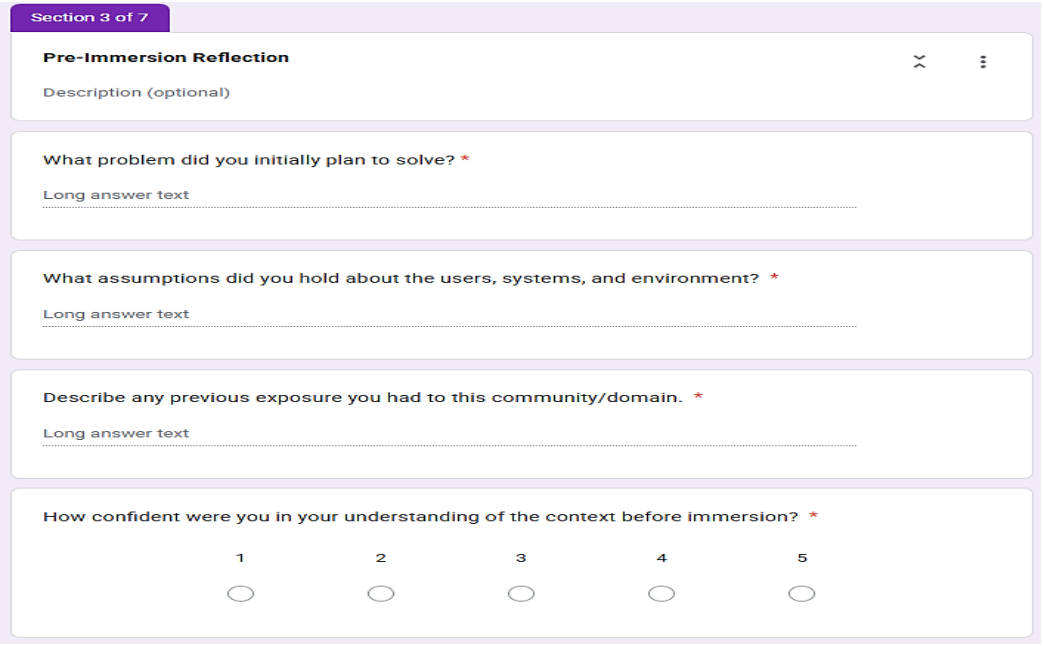

Fig. 7 Snapshot of the questions floated to the students pre-immersion

2. Post-immersion Survey (Quantitative + Open responses)
Conducted immediately after immersion, this survey measured:

- Self-reported growth in empathy, reflection, and use-centred framing (Likert scale: 1-5)
- Instances of design alteration due to user input (I.D.E.A.L. "Loop")
- Open responses to questions like:
  - **Perspective shifts**: Describe a moment that challenged your assumptions.
  - **User-driven iteration**: What design decisions did you revise after user engagement?
  - **Ethical awareness**: Describe any ethical dilemmas or cultural insights encountered.
  - **Growth Metrics:** Read your confidence in understanding user needs and context before and after immersion (1-5).

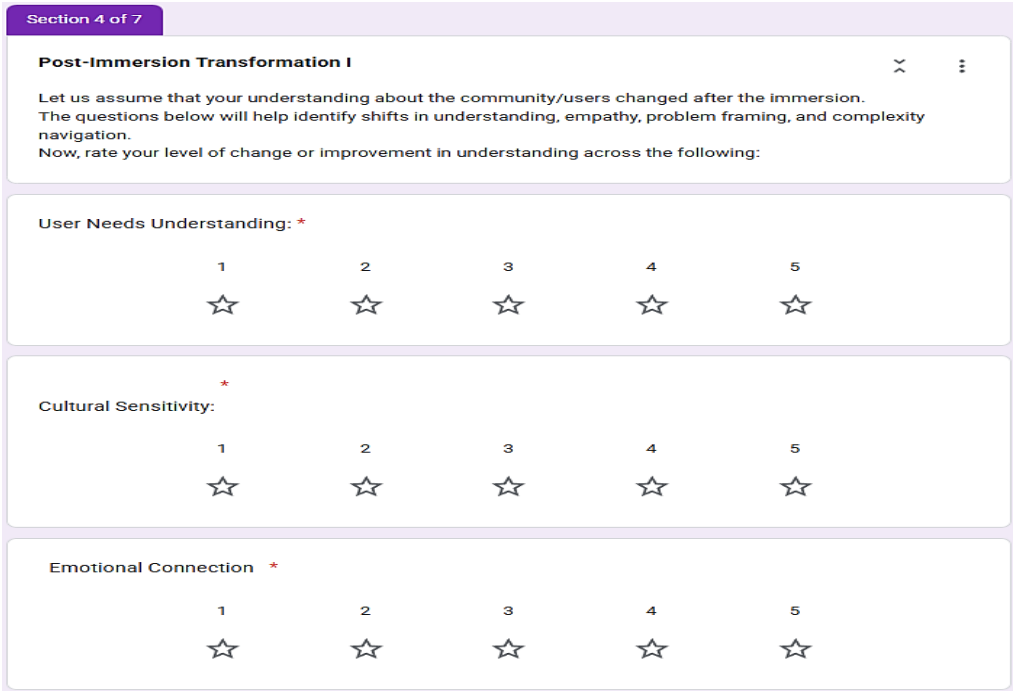

Fig. 8 Snapshot of some of the questions floated to the students post-immersion

3. Informal interviews (Qualitative)

Six students consented and participated in extended interviews to reflect upon:

- **Cognition**: What problem did you initially miss frame?
- **Empathy**: What surprised you about user behaviour today?
- **Reflection**: What internal shifts or discomforts did you experience?
- **Context**: What environmental all cultural conditions influenced your design ideas?
- **Learning**: How did your approach evolve based on this experience?
- **Engagement**: What role did users play in shaping your prototypes now?

These responses were used for thematic coding and offered insight into students' traversal through the IDEAL cycle, especially in **Engage, Assess**, and **Loop** stages.

4. Design Artefacts

Student submitted design projects (reports, wireframes, interactive prototypes). These artefacts were evaluated using a **C.E.R.C.L.E. rubric** to capture cognitive–behavioural quality, not just design finish.

Fig. 9 Sample of student artefact submission

D. Analytical Strategy

- **Quantitative**: Likert scale data showed pre-post shifts in empathy and contextual awareness. Open responses were coded for key reflective phrases.

- **Qualitative**: Interviews were coded against **C.E.R.C.L.E.,** mapping patterns across **I.D.E.A.L.** stages.
- **Artefact evaluation**: Faculty scored student work for context alignment, iteration, and ethical insight using the rubric.

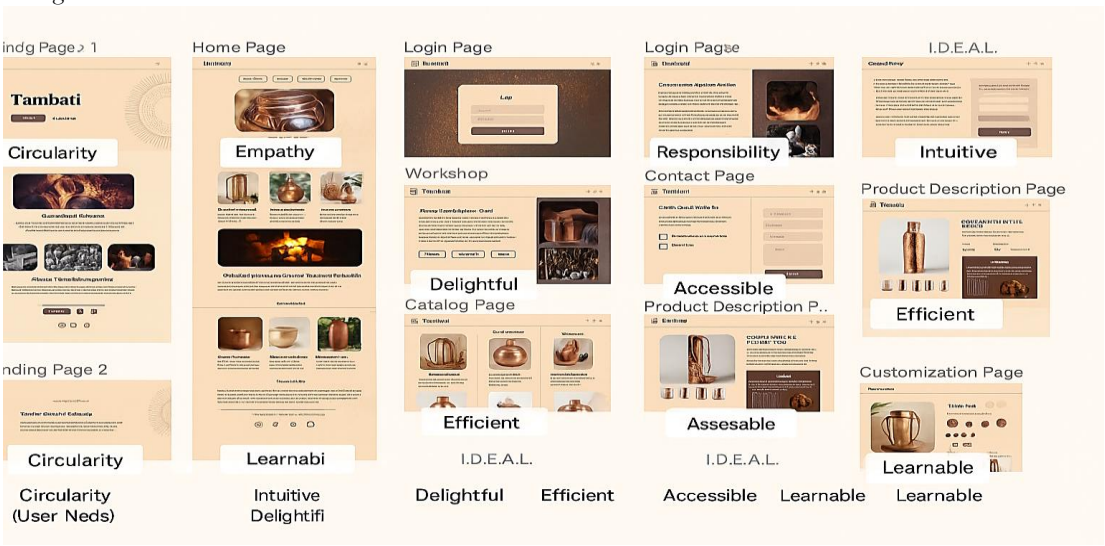

Fig. 10 Sample of assessment of student work w.r.t. CERCLE and IDEAL frameworks.

E. Ethical and Pedagogical Considerations

- Students gave informed consent for participation and anonymised use of their work.
- Faculty facilitated pre-immersion orientation and post-immersion debriefs to ensure psychological safety and reflective integration.

Sites for chosen in consultation with community partners to ensure reciprocity and ethical engagement.

V. RESULTS

A. Quantitative Outcomes: Self-Reported and Rubric-Based Growth

1. Likert Scale Analysis (pre/post survey)

Survey data revealed significant gains in core learning outcomes. When comparing pre- and post–immersion responses:

- **Empathy** showed a 28% increase in main scores (from 3.1 to 4.0)
- **Contextual awareness** rose by 25%
- **Confidence in reframing problems** improved by 22%
- **Ethical sensitivity** indicators increased notably in open responses

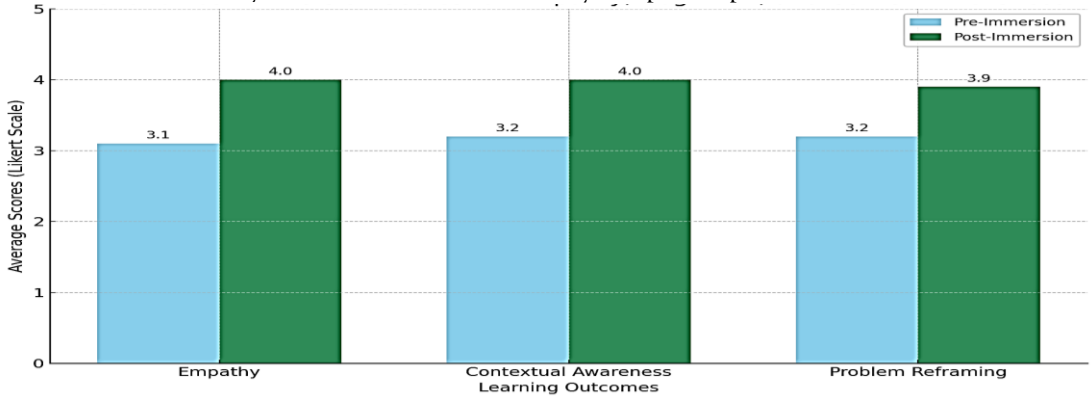

Fig. 11 Bar chart comparing pre- and post–immersion scores for empathy, cognition (problem reframing), and context–awareness.

B. Framework-Based Rubric Scores (C.E.R.C.L.E. and I.D.E.A.L.)

1. C.E.R.C.L.E. Rubric Evaluation

Faculty – rated artefact scores (n= 57) indicated high performance in:

- **Engagement (avg. 4.4 / 5)**: User co-creation, participatory testing, and iteration.

- **Empathy (avg. 4.2 / 5)**: Evident in student works and design choices
- **Context (avg. 4.1 / 5)**: Solutions reflected socio-cultural and environmental factors

Table. 2 Average C.E.R.C.L.E Rubric Scores across all six dimensions

CERCLE Dimension	Average Score (out of 5)	Key Indicators
Cognition	3.9	Problem reframing, critical thinking in design approaches
Empathy	4.2	Evident in student works, user-centred framing
Reflection	4.0	Self-awareness, ethical considerations, and perspective shifts
Context	4.1	Cultural, environmental, and socio-economic sensitivity
Learning	4.0	Adaptive thinking, iterative learning, process evolution
Engagement	4.4	User co-creation, participatory testing, iteration

2. I.D.E.A.L. Sequence Mapping

Reflections and project logs revealed a recurring engagement pattern:

- 100% of students engaged in **Immerse → Design**
- 92% proceeded to **Engage** and **Assess**
- 73% iterated through the loop phase

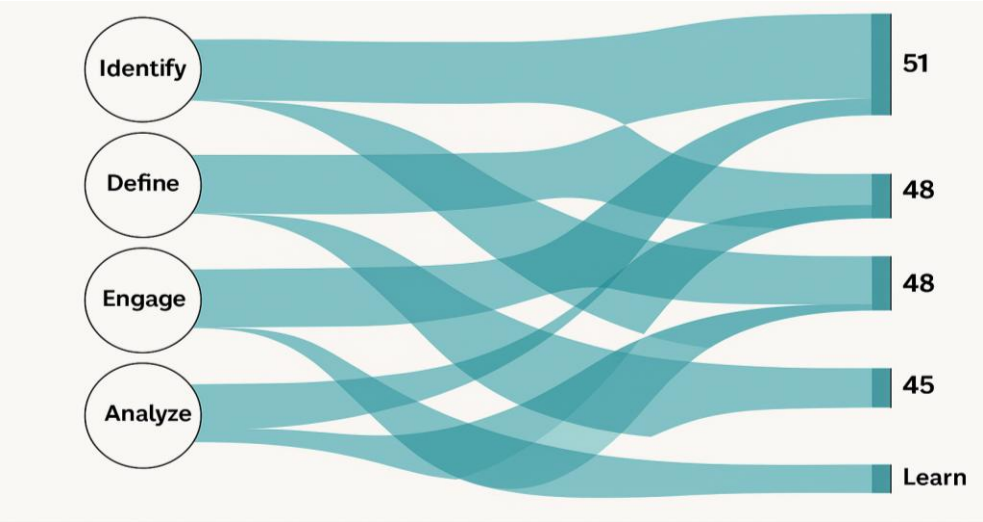

Fig. 12 Sankey diagram showing student adherence to I.D.E.A.L. stages

C. Qualitative Insights from Reflections and Interviews

1. Thematic coding (reflection logs + interviews)

Manual coding of reflection logs and in-depth interviews (n = 6) produced 160 + instances of themes aligned with the C.E.R.C.L.E. rubric.

- "Perspective shift" appeared in 38 responses
- "Cultural humility" in 27
- "Problem re-framing" in 22
- "Moral discomfort" in 19

Table. 3 Frequency of key C.E.R.C.L.E.- aligned themes across qualitative reflections.

C.E.R.C.L.E. Theme	**Frequency in Reflections (n=57)**
Cognition (reframing problems)	45
Empathy (perspective-taking)	48
Reflection (metacognition)	41
Context (cultural sensitivity)	38
Learning (process evolution)	42
Engagement (user collaboration)	44

Table. 4 Mapping of the most recurrent word themes across C.E.R.C.L.E.

Dimension	Top Keywords
Cognition	problem, seeing, thinking, understanding, narrow
Empathy	white, family, moment, stay, story
Reflection	realization, challenging, really, life, initially
Context	support, design, widely, economic, study
Learning	local, unexpectedly, language, tone, maps
Engagement	participatory, interaction, routines, observational, observed

2. Representative Student Quotes

"I started seeing the problems less as 'lack of tech' and more about trust, access, and habits."

- Student from the 2024 cohort, Utterakhand immersion.

"I developed a Much deeper appreciation for the fishermen's customs, spiritual beliefs (such as rituals before fishing) and generational practices. Our earlier assumptions were more functional and problem-solving oriented, but we learned to respect their rhythms, symbols, and traditions, realising that solutions must align with - not override – their cultural fabric."

- Student from the 2022 cohort, Morjim-Goa immersion.

"I reframed the initial problem from 'creating a website' to 'empowering artisans through digital presence and storytelling'."

- Student from the 2023 cohort, Maheshwar-Madhya Pradesh immersion.

These quotes reflect students' progression from **solutionism to socio-ethical design framing**.

D. Comparative Outcomes Across Sites

Students' learning very slightly by region:

- **Rural/ semi-urban sites (e.g., Uttarakhand, Maheshwar)** prompted stronger empathy and reflection scores
- **Urban sites (e.g., Pune)** emphasised ethical complexity and user navigation
- **Coastal sites (e.g., Goa, Konkan)** enhanced engagement through language and cultural friction

Summary of results

- **Quantitative surveys** confirm increases in empathy, reflection and contextual understanding.
- **C.E.R.C.L.E. rubric** Validated as an effective multi–dimensional assessment tool.
- **I.D.E.A.L. model** confirmed as a natural sequence in student behaviour, supporting its use as a curricular planning framework.

- Student artefacts show an authentic shift from interface–focused design to **ethically reflective context–aware UX practice**.

VI. DISCUSSION

The study demonstrates that **immersive, community-based learning** can meaningfully enhance behavioural and cognitive development in UX students. Across multiple contexts, students exhibited growth in **cognition, empathy, reflection, context, learning, and engagement**- the six dimensions later formalised in the **C.E.R.C.L.E. rubric**.

A. Immersion as a Catalyst for Transformation

Guided by experience learning theory [4], Social learning [6], and affective neuroscience [5], the results affirm that authentic field exposure enables students to reframe problems, confront ethical dilemmas, and shift their understanding of users from abstract personas to complex social actors. This supports Gray et al.'s [2] call for deeper behavioural assessment in UX pedagogy.

B. Validating C.E.R.C.L.E. as a Reflective Rubric

The **C.E.R.C.L.E. rubric** proved effective in capturing learners' internal transformations, particularly in empathy, reflection, and user engagement. Unlike conventional rubrics focused on the deliverables, C.E.R.C.L.E. evaluates the **quality of thought, process, and ethical reasoning**, aligning with Decety and Lamm's [7] view that cognitive empathy requires deliberate scaffolding.

C. I.D.E.A.L.: A Pedagogical Cycle of UX Integration

The **I.D.E.A.L. model** (Immerse, Design, Engage, Assist, Loop) emerged from observed student behaviour and offers a **repeatable structure** for embedding immersion into curricula. Its sequence ensures that **empathy, ethics, and context-awareness** are not isolated lessons but integrated phases of learning.

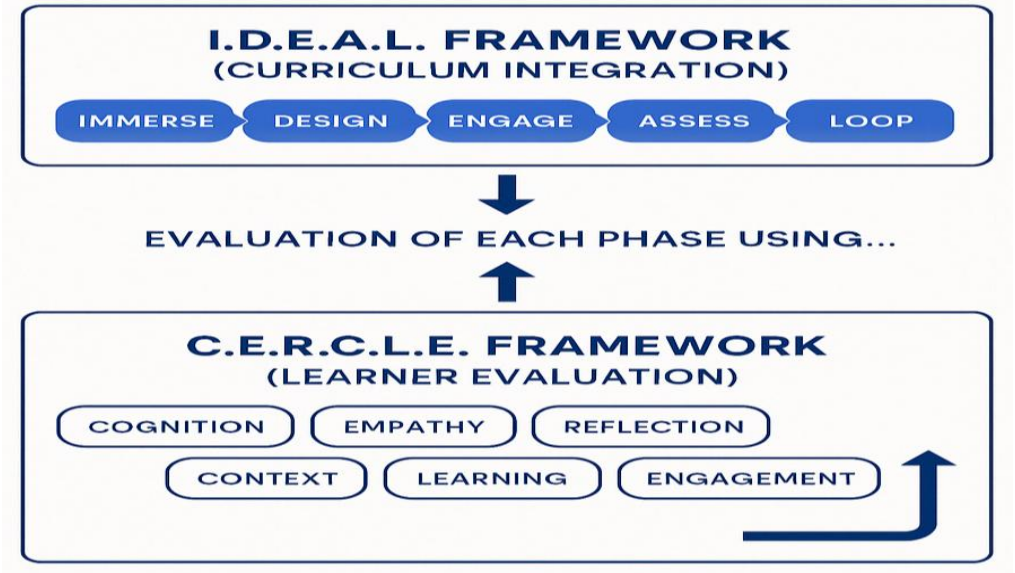

Fig. 13 I.D.E.A.L. stages mapped against C.E.R.C.L.E. outcomes.

D. Frameworks as Pedagogical Contributions

Together, C.E.R.C.L.E. and I.D.E.A.L. provide a **comprehensive, transferable approach** for UX education that prioritises human understanding and reflective practice. They are applicable beyond UX - to fields like service design, healthcare, architecture, policy making, and social innovation – where context and ethics matter.

E. From Studio to Society

Designers educated through immersive environmental exposure are better equipped to engage with real world sustainability challenges – making such pedagogy critical in the Anthropocene era.

Ultimately, these frameworks **bridge the gap between design education and real-world UX practice**. They help shape designers not just as interface creators, but as **reflective, socially responsible agents** – equipped to design with insight, empathy, and purpose.

VII. Limitations And Future Work

A. Limitations

While this study offers strong evidence for the value of immersive UX pedagogy through the **C.E.R.C.L.E.** and **I.D.E.A.L.** frameworks, certain limitations must be acknowledged:

1. **Single-institution scope**: The study was conducted within the UX program at MIT Academy of Engineering's School of Design. As such, its findings may reflect context-specific influences related to Faculty culture, institutional priorities and regional field access. Wider institutional testing is needed for broader generalisation.
2. **Variability in immersion depth and duration**: Students engaged with different community sites for wearing durations (a single day to 1 week). These inconsistencies may have influenced the depth of reflection, engagement, and behavioural transformation, captured through the Framework scores.
3. **Subjective elements in rubric scoring**: Although the C.E.R.C.L.E. rubric was designed to systematise assessment of internal learning outcomes dimensions such as empathy or reflection, it inevitably includes subjective interpretation by faculty assessors. Inter-rater reliability training and digital rubric calibration tools could improve consistency.
4. **Language and cultural mediation**: Some students encountered linguistic and cultural barriers during immersion (especially in tribal or remote sites), which may have limited their ability to engage deeply or capture nouns in their reflections.
5. **Lack of long-term follow-up**: The study assessed immediate post-immersion outcomes, but did not track whether these behavioural transformations persisted in professional practice after graduation. Longitudinal tracking is necessary to validate lasting impact.

B. Future work

1. **Multi-institutional deployment**: Future studies should test the C.E.R.C.L.E. and I.D.E.A.L. frameworks across multiple design institutions, both within and outside India, to examine cross–cultural adaptability and comparative outcomes.
2. **Digital implementation of rubrics**: A next step is to digitise the C.E.R.C.L.E. scoring process through an interactive rubric platform that can allow students to self-assess, peers to co-evaluate and faculty to generate analytics over time.
3. **Longitudinal tracking post-graduation**: An alumni tracking study could explore how immersion experiences and behavioural development influence graduates' real-world UX practice, ethical decisions, and project outcomes over the long term.
4. **Cross-disciplinary adaptation**: Given the universality of cognitive empathy and contextual reflection, the frameworks could be adapted for adjacent disciplines such as **architecture, public policy design, anthropology and health care innovation**.
5. **Integration with AI-driven learning analytics**: Future integration with learning management systems (LMS) and AI-supported feedback tools could enable real–time tracking of behavioural growth, reflection loops, and iteration cycles throughout the design curriculum.

VIII. CONCLUSION

The frameworks proposed in this study help build a bridge between user- centred design and environmental education, fostering holistic thinking in UX practitioners.

The study demonstrates that immersive, community-based learning, when supported by structured by pedagogical tools, can foster deep behavioural and cognitive development in UX design students. The **C.E.R.C.L.E. rubric** and **I.D.E.A.L. model**, both developed from grounded classroom evidence, offer a robust framework for evaluating and integrating real-world experiences into formal UX curricula. These frameworks not only facilitate the cultivation of empathy, reflection, and ethical design thinking but also enable scalable, repeatable and replicable learning cycles across diverse cultural contexts. As UX design increasingly intersects with social, ecological, and ethical complexities, pedagogical models that centre on transformation, rather than just output, are urgently needed. The findings and frameworks presented here aim to meet that need and serve as a foundation for future research, adaptation, and curricular innovation.

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