A Tale of Many Futures: Children in Finland and India Envision the Future of Education

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Abstract

While conversations around the future of education focus on AI, robots, and VR, they often overlook how children imagine futures within their own educational worlds. We conducted participatory speculative design workshops with 92 students (ages 12–14) in two contrasting settings: an autonomy-oriented international school in Finland and an exam-driven, high-stakes public school in India. Reflexive thematic analysis revealed that pedagogical ecologies, rather than national cultures, shaped children's technological imaginaries and future orientations. Students in Finland envisioned pragmatic, technologically advanced, yet human-centered classrooms, whereas students in India prioritized curricular choice, emotional safety, and systemic fairness. In the workshops in India, we observed that speculative possibilities expanded with careful scaffolding but remained tethered to current realities when scaffolding was disrupted. We argue for "plural design futuring" grounded in children's lived experiences and contribute methodological insights into scaffolding as a critical condition for participatory future-making. Our findings demonstrate how local educational cultures fundamentally shape the possibilities of speculative design.

CCS Concepts

• **Human-centered computing → Empirical studies in HCI**; • **Social and professional topics → Children**.

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CHI '26, Barcelona, Spain
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ACM ISBN 979-8-4007-2278-3/26/04
https://doi.org/10.1145/3772318.3793808

Keywords

Future of Education, Emerging Technologies, Global South, Design Futuring

ACM Reference Format:
Priyanka Sebastian, Sumita Sharma, Netta Iivari, Marianne Kinnula, Aakash Gautam, Sanna Pitkänen, and Charu Monga. 2026. A Tale of Many Futures: Children in Finland and India Envision the Future of Education. In *Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems (CHI '26), April 13–17, 2026, Barcelona, Spain.* ACM, New York, NY, USA, 18 pages. https://doi.org/10.1145/3772318.3793808

1 Introduction

Technologies, especially educational technologies (ed-tech) are frequently developed under the assumption that solutions designed in one context can be seamlessly transplanted into another. This universalist orientation is what Wong [90] describes as the 'one-world world' of technology design. This approach, which prioritizes scalability and efficiency by attempting to smooth over cultural, institutional, and socio-material differences, is fundamentally flawed. In practice, such universalist paradigms risk amplifying existing inequities by ignoring how educational practices are deeply situated within specific histories, power relations, and everyday realities. A design that promotes autonomy and creativity in one setting, for example, can increase academic stress or enable surveillance in another. The promise of personalization with artificial intelligence (AI) [58] or immersive learning through virtual reality (VR) [45] cannot be evaluated in isolation from cultural values [11], infrastructure constraints, and pedagogical traditions that shape how children experience technology in their schools and daily lives.

In addition, extensive scholarship in HCI and design has shown how Global North institutions often claim epistemic authority over which design methods are legitimate or should travel globally (e.g., [22]). This universalising stance treats methods as culturally neutral and risks reproducing hegemonic design expertise [68]. Such approaches overlook plurality, relationality, and the situated nature of design practice. They flatten the diverse conditions under which technologies are imagined and used, obscuring how the **meaning** and **purpose** of technology emerge from local values, pedagogical histories, and social expectations [27, 39, 90]. Recognising this situatedness is therefore essential, not only for interpreting children's imaginaries, but also for building design methodologies that remain accountable to the contexts in which they operate. (e.g., [22, 27]). As critical design and HCI scholars note, scaling approaches to technology often carry a 'colonial impulse,' embedding specific Western assumptions about learning and social organization into global technical infrastructures ([55], see also [22]). This challenge is particularly acute in education, where national and institutional cultures profoundly affect technology acceptance and utility [81]. In this light, our study proposes that it is crucial to move beyond simply examining how emerging technologies are introduced to children. Instead, the needs and perspectives of children must be a central consideration. This involves a shift in focus towards understanding how children speculate, imagine, and articulate their own futures with emerging technologies [5, 59]. Their imaginaries, unconstrained by adult-centric, market-driven logic, while grounded in their local realities and lived experiences, offer a vital lens into the genuine needs, anxieties, and aspirations that must inform the design of future educational technologies [3].

Five attributes have been linked in the definition of emerging technologies: (i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact, and (v) uncertainty and ambiguity [70]. While there are various types of emerging technologies, this paper focuses on those impacting children and schools [87]: Generative AI, VR, and social robots. These technologies were also selected for their potential in shaping future educational environments. For example, while the potential of VR for learning has been widely explored (e.g., [45]), it remains relevant as advances in headsets make them more accessible to a younger audience [17]. Child Computer Interaction (CCI) research has a keen interest in child-robot interactions, exploring, for instance, the role of social robots in language learning [47], and robots continue to be pictured in a classroom context. Generative AI has more recently embedded itself in the educational context, with several organizations working tirelessly to create frameworks to regulate and support its use [64]. Conducted in April 2023 (with Finnish seventh graders) and November 2023 (Indian eighth graders), when tools like DALL-E2 and ChatGPT were rapidly gaining prominence, the study captures an important moment in time, reflecting students' evolving perceptions of these transformative technologies during a crucial phase of their adoption. While these technologies have shown evident benefits from their application in various spheres of life, by their very nature, they raise the question of societal impacts with regard to their usage, design, and deployment [74, 86].

Participatory design (PD) scholars argue that children should not only use technologies, but also critically reflect on and help shape their development [21, 49]. This forms the foundation of computational empowerment (CE), which positions young learners as active designers and evaluators of digital systems [21, 38]. Despite the growing emphasis on CE of children, much of the existing research remains rooted in high-income, Global North contexts, offering limited insight into how technologies are understood, contextualized, and co-constructed in under-resourced educational settings [77, 78]. For example, participatory and speculative design projects with children have shown how structured prompts can support critical engagement with complex technologies [57, 82], but there is little evidence regarding how these approaches translate to public schools in Global South environments.

In light of this, a critical question arises: *How do children in different cultural and institutional settings imagine the roles of emerging technologies such as Generative AI, robots, and VR in their educational futures?* To answer this question, we conducted workshops with 92 adolescents (12-14-year-olds) in India and Finland, where they explored emerging technologies and envisioned future classrooms. Our findings reveal a stark divergence in the human-technology relationship, challenging one-size-fits-all approaches by highlighting the ethical concerns, cultural values, and everyday realities that shape young people's visions. We approach this comparison as an examination of how two specific institutional environments that are shaped by distinct pedagogical traditions, resource constraints, and curricular pressures, produce different imaginative repertoires. We build on it to reflect on the implications for futuring activities in participatory design and HCI. Our contributions are twofold: first, we provide methodological insights into how scaffolding can function as a speculative infrastructure that shapes children's imaginative possibilities across culturally and institutionally distinct contexts; second, we challenge the universalist framing of speculative design by highlighting the diverse, situated imaginaries of educational futures articulated by children.

This work extends prior critical and decolonial speculative design research by demonstrating how plural design futuring can operate as an analytic lens rather than solely a methodological stance. By centering students' imaginaries of future schools, the study highlights how futures are co-produced through educational infrastructures, power relations, and everyday practices, offering a grounded account of futuring from within formal educational systems rather than outside it.

2 Related Work

2.1 Cultural Settings Matter

CCI research has acknowledged the role and influence cultural setting has in relation to understanding, design, and use of digital technologies (e.g., [35]). This body of work emphasizes that when you co-design with a group, you must go beyond just the user's immediate needs and consider their broader cultural context. CCI work puts forth that Artificial Intelligence (AI) systems are built on assumptions from Western, "Global North" contexts and, as a result, often do not work well or are not appropriate for different cultural and social realities [6]. This kind of research is important because it highlights that psychological and social concepts like empathy may be understood or expressed differently across cultures, and methods for assessing them need to be adapted accordingly [66].

Previous research has established a precedent for cross-cultural comparisons in HCI, with studies exploring a range of cultural settings and their influence on technology perception, use and design. Common comparisons include India and the US [20], Finland and Namibia [72], Greece and the US [7], and Japan and Uganda [14].

This body of work highlights that while technological artifacts may be universal, their social meaning and use are deeply contextual.

Existing literature also demonstrates that cultural context is a critical factor in how individuals understand and interact with emerging technologies, such as AI and robots [44, 60]. Studies across diverse settings indicate that perceptions, attitudes or understandings are not universal but are shaped by social norms and values. For instance, research on children's views of AI has highlighted differences between Japan and Finland, where Japanese children tended to consider the societal implications and applications of AI, while their Finnish counterparts focused more on its technical aspects [51]. These findings are consistent with broader research with adults, which argues that cultural identity shapes people's attitudes towards and perceptions of AI [9, 28, 43, 46, 63]. This body of work also advocates for the need for culturally responsive and modified design practices to ensure they remain socially and contextually appropriate [20, 66, 78].

2.2 Examining Alternative Futures Through Speculative Design

The investigation of alternative future imaginaries through speculative design (SD) has become a central methodological approach in Human-Computer Interaction (HCI), enabling researchers to move beyond incremental design and explore what *could be* rather than what is technologically feasible [89, 90]. This approach is particularly critical for research conducted outside Western, corporate design contexts, where uncritical diffusion of technology risks embedding values that reproduce structural inequalities [15, 18, 39, 40, 48]. A growing body of work emphasizes the importance of situating SD within local cultural, institutional, and material contexts, foregrounding plural and community values and relational ethics [4, 19]. Within Child-Computer Interaction (CCI), SD serves as a tool for digital empowerment, allowing children, who are often passive recipients of technology, to become active **critical futurists**, voicing ethical, social, and institutional critiques that are difficult to articulate otherwise [87, 92]. Comparative and cross-cultural studies highlight how institutional systems and pedagogical ecologies shape children's imaginaries, not as fixed cultural traits but as situated responses to local realities [91]. Building on this work, our study examines speculative futures as articulated by children in two institutionally distinct educational contexts, illustrating how SD can make visible the **social, institutional, and cultural contexts** in which technology is embedded while supporting plural, context-sensitive design futures.

2.3 Rejecting Cultural Essentialism

Our study is located within two educational contexts — schools in India and Finland — that are located in distinct cultural settings. However, instead of assuming these two settings represent two distinct, fixed, coherent cultural entities or wholes (criticized also in, e.g. [37]), we explore how children within these two settings engage in emergent process of sense making and imagination, shaped by their local realities and lived experiences as well as being situated within broader social, cultural, political, and institutional systems, structures, and discourses (see e.g., [27, 76]). We build on the theoretical groundwork of Dourish and Mainwaring [22], Escobar [27], Irani [39], Wong and Khovanskaya [90], who question the colonial impulse in computing and design, and instead advocate for appreciating plurality, relationality, and cultural situatedness, and push towards embracing the critical agenda in computing and design.

We situate our work in a growing body of research that uses speculative design to critically explore alternative futures. These studies highlight that the design of new technologies cannot be separated from the social, cultural, and political contexts in which they are deployed. This is evident in the work of Muashekele et al. [65], who explore "lost futures of the past" by engaging indigenous communities in Southern Africa in a community-based design futuring approach that promotes the recovery of cultural practices through speculative design. This work challenges the Western-centric assumptions often embedded in technology design. Similarly, Atabey et al. [8] conducted a cross-cultural study with children in Scotland and Türkiye, revealing how children's concepts of fairness in AI-driven education are shaped by their local contexts, emphasizing the need for designs that align with their values and rights rather than a standardized approach. Furthermore, Lu et al. [61] used a speculative, participatory approach with transgender communities to design augmented reality technologies, demonstrating how a focus on lived experience and community-driven methods can lead to more inclusive and meaningful design outcomes. Collectively, these studies illustrate a crucial shift: from using speculative design as a tool for corporate innovation to a method for critical inquiry grounded in specific, real-world contexts.

Building on these studies, our work adapts their emphasis on situated, participatory methods to a comparative educational context, using speculative participatory design methods to explore how children in India and Finland articulate alternative futures shaped by their distinct pedagogical, social, and institutional realities. By doing so, we extend prior work on critical, context-sensitive SD by explicitly examining the political and ethical dimensions of children's imaginaries across contrasting school environments.

3 Research Methodology

This research adopts a qualitative, interpretive approach, grounded in social constructivism [16]. Our primary aim is to understand the meanings the participants attribute to phenomena. Therefore, our methodology does not rely on formal propositions or statistical hypothesis testing [50]. We conducted an interpretive comparison of children's imaginaries within two distinct situated pedagogical contexts, Finland and India (see Figures 1 and 2), and specifically did not attempt a controlled experiment. We did not collect data on children's cultural or socio-economic background, as that can be a sensitive issue. However, recognizing that the institutional and social conditions of each site fundamentally shape the emerging narratives [75], we present below the general cultural contexts. Our analysis highlights culturally and institutionally situated differences in meaning-making, consciously avoiding the generalization of national cultures. To elicit these deeper, more critical insights, we employed speculative design [25] as a method for critical inquiry, engaging students in envisioning and critiquing how emerging technologies might shape their future classrooms.

3.1 Context of Work in Finland

Zooming in to the context of our work, the school in Finland is an international school where the medium of instruction is English. Its student body comprises both Finnish and non-Finnish children, and it is a co-educational institution (mix of boys and girls). In Finland, students typically progress through a nine-year basic education system (Grades 1–9), guided by the Finnish National Core Curriculum, which goes beyond subject knowledge to emphasize transversal competencies such as digital literacy, multiliteracy, and cultural awareness [30, 83]. Because students use digital technologies extensively in their daily lives, especially in their leisure time, they can, in general, be regarded as digitally native [34, 42, 67]. See Figure 1 for what the classroom context looks like.

In Finland, teachers exercise significant agency, supported to experiment, reflect, and collaborate in applying technology meaningfully in their teaching, as shown in Mannila & colleagues' 2018 work that highlights the importance of teacher self-efficacy and ongoing professional development in Finnish schools [62]. Learning is inquiry-based and collaborative, with students engaging in project and problem-based tasks that span multiple subjects; recent multimodal research demonstrates how socially shared regulation of learning (SSRL) emerges naturally in Finnish student groups, showing that learning is co-constructed and technology-supported rather than passively delivered [56]. Finally, this approach is reinforced through strategic organizational development, where school culture, leadership, and resources collectively support meaningful digital learning [80]. It is also worth noting that the international school, while situated within the broader Finnish educational system and following the Finnish national curriculum, has English as the primary instructional language, which is not representative of all Finnish schools.

3.2 Context of Work in India

The all-girls school in a suburban Indian city serves a socioeconomically diverse student population. Since it is a public school, it is characterized by high student-to-teacher ratios and limited access to advanced digital learning tools [73]. The workshop took place in the school's Rashtriya Aavishkar Abhiyaan Lab (RAA), established by the Ministry of Education under the National Innovation program focusing on science, mathematics, and technology integration, encouraging young children towards innovation, tinkering, and experimental learning through the incorporation of new-age tools. There is also an integration of VR labs to promote digital learning in public schools in India. The school was chosen for our workshops because it is part of the RAA initiative, which facilitated our access. See Figure 2 for what the classroom context looks like.

The Indian education system is structured into four stages. The Foundational Stage covers five years for students aged 3-8, followed by the three-year Preparatory Stage for ages 8-11. The Middle Stage spans three years for children aged 11-14, and the final Secondary Stage covers four years for ages 14-18. The system is overseen by a range of national educational bodies, including NCERT, UGC, and AICTE, which promote critical thinking, foundational learning, and technological advancements [2, 54]. The school follows the CBSE curriculum (Central Board of Secondary Education), where progress is evaluated based on examination scores, and the ranking of students based on their exam performance is typical. Like many Indian schools, it operates within a system in which high-stakes examinations significantly shape pedagogical practice and student experience.

3.3 Consent and Assent Procedure

Ethical procedures were in line with local practices [69]. In Finland, the ICT teacher sent consent forms to the students' parents through an online school tool, which parents, teachers, and students use to communicate. This consent form included information on the workshop's goals and expected outcomes. We obtained written consent from all parents.

In India, written consent was secured from the school principal and teachers, again following local school procedures, where it is not common to send letters home to parents, for several reasons, including parents' having varying literacy levels [69]. There, the school principal signed and permitted the workshop with the 8th-grade class.

In the first session, students were introduced to the workshop goals and were asked for their verbal assent to participate and to allow data collection, which all students provided us. They were informed about how the data would be stored and analyzed. We informed them about the goals and expected outcomes and made it clear that their participation was voluntary. To ensure students felt comfortable sharing, they were told they could ask the researchers to pause audio recordings at any time, allowing them to control what was and was not recorded. Students were also told they could ask the researchers to pause audio recordings if they wanted to share anything "off the record." To ensure students' comfort, two GoPro cameras on tripods were positioned to record only half of the classroom, allowing students who preferred not to be recorded to move to the other side of the room. Participants could also ask the researchers to stop recording at any time. In this way, they were able to control when and how their data was shared. Participation was voluntary, and students could choose to stop at any time and ask for an alternative activity from their teacher; however, all students participated in the workshop activities.

3.4 Participants

A total of 92 students participated across the two school sites. In Finland, 45 students from two 7th-grade classes (7A, 7B) participated, during their ICT class schedules (12-13-year-olds; 22 boys, 23 girls) in April-May 2023. The ICT teacher invited the researchers to her ICT classes. The recruitment was driven by the ICT teacher. In India, 47 girl students from an 8th-grade class (13-14-year-olds) were selected by their class teacher and ICT teacher to participate (see Table 1) in November 2023. Due to large class sizes, the ICT teacher and the class teacher selected for the workshop those students who were more interactive. The class was split into two groups by the teachers, with one group (23 students) participating on day one and the other (24 students) on day two. Thus, here too, the researchers were not involved in student recruitment. Individual socio-economic data were not collected from participants, as this was neither appropriate nor necessary for the aims of our study. Instead, we describe the broader contextual characteristics of each site. Both schools are located in major urban centres. The school

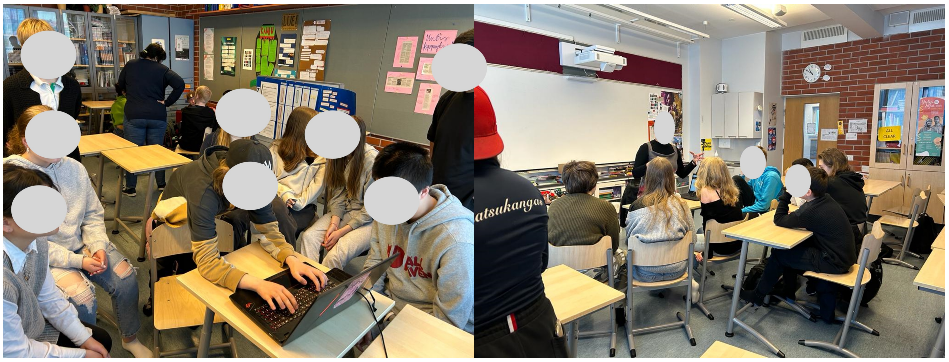

Figure 1: Workshop participants in a Finnish classroom

Figure 2: Workshop participants in the RAA lab in India.

in India, in particular, draws students from mixed-income neighbourhoods in the city. The participants in the Finnish institutional context attended this international school in which instruction is primarily in English, and the upper grades follow the International Baccalaureate (IB) curriculum. This setting differs from mainstream Finnish schools and reflects the multilingual and internationally oriented profile common to such institutions. Rather than collecting individual socio-economic or immigration data, which would not meaningfully advance our research aims, we provide school-level contextual information to appropriately situate the Finnish participants within their educational environment.

3.5 Workshop Procedure

The workshops in both locations followed the same procedure. However, in Finland, the workshops were conducted in four 45-minute sessions, which also included brief periods for students to settle in and prepare for their next class. In India, the workshops were conducted in two 2-hour sessions.

The primary focus of the workshops was exploring the role of emerging technologies in the future of education. These technologies included VR, social robots such as NAO and Lego Mindstorm, and Generative AI. Although Generative AI has since become more prevalent, at the time of these workshops, some participants had heard of tools like DALL-E 2, ChatGPT, and Midjourney, but had not used them. In fact, very few students in Finland were familiar with them. With regard to VR, only a handful of students in the Finnish school had any prior experience using headsets for gaming. In the Indian context, the workshops provided participants with their first opportunity to engage directly with VR, block programming the NAO, and generative AI tools. The workshops were conducted in English in Finland and in Hindi in India, reflecting the languages commonly spoken in their respective school environments. The workshop was structured into four parts, of varying durations, as shown in Table 1.

Part 1: Introduction (15-20 minutes): The workshops began with an introductory session that outlined the goals and expected outcomes for the participants. Students were given time to ask questions before providing their verbal assent to participate in the study. To set a shared foundation for the activities, participants were introduced to the core concepts of *design futuring* [53] and SD through a short video. This orientation was provided to both cohorts, except on the first day of the workshop in India, where a missing HDMI cable at the school prevented the video from being shown. Developed by a senior researcher, the video's purpose was to provoke imaginative and critical thinking in the students by establishing a shared, speculative framework. It began by introducing the concept of design fiction in simple, relatable terms, using examples such as "flying cars," "cyborgs," and "time travel." The video then posed a direct and open-ended prompt to the young viewers: "How would your grandchildren's grandchildren learn new skills at school?" This question was intentionally designed to encourage participants to think beyond their immediate experiences and constraints, thereby facilitating a more expansive and less grounded exploration of future educational technologies during the subsequent co-design activities. This video served as a tool for bridging the gap between familiar technological concepts and the abstract, future-oriented thinking required for the speculative design portion of the workshops. By making the concept of future-thinking accessible and exciting, it ensured that the students could fully engage with the research activities.

Part 2: Technology Demos (60 minutes): This 60-minute segment was designed to provide students with direct, hands-on experience with three distinct emerging technologies. Participants were divided into three smaller groups, each spending approximately 20 minutes at each of the three demonstration stations. These sessions were facilitated by the researchers to ensure close, guided interaction.

Social Robots: The robot demonstration began with a foundational activity designed to challenge the students' preconceived notions of what is/isn't a robot. By showing a range of images, from consumer products like the Roomba to fictional companions like J.A.R.V.I.S., we provoked a discussion that led to the participants collaboratively defining what a robot is and what it can be used for. The hands-on portion allowed them to apply this new understanding by programming the Nao and Lego Mindstorms robots using block-based interfaces. They experimented with basic functionalities like walking and changing eye colors to gain a practical understanding of how robots are controlled.

Generative AI: At this station, the groups were introduced to the concepts of Generative AI through popular tools, ChatGPT and Dall-E2. Working together, students collectively constructed prompts to see the technology in action. This interactive experience served as a springboard for a deeper, facilitated discussion on the opportunities and ethical considerations of integrating AI into educational settings.

Virtual Reality: To explore the potential of immersive technology, participants used the Meta Quest 2 headset to view 360-degree videos. Before the experience, they were informed about the risks of motion sickness and instructed to communicate any discomfort. Following the immersive video, the groups reflected on their sensations and the sense of presence they felt. This personal reflection led to a collective brainstorming session on how VR might be used to enhance learning and what a classroom with this technology could look like.

Part 3: Design activity (20-30 minutes): In this part, participants continued working in their small groups and engaged in envisioning and designing their future classroom, considering the types of emerging technologies their future classrooms would contain. Participants could draw, color, or write their imaginaries, working in groups or individually using a design sheet. After finishing their designs, participants presented their future classrooms to the larger group, discussing how technologies could potentially enhance learning in the future, what problems they would solve, and what new types of problems may arise.

Part 4: Wrap-up (10 minutes): Lastly, participants shared their experiences with the workshop and gave informal feedback.

3.6 Cross-Context Variations and Implications

While the core workshop procedures were similar, we acknowledge key differences driven by institutional constraints. In India, the workshops were conducted over a single 120-minute session per group, requiring us to repeat the session twice to cover the large cohort of 8th graders. This format and grade level were chosen to align with the students' limited class availability and the specific school timetable. Conversely, in Finland, the workshops totaled 180 minutes per participant, divided into four weekly 45-minute sessions scheduled during the 7th graders' regular ICT class, as arranged by the coordinating teacher. This meant the Finnish total time included transitional activities (settling in, announcements, wrap-up). Crucially, the differing grade levels (7th vs. 8th) and session formats (segmented vs. single block) were necessitated by local school logistics, not research design. Given the focus on situated imaginaries, we treat these differences as contextual factors rather than barriers to direct comparison. Another procedural difference was that technical issues on Day 1 of the workshop in India led to the first group of participants not seeing the design fiction video. While this impacted the level of external prompting for future imaginaries, all participants still experienced the core technology demonstrations. We explicitly address this asymmetry (the missing scaffolding cue) in sections 4 and 5. We observed that the reduced scaffolding for Groups G1–G3 led to more grounded, practical visions tied closely to existing classroom anxieties, which ultimately reinforces the situated nature of their imaginaries. This methodological variation is thus analyzed as a key part of our contribution on scaffolding, specifically, how the presence or absence of speculative cues shapes the resulting visions. A minor, on-the-spot procedural variation was the inclusion of an icebreaker for the second set of participant groups in India (G4–G6) to alleviate apparent participant shyness. This activity involved playing lively music, guiding the students through brief, relaxing movements (e.g., jumping followed by relaxation), and a round of self-introductions (including the researchers), which successfully put the students at ease before the main tasks. We confirm this minor procedural variation did not affect the core data collection task. Ultimately, our goal is not a direct methodological comparison of the outcomes, but rather to present and theoretically discuss the rich future imaginaries produced by the children, and underscore their aspirations for the futures of education.

3.7 Researcher Positionality and Reflexivity

This work was conducted by a cross-context research team with deep engagement in both Indian and Finnish schooling systems. Our collaborative approach helps mitigate single-context bias and supports a more reflexive, situated interpretation of the findings. The researchers mostly grew up and studied within their native educational systems, with three of the researchers migrating to the Global North for their research and work. Of the seven researchers, three have more than a decade of experience each in Child-Computer Interaction working with children in the Global North and South. Researchers' backgrounds include cultural anthropology, Information Systems, Human-Computer Interaction, design, learning sciences, business, and technology. Two of the Indian researchers co-conducted the workshops in India and Finland, with another researcher joining the Finnish workshop. The two (senior) Finnish researchers are also part of the entire project, which includes planning, coordinating, supporting, analyzing, and writing, including this paper. One researcher joined the project after the workshops were conducted. The research team speaks Hindi and Finnish at a native level. While there is potential to lose nuance in translating contextual data into English [79, 88], our linguistic expertise enables us to translate, interpret, and analyse data within participants' cultural and linguistic contexts. Together, the research team has expertise in the cultural, educational, linguistic, and technical context of the workshop locations and participants.

3.8 Data Collection and Analysis

The study followed a six-step process of data collection and analysis, as described in Table 2, with reflexive thematic analysis of the collected data [12, 29]. This iterative and comparative approach ensured that children's imaginaries were examined both within and across cultural contexts, while remaining attentive to the role of scaffolding, institutional environments, and cultural repertoires in shaping their visions of the future.

Step 1: Data Collection. Workshops were conducted in school settings in India and Finland, building on the research team's longstanding engagement within both contexts. Each workshop session blended technology demonstrations, speculative design prompts, and structured discussions. Children engaged directly with NAO, Lego Mindstorm, Meta Quest 2 headsets, and ChatGPT and DALL-E2. The data consisted of audio-video recordings of group discussions, field notes taken by the facilitators, and students' individual design sheets. Digital voice recorders and GoPro cameras captured the sessions, which were later transcribed, translated from Hindi to English for the Indian transcripts, and anonymized.

Step 2: Initial Coding. The translated transcripts, researcher diaries, and student design artifacts were subjected to open coding, the first phase of Braun and Clarke's thematic analysis [12]. Codes were developed separately for the two datasets (students in the Indian school and the Finnish school) to avoid pre-imposing cross-cultural themes. The coding process was iterative and inductive [29], focusing on recurring ideas, metaphors, and concerns voiced by the participants. This initial step was crucial for capturing the children's immediate and unprompted framings, without forcing early alignment across the two contexts.

Step 3: Theme Identification (Within Cultural Contexts). In this phase, we moved from individual codes to broader themes within each national dataset. For the students in the Finnish school, salient themes emerged around sustainability, digital wellness, and establishing clear boundaries between humans and machines. In contrast, the concerns of students in the Indian school centered on emotional safety, relief from the pressures of high-stakes academic culture, and academic integrity. This phase of the analysis allowed us to emphasize how local educational and cultural contexts directly shaped divergent imaginaries.

Step 4: Cross-Context Comparative Analysis. We then shifted to a comparative analysis, bringing the themes from both datasets into dialogue. This step highlighted both shared and divergent imaginaries. For example, a shared theme was the desire for technology to be a supportive tool rather than a replacement for human relationships, alongside a common emphasis on values like personal autonomy and safety. Divergent themes revealed differences in orientation: Students in the Finnish school approached technology with a pragmatic lens, while students in the Indian school often responded through moral framings.

Step 5: Higher-Order Thematic Synthesis. The comparative themes were synthesized and situated within broader cultural, institutional, and media repertoires. This interpretive step connected children's imaginaries to structural and situated conditions. It also linked their ideas to the scaffolding provided in the workshops, including speculative prompts and media references. We identified cross-cutting values like fairness, trust, and care that mediated how students envisioned technology.

Step 6: Linking to Theoretical Frames. Finally, the synthesized findings were interpreted through relevant theoretical lenses, including participatory, speculative design [25, 52, 61, 65], and socio-cultural perspectives [58, 60]. By grounding our analysis in these frameworks, the study contributes to ongoing debates in HCI and CCI about plural futures, decolonial design [1, 33], and the vital role of children's voices in shaping technological trajectories.

4 Findings

The two participatory speculative design studies provide insight into how adolescents located in different institutional, pedagogical, and sociomaterial contexts imagine the role of emerging technologies in their educational futures. Across both sites, students approached speculative futures with curiosity, critical engagement, and imaginative breadth. However, the directions their visions took were shaped less by broad notions of national "culture" and more

Table 1: Workshop procedure (*Class 8E was divided into half with each half participating only once and on one day, **design fiction video was not shown)

Workshop	Class 8E* (India)	Class 8E* (India)	Class 7A (Finland)	Class 7B (Finland)
Part 1	Introduction**	Introduction	Introduction (session 1)	Introduction (session 1)
Part 2	Tech demos	Tech demos	Design activity (session 1, 2)	Tech demos (session 1, 2)
Part 3	Design activity	Design activity	Tech demos (session 3, 4)	Design activity (session 3, 4)
Part 4	Wrap-up	Wrap-up	Wrap-up (session 4)	Wrap-up (session 4)
Participants	23	24	23	22
Age	13-14 years	13-14 years	12-13 years	12-13 years
Gender	all girls	all girls	9 boys, 14 girls	13 boys, 9 girls
Groups	G1-G3	G4-G6	G7-G9	G10-12

Table 2: Our analysis process

Steps	Process followed
Step 1	Data collection, audio transcripts, design sheets
Step 2	Initial coding for the student groups Students in Indian school (G1-G6) and students in Finnish school (G7-G12)
Step 3	Theme identification (for each location) India: academic integrity, emotional safety, resource limitations, high stakes Finland: sustainability, wellness, human-machine boundaries
Step 4	Cross context analysis Shared themes: technology enhancing human abilities instead of replacing them, personal autonomy, safety Divergent themes: pragmatic vs. emotional approach towards technologies
Step 5	Higher order thematic synthesis Interpreting and situating themes within cultural, institutional, and media contexts, and scaffolding and ethical orientations
Step 6	Linking to theoretical frames (participatory, speculative design; socio-cultural)

by the local logics of schooling, discursive environments, and the speculative scaffolding available to them during the workshops. Rather than treating the two study sites as fixed cultural categories, we understand adolescents' imaginaries as situated pedagogical imaginaries: futures co-constructed through their everyday educational experiences, access to institutional resources, exposure to media narratives, and the speculative prompts introduced in the workshop. This framing aligns with relational and postcolonial perspectives that view culture as emergent, negotiated, and intertwined with material conditions [4, 85]. We examine these themes in three areas (summarized in Table 3). Illustrative quotations are included from students in the Indian school (G1–G6) and students in the Finnish school (G7–G12).

4.1 Situated Pedagogical Imaginaries

4.1.1 Trust, Care, and the Human Element in Learning. Students across both contexts consistently emphasized that future learning environments must remain grounded in relationships of care, support, and emotional safety, even as technologies become more present. Students in the Finnish school repeatedly emphasized that teachers' relational roles could not be replaced by AI or robots. One student stated: *"Teachers don't just teach. A lot of students consider teachers as their guardians as well, and AI cannot do that"* (G9). This sentiment aligned with broader Finnish visions of learning environments oriented toward well-being and calmness, such as "meditation rooms", "silent zones", "snack dispensers", and even having "massage chairs"(G7–G9), highlighting a desire for wellbeing-focused school environments, not simply efficient ones. AI was framed as a helpful tool or a facilitator that supports personalization ("serving the unique learning needs of each student"), but still bound by epistemic limits: "Generative AI and robots can only help as tools. But they can't discover anything new by themselves" (G7). "In the future it will be hard to tell what is AI and what is not" (G8). Robots were imagined in non-anthropomorphic, task-oriented ways, such as assisting with classroom management or mundane chores, reflecting a pragmatic approach rather than emotional attachment.

Table 3: Overview of the themes

Finnish school site	Indian school site	Key insights
	Situated Pedagogical Imaginaries	
AI seen as a "personalized teacher" to cater to "unique learning needs of each student". Teachers seen as "guardians" beyond academics. VR as immersive tool for abstract subjects; concerns about replacing authentic experiences.	Robots imagined as patient, non-judgmental tutors, sometimes emotional companions; teachers compared to robots (less angry, less biased). VR exciting for science and math learning; concerns about overstimulation, sedentary life, and escapism.	Both positioned AI/robots as assistants, not replacements; teachers valued for empathy and deep understanding. Students in Finnish school resisted anthropomorphizing; Students in Indian school gendered robots ("she") and imagined them as companions. Both cohorts saw VR as promising but risky. Students from Finnish school stressed authentic experiences; Students from Indian school stressed on the detriment of health due to staying indoors, family disconnection, and curricular disruption.
Aware AI cannot create new knowledge by itself or replace teachers. Concerned about creativity loss and distinguishing human vs. AI-made work ("It can be used badly. It could be hard to tell in the future what is AI and what's not.")	Concrete safety worries: bombs, fake IDs (misuse of data), cheating (in exams). There were also some misconceptions about AI. Concern about unemployment and disconnection ("If there are robots, nobody would want to work").	Both skeptical of AI's limitations and risks (misuse, misinformation, creativity erosion). Students in Finnish school focused on epistemic limits and authentic experiences. Indian students focused on job, health, and disconnectedness from family.
	Technological Futures Shaped by Material Conditions & Scaffolding	
The tone of imaginaries were rich and expansive from the very outset as students in the Finnish institutional context received full scaffolding	On Day 2, scaffolding allowed expansion into richer, more imaginative possibilities.	Scaffolding led to richer, expansive, speculative imaginaries; both cohorts could explore futures beyond immediate, infrastructural needs.
	On Day 1 without scaffolding, students' visions remained tied to immediate, tangible classroom needs.	Lack of scaffolding constrained speculation; students' imaginaries remained practical and limited.
	Media, Popular Culture, and Everyday Sociotechnical Discourses	
Imagined accessing the classroom from "bed" via "hologram watch," highlighting desire to access learning at their own pace and convenience. Expressed the desire for more ICT classes.	Envisioned future schools with no academic pressure, ability to study "subjects of own choice" and "Barbie (movie)-themed classroom" with activity-based learning.	Both cohorts emphasized personal autonomy, though expressed differently. Finnish students prioritized self-directed, well-being focused imaginaries; Indian students prioritized curricular choice and reducing exam stress.
Influenced by popular media tropes: dystopian 'doomsday' scenarios, "brain microchips", "whole city inside moving spaceships, along with animals and plants"	Drew heavily on Bollywood films to imagine anthropomorphic, loyal yet rebellious robots. (Rajnikant movie, Robot 2.0).	Bollywood strongly shaped children's imaginaries in India. Robots were envisioned as "secret keepers" that wouldn't betray trust, unlike human friends. Finnish students stressed sustainability, personalization, and aesthetics. Media narratives shaped futuristic elements alongside pedagogical imaginaries.

In contrast, many students in the Indian school envisioned robots as emotionally supportive figures, perhaps reflecting lived experiences of teacher strictness and high-performance pressure. Robots were imagined as patient, friendly, and non-punitive: *"Robot should be a friend and not a slave, because a friend is someone one can play with. But a (human) friend can go behind your back"* (G3). "If we ask teachers something again and again, a (human) teacher can get angry. But a robot won't" (G3). This quote reveals a subtle yet powerful need: students' desire for emotional consistency from authority figures. It demonstrates that they want technology to fill specific emotional gaps in the learning experience. This aspiration, however, does not lead to a desire for replacement. As one student affirmed, "Robots cannot teach as well as teachers" (G2), acknowledging the vital, irreplaceable role of human warmth and guidance. They also explicitly connected care with the desire for fairness and reduced judgment. Robots were described as *"secret keepers"*, "buddies," or patient tutors who avoid anger and punishment, revealing how emotional safety is a pressing pedagogical concern within high-stakes, exam-oriented schooling environments. Even when expressing caution, they imagined relational stakes: "Robots should not be used for household chores because that would make us lazy. Rather, robots should be a buddy" (G5).

Students in the Finnish school largely reaffirmed the indispensability of human teachers, while students in the Indian school more often projected qualities such as patience, non-judgment, or companionship onto robots. These patterns reflect the educational pressures and the emotional climates that shaped each group's reflections. In line with Escobar's [27] call to recognize multiple, situated worlds rather than assume a single universal model, these imaginaries illustrate how 'cultural differences' also emerge through specific institutional practices and relations rather than through purely inherent national traits. Across both sites, however, a shared principle emerged: future learning environments, regardless of the technologies they incorporate, must sustain care, trust, and emotional support as foundational educational values.

4.1.2 Fairness, Integrity, and Accountability in High-Stakes Environments.

Across both sites, students evaluated emerging technologies not only for their potential benefits but also for the rules, risks, and responsibilities that should govern their use. The ethical concerns they articulated were tightly coupled to the institutional and material conditions of their schooling and to the accountability structures, pedagogical expectations, and pressures they encounter daily. In this sense, students' imaginaries reflect how young people make sense of fairness and responsibility from within their own situated educational worlds.

In India, where grades and competitive examinations structure access to future opportunities, concerns about academic integrity

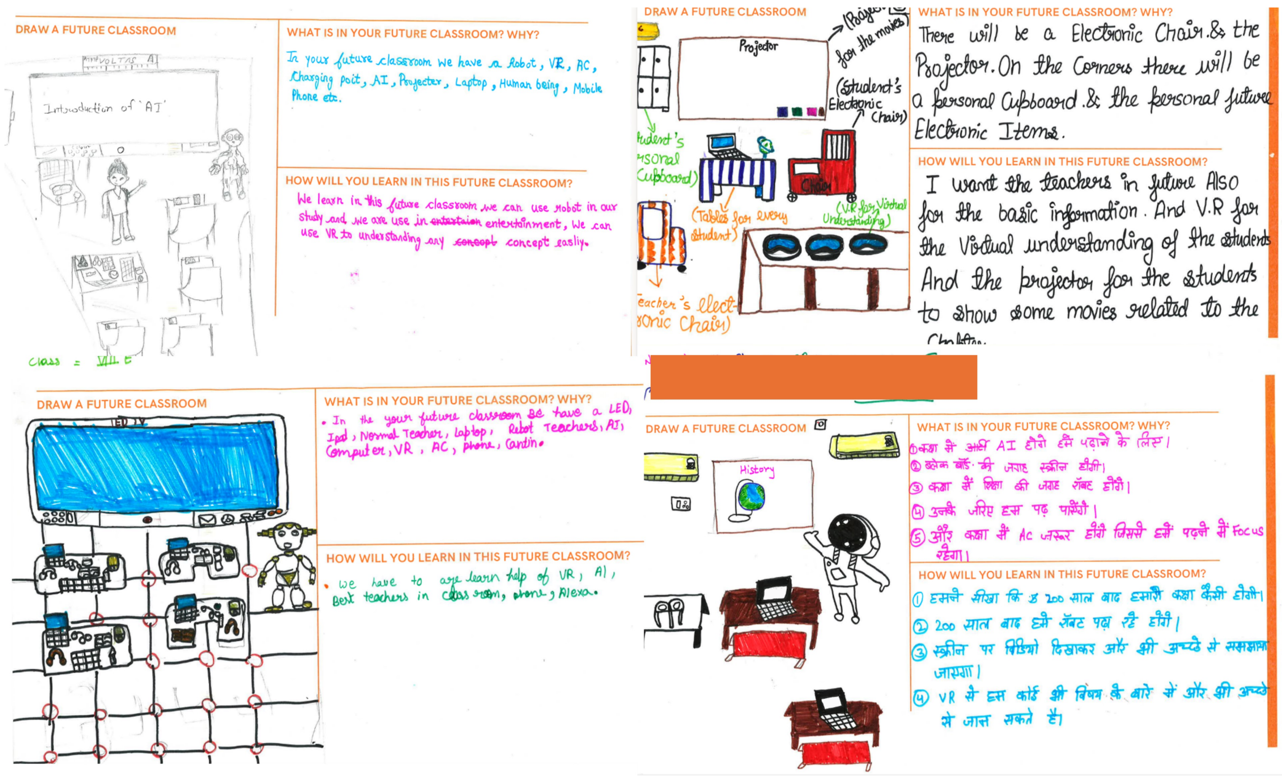

Figure 3: Design sheets from Day 1 of the workshop in India

and misuse of technology were particularly salient. Students worried that AI could enable dishonest shortcuts like cheating, generating work without effort, or even forging identities ("fake IDs") or causing harm ("learn bomb making"). These statements should not be read as literal expectations, but as expressions of how powerful technologies might destabilize mechanisms of fairness in a system where stakes feel high and rules tightly policed. As one student asked: "There are children who are not good academically. What if they want to top their exams? How can they do it?" (G6). The question reflects a central anxiety: academic performance is widely understood as a pathway to upward mobility, not only for the student but often for their entire family. In this context, the student's question expresses an aspiration shaped by the high-stakes educational environment itself: if education is the primary "ticket" to a better future, then technologies like Generative AI become imagined as potential tools to overcome systemic barriers, compensate for uneven support structures, or 'level up' in a competitive landscape. Rather than signaling a desire to circumvent effort, the question reveals a deeper truth: the G6 student is trying to understand whether emerging technologies might serve as instruments of empowerment in contexts where opportunity is scarce, resources are unequal, and academic success carries significant socio-economic weight. Other ethical concerns such as unemployment and laziness ("If there are robots, nobody would want to work", G2) or decline in cognitive ability ("Memory will be less developed and we won't be able to focus on studies", G6, referring to VR) pointed toward a deeper unease about how technologies might erode students' capacity to succeed in demanding academic environments. Here, attention, memory, and disciplined study were seen as fundamental skills. Ethical design, from this perspective, means ensuring that technologies enhance, not diminish, the cognitive foundations of students' capacities.

Students in the Finnish school, situated in an educational system defined by developmental and trust-based evaluation, autonomy, and ecological responsibility, articulated a distinct set of ethical priorities that centered on systemic integrity and system-level accountability, i.e., how technologies should be used sustainably, transparently, and responsibly. Students proposed future schools that are environmentally friendly, with reduced reliance on resources like paper and electricity. These schools would be "zero-waste schools" with "natural light from the sun" (G9), "recycled furniture, "plants inside the classrooms to create a more natural environment (G9)". Students in the Finnish school also prioritized safety and personal security. A G8 student imagined having biometric access to enter the school premises, "face scanning for entering the school building" and "biometrics for locker access" indicating their concern for safety in light of international and local news to which they are exposed. We interpret these visions as a form of protective vision: an imaginary designed to safeguard the core institutional strengths of their existing trust-based system from disruptive external threats. This institutional concern was further evident in their focus on broader societal risks, such as the authenticity and transparency of AI-generated content: "It (AI) can be used badly. It could be hard to tell in the future what is AI and what is not." (G12). Unlike their

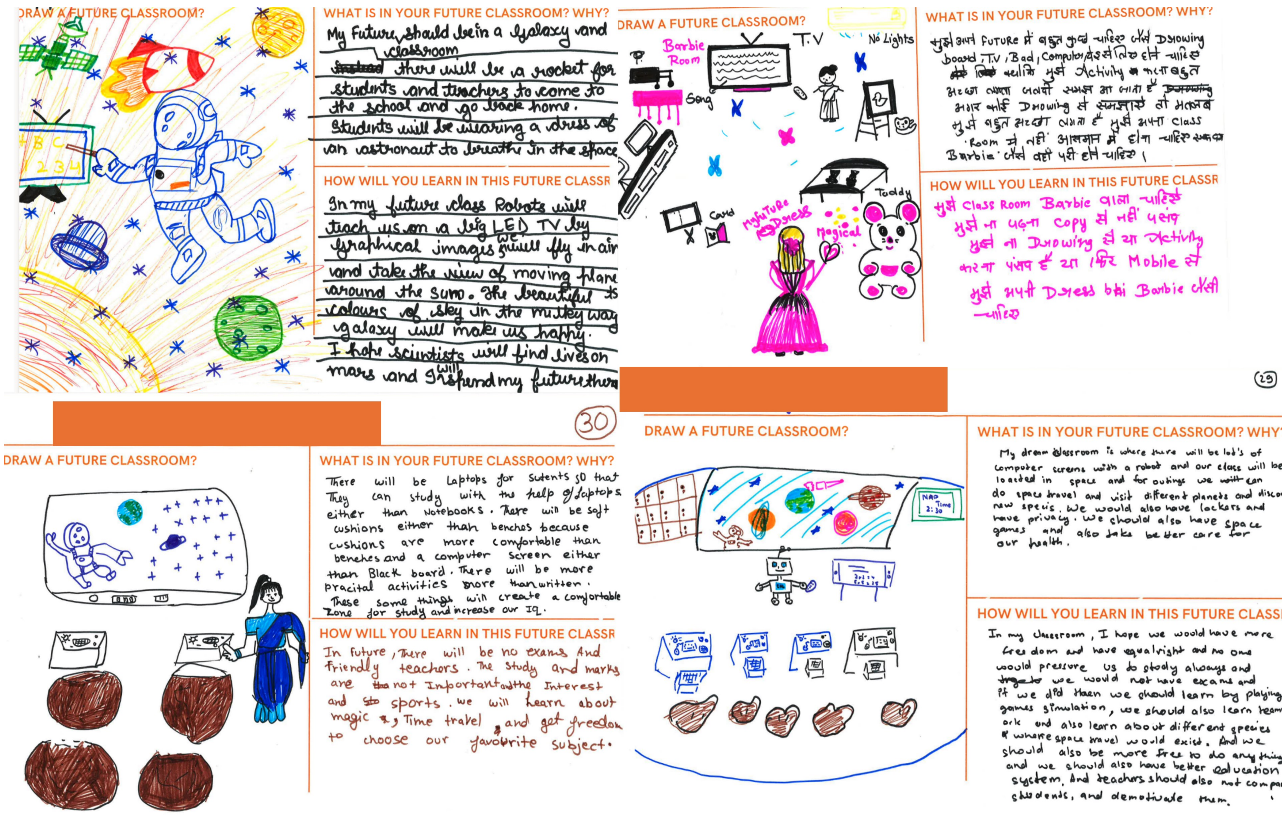

Figure 4: Design sheets from Day 2 of workshop in India

peers in India, who primarily worried about internal threats (e.g., cheating in exams), students in the Finnish school were concerned about AI authenticity, reflecting a desire to protect the epistemic integrity and relational trust that underpins their learning environment. Their imaginaries functioned as a preemptive defense mechanism, ensuring that future technological integration aligns with, rather than erodes, the core institutional value of personal autonomy and civic responsibility. A student in the Finnish school voiced that depending on Gen AI for "making art can reduce our creative skills" and "make us lazy" (G7).

Across both contexts, students drew clear boundaries around what emerging technologies should and should not do. The shared underlying value was accountability, but its meaning diverged based on local conditions. In India, accountability was linked to academic honesty, effort, and preventing misuse in a competitive, high-pressure system. In Finland, accountability was tied to ecological responsibility, transparent infrastructure, and maintaining human agency in a developmental and trust-based learning environment. These patterns underscore that young people's ethical orientations are shaped not by static "cultural traits" but by the material realities, pedagogical norms, and social narratives that structure their daily lives. Fairness is better understood as a relational and context-responsive value that takes shape within specific institutional ecologies. Attending to these situated ethical logics is crucial for advancing SD toward a decolonial and structurally grounded practice rather than relying on generalized notions of "culture."

4.2 Technological Futures Shaped by Material Conditions and Scaffolding

Students' visions of future educational technologies were shaped by what they had access to, what they were shown, and how the speculative space was scaffolded. In both settings, the workshop prompts, video cues, and existing technology demonstrations played a decisive role in expanding or constraining the scope of students' imaginaries. We present these findings through two contrasting cases.

4.2.1 When Scaffolding Opens Speculation (Finland and Day 2, India). When students were provided with full speculative scaffolding, i.e., a design-fiction video, technology demonstrations, and hands-on experience, their imaginaries shifted remarkably. Rather than describing incremental improvements to current classrooms, they began to construct futures that reconfigured the conditions of learning. This confirms a key methodological insight: speculative prompts can open conceptual spaces for children to imagine beyond the immediate, material constraints of their present environments.

Students in the Finnish school responded to speculative cues with futures that were highly advanced but institutionally grounded. There was a contrast between the high-tech vision and an adherence to existing pedagogical structures. For example, students frequently extrapolated from existing technological trends toward highly speculative futures that focused on efficiency and immediate knowledge access. One student envisioned the ultimate technological shortcut to bypassing the labor of learning: "I'd love a microchip in my brain because there would be no homework" (G8). This desire for instantaneous knowledge transfer or bypassing the need for effortful study is especially appealing among seventh graders who may not yet fully value slow, effortful methods of learning. More directly, this suggests a wish to bypass the hardest parts of learning, such as repetition, studying, or delayed gratification. Other imaginaries focused on transcending physical presence, such as one student who imagined attendance freed from physical limits: "There could be hologram watches, so you can attend class from anywhere" (G10).

These ideas do not indicate a desire for learning to disappear, nor do they reflect fixation with efficiency. Instead, they may extend to Finnish educational values of autonomy, flexibility, and student-centered learning into speculative form. The microchip and hologram concepts emerged in discussions about reducing cognitive overload, supporting diverse learning needs, and making school more adaptable to students' everyday rhythms. Technology was imagined as a way to lighten the cognitive and logistical demands of schooling, while human teachers remained central sources of guidance and care in almost all groups in the Finnish cohort.

When students in the Indian school received the same speculative cues on Day 2 (after the video playback failure on Day 1), their imaginaries expanded with similar intensity. Students began proposing futures that challenged their schooling system. A student envisioned: "In the future there will be no exams and friendly teachers. Studies and marks are not as important as an interest in sports. We will learn about magic, time travel and get the freedom to choose our favorite subjects." (G4) This quote reveals that speculative prompts allowed students to articulate their grievances with high-pressure education systems, i.e., exam pressure, punitive teacher–student dynamics, and restricted curricular choice. Fantastical elements like "magic" or "time travel" were not whimsical detours; they represented students' imagination taking flight when scaffolded to think beyond what is materially or institutionally possible. The speculative prompt enabled students to temporarily step outside the realities of exam pressure, restricted curricula, or fixed school routines. They proposed having "exams in the metaverse, where we are evaluated based on our skills and interests," and "galaxy classrooms" (G5). These demonstrate how speculative cues unlocked structural reimagination, not just critique. These ideas do not directly map onto present frustrations; rather, they show how young people, once scaffolded, engage playfully and boldly with the notion of what a school curriculum could be, unconstrained by feasibility.

Across the workshops with Finnish participants and Day 2 with Indian participants, scaffolding did not just broaden the technological horizon of students' ideas. It critically broadened the imaginative, political and emotional horizons of what education could be. In both contexts, speculative cues enabled students to imagine futures that reorganized time, space, authority, and care. The fundamental contrast was not in the capacity for imagination but in what speculation allowed each group to critique and re-imagine:

- **Students in the Finnish school** leveraged scaffolding to stretch familiar values of flexibility, cognitive ease, and student autonomy into more futuristic technological forms.
- **Students in the Indian school (Day 2)** used scaffolding to move beyond their present altogether, generating worlds where the structure of schooling could be fundamentally reconfigured, and where imagination was not bound by feasibility or existing norms.

In both cases, the situated imaginaries seem to be the manifestations of the material, institutional, and affective conditions that shaped how the students approach the act of imagining. Exploring the materials and the processes can open spaces for imagining alternative technology, and further, articulating alternative educational and relational possibilities.

4.2.2 When Scaffolding was Missing (India, Day 1) . The absence of the design-fiction video on Day 1 of the Indian workshop created a striking contrast that revealed how strongly speculative scaffolding shapes children's imaginative horizons. Without this prompt, students' ideas remained closely tied to their lived realities. Specifically, the material constraints and everyday frictions of their schooling environment.

Rather than reimagining learning systems or proposing fantastical futures, Day 1 students focused on changes that would make their current classrooms more functional and comfortable. Common suggestions included "air conditioning," "classroom projectors," and "screens instead of blackboards." As one student explained, "Classrooms must have air conditioning so that we can focus while studying" (G3). These ideas directly mirrored the infrastructural gaps the students routinely encounter (see Figure 3, bottom-right design sheet). Similarly, their engagement with the technologies remained anchored in familiar or entertainment-based framings. Robots were imagined as helpers who "follow commands" (G1), and VR was associated with its most accessible uses like "watching horror movies" or simple educational tasks such as, "Little children can learn A B C D using VR" (G3). Rather than exploring speculative or systemic possibilities, students stayed within the bounds of practical or already-encountered uses of technology. Without the scaffolding of the video, their imaginary futures drew primarily from existing infrastructural constraints and media exposures.

Importantly, this is **not** evidence of limited imagination. Instead, it illustrates that speculation is a socially mediated activity - one that requires cues, examples, and legitimizing narratives to temporarily loosen the grip of everyday constraints. On Day 1, without such cues, students used the workshop to voice the practical aspirations most relevant to their daily schooling: comfort, infrastructural adequacy, and basic technological access.

The contrast between Day 1 and Day 2 reveals a methodological insight: speculative workshops can unintentionally reproduce the inequities of the environments they are situated in. When students are not scaffolded to think beyond their immediate realities, their futures remain shaped by material constraints rather than possibility. This highlights the importance of intentional, context-sensitive speculative cues for facilitating equitable imagination.

4.2.3 Shared Tropes from Shared Scaffolding. Despite the sharp divergence in critical focus, the workshops revealed clear commonalities in the design outputs of both sets of participants. These shared imaginative outcomes, specifically the frequent inclusion of robots and robot teachers, and educational settings in outer space, can be methodologically traced back to the content of the design fiction video and technology demonstrations. The video explicitly featured narratives involving cyborgs, robots and outer space travel, providing a common vocabulary of futuristic elements.

This finding is crucial for methodological reflexivity, affirming that the material of the prompt significantly shapes the speculative output, a concept central to design studies [90]. The consistent emergence of these specific imaginaries across both the diverse contexts confirms the premise that scaffolding acts as a necessary anchor for the imaginary. When children are given a specific palette of future technologies (i.e., robots, space travel), they use those elements, adapting their function to suit their local values and critique [71]. This highlights the co-constructive nature of speculation, where imagination is not purely internal but is significantly influenced by the enabling materials provided, echoing prior work in CCI that leverages design fiction prompts [87]. Thus, similarities in imaginative output are evidence of effective methodological scaffolding, not necessarily shared cultural convergence. In both contexts, speculative cues enabled students to imagine futures that move beyond time, space, authority, and care. The fundamental contrast was not in the capacity for imagination but in what speculation allowed each group to critique and reimagine.

4.3 Media, Popular Culture, and Everyday Sociotechnical Discourses

Across both sites, children's imaginaries were influenced not only by the workshop activities but also by the wider sociotechnical narratives circulating through their media interactions. Film, television, social media, gaming, school curriculum, and national discourses about climate, safety, and education provided templates through which students made sense of the technologies demonstrated to them. Importantly, these influences did not produce uniform visions; instead, children remixed global techno futures with their local cultural, linguistic, and institutional frames.

4.3.1 Bollywood, Social Media, and Media Portrayals (India). The imaginaries of students in the Indian school were shaped by Bollywood imagery, serialized television, social media trends, and the portrayals of technology common in Indian pop culture. Several students referenced *Robot 2.0*, a widely known Tamil science-fiction film starring *Rajnikanth*, whose narrative positions robots as beings capable of deep loyalty, emotional attachment, yet dramatic unpredictability. Such cinematic templates appeared to inform how students imagined robots. Rather than describing robots in functional or task-oriented ways, students often anthropomorphized it: beings who never get angry (unlike human teachers), don't punish, or who act as "secret keepers". These framings could reflect Bollywood's portrayal of machines as empathic figures, capable of care, companionship, or moral transformation; references that children readily re-appropriate when imagining future classrooms.

Gendered media imagery also shaped how robots were personified. During the discussion, in the context of what robots should or should not do, a student stated, "She (robot) can help the teacher; she will follow commands, she will explain" (G3), implying caregiving, obedience, and communication; traits commonly associated with feminized caregiving roles in Bollywood and popular television narratives that students referenced.

At the time of the workshop, the global release of the Barbie movie (2023) had generated a highly visible cultural moment in India. This media saturation surfaced directly in one group's design of a "Barbie-themed classroom," (refer to Figure 4). The design reflects how popular media events, especially those amplified simultaneously online and offline, become symbolic resources through which children articulate aspirations for joy, identity expression, and belonging within educational spaces.

4.3.2 Climate Narratives, Tech Pragmatism, and Ecological Discourse (Finland). The imaginaries of students in the Finnish school blended pragmatic concerns with speculative visions of future schooling. Their ideas often moved fluidly between radical technological interventions and everyday institutional norms, suggesting that their sense-making drew simultaneously from public climate conversations, school-based discourses, and media that prioritized environmental awareness. While ideas of zero-waste schools and green electricity cannot be attributed to any single media source, they do resonate strongly with themes that are routinely present in Finnish school projects, youth science programming, and public discussions about climate responsibility. This indicates that students were drawing on discourses familiar in their educational environment.

Alongside this ecological framing, students in the Finnish school articulated highly speculative technological possibilities. These ranged from "brain microchips to download information directly into the brain..." to visions of "a whole city inside moving spaceships, along with animals and plants." These futures resemble narrative tropes common in popular Hollywood sci-fi movies, which feature hybrid human–machine cognition, post-Earth habitats, and technologically enhanced living (see Figure 5). Like the Bollywood-inspired projections of their peers in India, these examples demonstrate that students in the Finnish also tapped into media imaginaries when thinking about technological futures; they drew from different narrative repertoires.

These examples show that the technological imaginaries of students in the Finnish school were shaped by a mix of curricular narratives (e.g., sustainability, digital literacy) as well as popular speculative tropes in the media (e.g., brain-tech integration, space habitats). Interestingly, students in the Finnish school did not gender robots, which may partly reflect Finnish linguistic structures, where the pronoun 'hän' (in English: she/he) is non-gendered.

5 Discussion

This study asked how adolescents in two distinct educational systems imagine the roles of AI, robots, and VR in their learning futures. Rather than interpreting differences as "cultural contrasts," our analysis demonstrates that children's speculative imaginaries are situated outcomes, co-produced by institutional conditions, discursive environments, and the speculative infrastructures available to them. Below, we theorize three contributions that extend current work in children's HCI, cross-cultural technological futures, and speculative design.

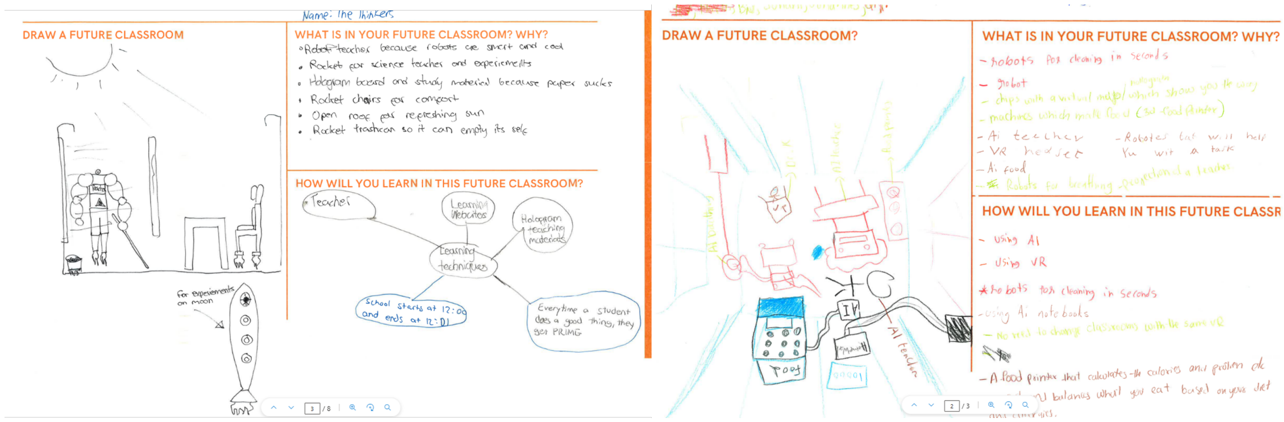

Figure 5: Design sheets from Day 1 of workshop in Finland

5.1 Speculative Imaginaries are Situated

Across contexts, children's imaginaries emerged through the socio-material infrastructures of schooling. This aligns with postcolonial critiques in HCI that warn against treating "culture" as a static explanatory category [27, 39]. When students in the Finnish school emphasized autonomy, teacher indispensability, and human authority, and students in the Indian school emphasized aspiration, apprehension, non-judgment, and fairness, these orientations mapped directly onto the affordances and constraints of their educational ecologies, not onto cultural archetypes.

This mirrors findings from Atabey and colleagues' 2025 cross-cultural study of children's AI ethics: understandings of fairness are not universal but arise from local expectations and everyday institutional pressures [8]. In our study, fairness and integrity surfaced in the discussions with students in the Indian school through the lens of high-stakes academic structures, whereas students in the Finnish school had concerns centered on agency and humane technology.

The imaginaries and reflections of the students in the Indian school highlighted an environment where academic performance is intrinsically tied to socio-economic mobility and future security. This focus underscores the powerful, highly collective dynamic in which individual achievement is viewed as a family and community project and success, a sentiment often captured by the idiom, *"Ek haath se taali nahi bajti"* (you cannot clap with one hand, i.e., success needs cooperation). The imaginative framing here centers on AI as a social equalizer and an enabler of aspiration. The students were not just critiquing the current system; they were asking how emerging technologies can grant those currently struggling against the power to achieve the highest possible success, thereby circumventing existing limitations and fulfilling the moral imperative to secure a better future for their families.

Students in the Finnish school, by contrast, imagined technology that supports personal agency and wellbeing within an educational system that prioritizes personal agency and self-expression. They rejected robot and AI replacement for human teachers and instead envisioned tools that preserve autonomy and human authority over technology. This resonates with the ethos encapsulated in the Finnish saying *"Oma tupa, oma lupa"* (one's own space, one's own permission), which emphasizes personal agency and discretion.

Following relational and postcolonial accounts of culture, design and computing [22, 27, 39], our findings show that futures emerge relationally, co-produced by students, facilitators, and the sociomaterial infrastructures in which they are embedded. A key methodological insight is that situatedness is not a limitation but a condition of possibility. Working within two contrasting educational ecologies revealed structural forces that deeply influence speculative work. Rather than generalizable patterns, what becomes transferable is the approach: attending to institutional constraints, discursive repertoires, and material histories as constitutive of imagination. This suggests that speculative design with children elsewhere must begin from a close reading of their local educational infrastructures and not from assumptions of cultural differences.

5.2 Scaffolding as Speculative Infrastructure

Speculation did not arise spontaneously; it was materially scaffolded through design fiction, technological demonstrations, and discourse. These scaffolds acted as speculative infrastructures that opened certain imaginative trajectories while limiting others [25, 90]. The omission of the design-fiction video on Day 1 in India vividly revealed this. Without it, children stayed close to everyday frictions such as "air conditioning," "projectors," or "screens instead of blackboards," and imagined technologies (robots, VR) for immediate, familiar uses. These grounded ideas were not indicative of limited imagination but of the absence of discursive permission to step outside of their lived constraints. Following the proper scaffolding process on Day 2, their speculative range expanded sharply with "no exams… magic, time travel… and the freedom to choose our favorite subjects," revealing the catalytic role of speculative media. Students in the Finnish school, scaffolded from the outset, immediately generated high-concept imaginaries. These futures blended everyday educational values with speculative technologies, illustrating what becomes possible when speculative infrastructures are available.

These patterns illustrate that speculative design is never value neutral nor happens in isolation [26, 65]. The prompts, artifacts, and examples we introduce co-produce the futures that children are able to articulate. We observed that layered scaffolding, combining a demo, design fiction, and prompts, effectively supported expansive, imaginative futures while narrative scaffolds (such as examples and stories) encouraged children to articulate relational, ethical, and affective concerns rather than only functional ones. Temporal scaffolding, which invited futures beyond immediate needs, also helped participants move past infrastructural-repair imaginaries. However, asymmetrical scaffolding generated asymmetrical imaginaries. Similarly, assuming familiarity with speculative genres overestimated students' prior exposure. That is, some needed more probing or narrative permission to 'think beyond'. At the same time, this highlights the methodological responsibility embedded in speculative design. Recent calls in HCI also urge researchers to situate futuring within the histories and local contexts that shape participants' worlds [13, 32, 36].

These insights are not generalizable across contexts, nor should they be. Instead, they offer methodological takeaways for others designing speculative work with young people. Our findings indicate that speculative genre literacy must be scaffolded rather than assumed; scaffolding must be adapted to local institutional pressures such as exam orientations, levels of student autonomy, or infrastructural precarity. Our findings also indicated that the purpose of scaffolding is not to standardize imagination but to enable divergence. Researchers and practitioners must therefore track how prompts co-produce imaginaries and adjust dynamically. In this sense, scaffolding becomes less a tool of instruction and more a speculative infrastructure intentionally assembled to cultivate conditions for imaginative plurality.

5.3 Plurality Requires Attending to Children's Lived Worlds

Children across both settings articulated futures anchored in relational ethics and ethics of care (see e.g [10, 19]), i.e., trust, fairness, emotional safety, and the wellbeing of the young learners. These values were expressed differently but pointed to shared aspirations for caring educational systems that preserve human value and dignity.

The Finnish participants emphasized maintaining the relational integrity of teaching, asserting that care, responsibility, and moral guidance must remain human. Students in the Indian school imagined robots as patient, nonjudgmental companions, more-than-human allies who could mitigate punitive classroom dynamics. These are articulations of what matters in their lived pedagogical worlds. This aligns with de la Bellacasa's "matters of care," which shifts attention from technology's capacities to the relational and ethical ecologies that technologies participate in [19]. Among both participant groups, robots, holograms, and AI tutors were imagined not as replacements but as participants in a system of support and wellbeing. Escobar's call for designing within the pluriverse further reminds us of the non-universalizable more-than-human futures where humans, technologies, and environments might co-exist [27]. Children's concern for non-human worlds also surfaced subtly, especially in the Finnish school, where integration of plants, nature, and ecological continuity within their speculative city-spaceships. These imaginaries echo Wakkary (2021) about designing futures that engage with multispecies, more-than-human and plural futures, rather than treating nature as an external, ornamental element to technological progress [89].

Plurality in futures, therefore, emerges when design attends to children's lived worlds, not when it imposes universalized evaluative frameworks. Rather than applying value-sensitive design (VSD) uniformly, our findings support working with locally resonant ethical repertoires such as drawing on *dharma* (duty) when discussing fairness with Indian participants, or *sisu* (perseverance) when addressing resilience and sustainability in Finnish contexts. Such framings offer culturally grounded starting points for co-speculating futures with children.

Together, these imaginaries show that students see education as a socio-technical system where infrastructures, rules, values, and daily practices shape each other. Instead of viewing technology as an external tool, students imagine educational futures as emerging through the interactions between digital systems, institutional authority, cultural norms, and lived experience. This perspective shifts the focus from what technology does to education to how education itself is understood as a dynamic, interconnected system in the making.

5.4 Limitations

Our study carries several limitations that shape how the findings should be read. First, the comparison is limited to two countries and specific school contexts, which cannot capture the full diversity within either country. As with many cross-cultural studies in CCI [1, 84, 91], practical constraints such as language, school access, and facilitation also shaped the scope of our inquiry. This means that our findings cannot be generalized as "Indian" or "Finnish" perspectives writ large, but rather as situated glimpses into particular school environments.

Second, the outcomes of speculative design workshops are inseparable from the scaffolding used. In our case, a technical issue during the first day of the Indian workshop meant that students did not receive the same design fiction prompts as their Finnish counterparts. This led to imaginaries that were initially more grounded in immediate material needs, expanding toward more radical visions when speculative cues were introduced (Day 2, India). While this variation provided insight into how scaffolding shapes children's imaginations, it also limits the comparability of the two cohorts.

Third, reflecting on our experience, we also note that speculative workshop outcomes depend on the facilitation and prompts provided. Different storytelling prompts might have yielded different emphases in each setting. Future studies could explore alternative speculative formats such as drawing, drama, and writing, and examine how they resonate across cultures.

We note that this study does not separately analyze findings based on students' socioeconomic, migration-based, or cultural backgrounds. While educational research has demonstrated that such factors can shape learning experiences and responses to curricula, our study did not collect or analyze individual-level demographic data, as doing so was beyond the scope of this work and raised ethical considerations given the age of participants and the study's focus on collective imaginaries rather than individual differences. Future research may productively build on this work by examining how plural design futuring practices intersect with students' diverse socio-cultural and socioeconomic contexts, particularly in ways that remain attentive to care, consent, and power in research with children

Lastly, the workshop materials, prompts, and facilitation oriented participants primarily toward human–technology relations within schooling. As a result, our findings speak more directly to interpersonal relational futures than to the multispecies, ecological, or planetary entanglements that shape educational life. This is a methodological limitation of our scaffold: by centering AI, robots, and VR as the focal speculative actors, we limited the space for children to articulate futures grounded in interdependence with land, non-human beings, or ecological systems. Future speculative workshops that intentionally invite more-than-human entities through prompts, artefacts, or outdoor engagements could extend relational ethics beyond the human, aligning more closely with pluriversal design commitments [10, 19, 27].

Despite these limitations, our comparative approach demonstrates the value of engaging children in envisioning the futures with emerging technologies, echoing [23] and many others (e.g., [24, 31, 41, 92]), and while doing so, adapting our methods to their cultural worldviews. We believe that doing so can be a generative approach to reveal what children in different settings *truly* want with emerging technology and, just as critically, what they *do not* want. We view limitations not as constraints but as opportunities. They point toward the need for future work that engages with more varied cultural and subcultural settings, experiments with multiple speculative formats, and systematically examines how different scaffolds shape children's visions. Doing so would enrich cross-cultural CCI research and deepen our understanding of how young people around the world imagine and contest the futures of technology.

6 Conclusion

This study has shown how children's sociotechnical imaginaries were grounded in institutional contexts, everyday lived experiences, and the scaffolds they received during speculative workshops. By comparing India and Finland, we demonstrated that futures are never imagined in the abstract: they are situated in local infrastructures, values, and discourses. This underscores a methodological lesson for participatory speculative design—scaffolding must be culturally attuned rather than imported wholesale. Technologies or prompts disconnected from local realities risk producing thin or irrelevant imaginaries. Our findings align with ongoing calls for decolonial and context-sensitive design approaches, reminding us that speculation is always a culturally embedded practice.

At the same time, our work highlights a deeper challenge: fostering plural imaginaries in the face of dominant narratives about efficiency, scale, and optimization. Such metrics, while powerful in shaping global technology discourses, are deeply limiting. The visions articulated by children, emphasizing warmth, trust, fairness, and care, point to alternative directions that resist reduction to efficiency alone. Speculative co-design must therefore not only surface these plural values but also work to protect them against being subsumed by dominant paradigms of technological progress.

Finally, bringing adolescent voices into this conversation reveals futures that differ starkly from adult-centered imaginaries. Children do not simply echo deterministic narratives of emerging technologies as inevitable and realist; instead, they situate technology within relational, ethical, and imaginative frames. This is particularly important when considering perspectives from the global majority, which remain underrepresented in speculative design research. Engaging youth from diverse contexts is more than a participatory approach; it is a democratic necessity. Whose futures we imagine, and whose voices we amplify, determine the justice and inclusivity of the digital futures we build.

By illustrating culturally situated, plural, and youth-centered imaginaries, our study contributes to an expanding agenda in HCI and CCI: to treat speculative design not as abstract futuring, but as a practice rooted in everyday lives, local histories, and global struggles for justice.

Acknowledgments

We are grateful to all the children and teachers who participated in the workshops, as well as to our research collaborators at IIT Delhi, notably the doctoral researchers in the Department of Design- Deepanshu Verma, Chinmay Pade and Chandni Tandon. This research was supported by several projects funded by the Research Council of Finland at the University of Oulu, including PAIZ (#340603), TakeOver (#363594), FutuProta (#351584), and ATOM (#371079). It is also a part of the EDUFI TFK 2025 funded project Design Thinking Curriculum (DTC).

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