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Reflecting on Methods

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Reflecting on Methods: From Unfolding to Supporting Co-exploration in Collaborative Design

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Abstract

This paper reflects on the multi-stage methodological journey to understand and ultimately support "co-exploration" in collaborative design. The longitudinal observational study, employing visual diaries and co-reflection sessions with 16 design teams, was instrumental in revealing co-exploration not as a fixed activity but as a situated, emergent experience whose presence and quality depend on specific collaborative conditions. This insight altered our initial understanding of co-exploration and led us to bring a more concrete working definition to the field of design collaboration. The paper then details how this understanding guided a subsequent study with design experts, revealing the importance of shaping conditions that support co-exploration through the coordinated use of people, materials, and interactions. We argue that this comprehensive journey offers a powerful way to approach complex, hard-to-define concepts in HCI, providing both a clear theoretical understanding and practical design guidance.

Keywords

Co-exploration, Design research methods, Collaborative design, Longitudinal diary interview, Intermediate-level design knowledge, Phenomenology,

1. Introduction: The Enigma of Co-exploration

In the field of collaborative design, some concepts are universally recognized for their profound value yet remain surprisingly difficult to define clearly [1, 2]. "Co-exploration" is one such concept. It describes the collaborative process where design teams iteratively explore ideas, build on each other's insights, and collectively discover unexpected possibilities, achieving outcomes beyond individual contributions. While designers intuitively know when they are "co-exploring," articulating its precise nature and, more importantly, designing ways to effectively support it, has proven challenging. This ambiguity became particularly evident during the COVID-19 pandemic, when remote teams articulated a "loss of co-exploration" [3], yet lacked a shared vocabulary to pinpoint exactly what had diminished or how to restore it.

This paper offers a reflection on our research journey, spanning two major studies dedicated to understanding and supporting co-exploration. Our path began by unfolding the phenomenon of co-exploration through a longitudinal observational study, ethnographic in its nature, challenging our initial assumptions about its definition. This foundational understanding informed the second phase, which investigated how to effectively support this complex and hard-to-define phenomenon, particularly in the challenging context of remote collaboration. The central argument is that the deliberate choice of research methods throughout this journey was paramount, transforming both the conceptual understanding and the ability to yield practical, actionable insights for design.

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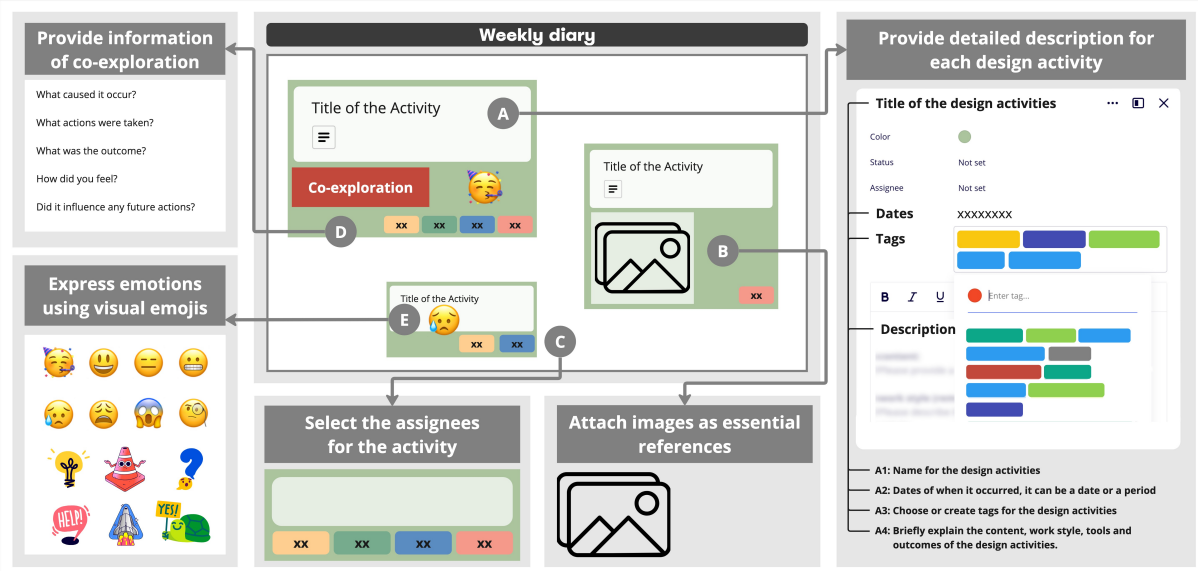

Figure 1: A schema of the weekly diary entry

2. Phase 1: Unfolding Co-exploration

Our initial quest to understand co-exploration began with a five-month longitudinal observational study involving 61 students across 16 collaborative design teams [4]. Drawing heavily on ethnographic principles, our methodological approach was deliberately designed to delve into the experience of co-exploration from the participants' own perspectives, rather than imposing external, predefined categories. This allowed us to investigate the phenomenon as it unfolded in its natural context.

2.1. Methods: Visual Diaries and Co-reflection

Recognizing that collaborative experience unfolds over time and is deeply intertwined with interaction, materials, and context, we developed two methods for data collection:

- **Visual Group Diaries with Interviews:**
  Diary entries [5] are a valuable method for observing participants in design research. Advances in digital tools have made image and audio diaries more accessible, and the diary-interview method offers deeper insights into participants' evolving experiences over time [6, 7]. For our study, design teams used collaborative Miro boards as living, weekly diaries. This digital platform was chosen for its familiarity to students and its capacity to integrate diverse design artifacts alongside textual descriptions. As shown in Figure 1, design teams were instructed to provide detailed information for each design activity, including the title (A1), date (A2), tags related to different actions (A3), and a brief description (A4). They were encouraged to attach images as references during explanations and to serve as prompts in later interviews (B). Assignees for each activity were selected by participants, with name labels were easily removable if certain individuals did not participate (C). Next, participants were asked to share which design activities were perceived as co-exploration and their selection reasons (D). Finally, participants expressed their emotions about activities using visual emojis, providing insights beyond textual descriptions (E). Note that the diary board remained continuous, allowing participants to revisit and edit previous entries and link related activities. Crucially, participants were empowered to identify and explain why certain moments felt like "co-exploration" to them, often expressing their emotions through emojis. This approach moved beyond mere activity logging, capturing the felt quality of their collaboration as it happened, directly from their viewpoint. It turned participants into co-theorists of their own experience.

Figure 2: Participants engage in evaluating their co-exploration activities. Left: Participants engaging in evaluating their co-exploration activities. Right: Participants read the back side to recall the details of their co-exploration activities.

- **Co-reflection Sessions:**
  At the end of the design process, we held co-reflection sessions. We transformed selected digital diary entries of identified co-exploration moments into physical cards. As shown in Figure 2, these tangible artifacts served as prompts for teams to collectively reflect on their design journey, categorize co-exploration moments into different clusters, and, most importantly, engage in a structured discussion to articulate their own definitions of co-exploration, characterizing what made an activity "co-exploratory" for them. This process fostered intersubjective meaning-making, allowing collective understanding to emerge from shared experience.

2.2. Insight: From Recognizing Activities to Identifying Experience

Our analysis of the rich data collected from the visual group diaries and co-reflection sessions followed an iterative qualitative approach, moving from initial identification to deeper conceptualization.

Among 1,562 recorded collaborative design activities, we collected 220 that were labeled as co-exploration by the participants. Even within the same team, seemingly similar activities often led to different outcomes. For instance, some discussions were purely decision-making sessions, while others, equally structured, transformed into co-exploration. This revealed that the generic label of an activity did not determine whether co-exploration occurred. Instead, what mattered was how that activity was experienced by the participants, which we termed its phenomenal quality.

From the co-reflection sessions, participants articulated these phenomenal qualities that allowed us to initially recognize the phenomenon of co-exploration among all recorded activities. These included a profound sense of togetherness within the team, a feeling of collective contribution enabled by the synergy of individual skills, and a spirit of open-mindedness and active engagement. When present, these qualities propelled the design process forward and fostered stronger team cohesion.

However, we soon realized that simply recognizing these features didn't fully explain how or why this phenomenon occurred, or what distinguished its different manifestations. This led us to move from general recognition to a more detailed description of the co-exploration experience itself. We shifted from analyzing the overall co-reflection data to dissecting the detailed, in-situ descriptions of each identified co-exploration activity from the visual diaries.

This deeper analysis allowed us to identify four distinct dimensions that describe the co-exploration activities and help differentiate their various forms, including how information is shared, how diverse insights are introduced, the types of communication that occur, and how participants are spatially distributed. The identification of these dimensions was a pivotal moment, providing us with the precise language to understand that co-exploration's presence and character were determined by the dynamic

interplay of these conditions and the way teams interacted, not merely the activity itself.

While we might label a particular moment as a "co-exploration activity" for practical purposes, our insights revealed that co-exploration itself is not a discrete activity. We initially recognized co-exploration as certain collaborative activities, but as we delved deeper into the phenomenon through our methods, we realized it was an emergent, situated experience that occurs in and throughout activities. This shift from simply recognizing a phenomenon to truly understanding its experiential, contextualized nature was critical to our research.

3. Phase 2: Supporting Co-exploration

The understanding gained from "unfolding co-exploration" in the longitudinal study guided the second phase of our research: investigating how to support it, particularly in the challenging context of remote collaboration.

3.1. Bridging Observation to Application

We conducted a follow-up study involving interviews with eight professional design experts. The aim was twofold: 1. to validate whether our identified patterns of co-exploration resonated within professional practice. 2. to understand how these experiential qualities were affected by remote work settings and how they might be supported.

Experts confirmed the presence of the co-exploration patterns but highlighted challenges in their execution and quality in remote collaboration. Specifically, they noted that remote collaboration often led to a diminished sense of shared awareness of colleagues' work and fewer opportunities for informal, spontaneous interactions - qualities typically afforded by physical co-presence. This often resulted in remote design processes tending toward a more "design as search" approach [8], focused on solving well-defined problems, rather than the iterative "design as exploration" [8] characteristic of creative design processes in co-located environments.

To explore solutions for supporting co-exploration in remote settings, experts then engaged in speculative ideation using tailored Inspiration Cards [9]. These cards served as tangible prompts, encouraging experts to propose ideas grounded in their practical experiences.

3.2. Translating Insights into Design Knowledge

This expert validation, synthesized together with our understanding of co-exploration, informed the development of the Designing Tools for Co-exploration (DTC) guideline [10]. It offers intermediate-level knowledge [11] focused on shaping the conditions for co-exploration to emerge, providing insights that are more specific than abstract theories, but more flexible than strict how-to instructions.

As shown in Table 1, the DTC guideline is organized through three collaborative spaces: meeting space, working space, and project-specific space. Each space describes three interwoven themes: people, materials, and interactions. Together, they form an integrated perspective connecting social coordination, material engagement, and temporal project dynamics. For example, in the meeting space, participants described how the heavy demand for individual preparation before remote sessions often turned meetings into updates rather than opportunities for exploration. During the expert ideation, they proposed ways to reduce this load, such as maintaining contextual awareness of both individual and project work-in-progress, improving synchronization of design materials, and providing lightweight channels to sustain the team's engagement. In the working space, the absence of spontaneous interaction emerged as a central concern. When informal interaction disappears, teams lose the quick feedback and social energy that sustain exploration. Ideas such as enabling casual online encounters and supporting the visibility of communication cues were synthesized into aspects that emphasize togetherness and real-time awareness. In the project-specific space, the challenge of maintaining contextual continuity was evident: missing repositories and scattered artifacts made it hard for participants to see how work connected across time. Ideas about trace archives or visual progress maps were synthesized as the

Table 1
The first three columns of the DTC guideline

Spaces	Theme	Key Aspects
Meeting space	People	- Contextual awareness of an individual's work-in-progress
		- Contextual awareness of project's status
		- Individual preparation
	Materials	- Multi-fidelity prototypes
		- Accessibility and synchronization
		- Meeting continuity
	Interactions	- Group-based techniques
		- Maintaining enthusiasm and engagement
		- Expressing and understanding communication cues
		- Facilitating side conversation
		- AI-generated content
Working space	People	- Informal encounters
		- Contextual awareness of individual's work-in-progress
		- Contextual awareness of project's status
	Materials	- Ambient creative stimulus
	Interactions	- Informal social interactions
		- Maintaining togetherness
		- Pre-meeting huddle
		- Expressing and understanding communication cues
Project-specific space	People	- Contextual awareness of the project's status
	Materials	- Material archives for future reference
		- Encouraging knowledge sharing
		- Accessibility and synchronization
	Interactions	- Traces of interactions with materials

knowledge that collaborative systems should embody project history and make the ongoing context tangible.

Across these examples, DTC emphasizes that the strength of co-exploration does not lie in isolated fixes but in how these spaces interact. Overload in preparation can dampen informal engagement; missing context increases meeting frustration; fragmented interactions weaken a sense of togetherness. The contribution of DTC, therefore, lies in its holistic view of how seemingly familiar challenges manifest differently across spaces, how they influence one another, and how their combined effects can hinder collaborative exploration.

3.3. Reflection

In this section, we reflect on our research journey, from initially recognizing the co-exploration phenomenon to deeply understanding its emergent nature and, finally, informing its support. This reflection offers valuable insights into our understanding of phenomenological concepts and methods within HCI research.

The first phase of our research, an ethnographically-inspired longitudinal study, relied on the combination of visual diaries and co-reflection sessions. These methods were instrumental in collecting diverse types of data throughout different stages of the research, allowing us to unfold a nuanced understanding of co-exploration as an emergent, situated experience. By prioritizing participants' own interpretations and providing them with accessible tools for self-documentation and collective sense-making, we gained insights into the phenomenon that were largely inaccessible through purely objective, external observation. This approach demonstrated its value in exploring the complex, subjective aspects of human interaction, enabling a deeper understanding of what people genuinely experience rather than merely what they do.

In the second phase, based on the conceptual understanding gained from the first study, we synthesized experts' insights from interviews, utilizing Inspiration Cards to facilitate their ideation and translation of that core understanding into actionable knowledge for design. This process led to the creation of the Designing Tools for Co-exploration (DTC) guideline, a concrete output that serves as a testament to the

journey from conceptual understanding to practical application.

This multi-stage journey taught us how to identify and understand a phenomenon. For co-exploration, we realized it required moving beyond analyzing specific "activities" to understanding the underlying "conditions" that enable desired experiences to emerge [12]. This shift in perspective was fundamental for our understanding of how collaborative technologies could truly resonate with how people experience and engage in their work.

4. Conclusion

Our research journey regarding co-exploration presents the understanding of how to approach phenomena in the HCI field. By embracing methods that allowed us to unfold co-exploration and gain a conceptual clarity that was previously elusive. These insights led us to define co-exploration as emerging across diverse activities and team interactions, fostering togetherness and keeping design teams open-minded. This engagement cultivates collective intelligence and enables teams to share knowledge, which often coincides with instances of effective and healthy teamwork. This understanding was not an endpoint but a launchpad, directly leading our steps to contribute to the Designing Tools for Co-exploration (DTC) guideline, which offers intermediate-level design knowledge to support remote co-exploration. The guideline is intended to assist tool designers in creating interventions that enable specific co-exploration patterns, and to support design teams in reflecting on their collaborative practices and identifying opportunities for improvement.

Declaration on Generative AI

During the preparation of this work, the author(s) used GPT-5 and Gemini 2.5 Pro in order to: Grammar and spelling check, improve writing style, and Paraphrase and reword. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

References

[1] K. Koskela-Huotari, P. Friedrich, M. Isomursu, Jungle of "co", in: Proceedings of the Naples Forum on Service, 2013, pp. 18–21.

[2] T. Mattelmäki, F. S. Visser, Lost in co-x, Proceedings of the IASDR2011 (2011).

[3] X. Ye, J. Frens, J. Hu, Adjusting to a distributed collaborative design process during the covid-19 pandemic, IEEE Pervasive Computing 20 (2021) 9–17.

[4] X. Ye, J. Frens, J. Hu, Beyond divergence: Characterizing co-exploration patterns in collaborative design processes, She Ji: The Journal of Design, Economics, and Innovation 11 (2025) 345–372.

[5] N. Bolger, A. Davis, E. Rafaeli, Diary methods: Capturing life as it is lived, Annual review of psychology 54 (2003) 579–616.

[6] D. H. Zimmerman, D. L. Wieder, The diary: diaryinterview method, Urban life 5 (1977) 479–498.

[7] P. Thille, L. Chartrand, C. Brown, Diary-interview studies: longitudinal, flexible qualitative research design, Family Practice 39 (2022) 996–999.

[8] L. Hay, A. H. Duffy, C. McTeague, L. M. Pidgeon, T. Vuletic, M. Grealy, A systematic review of protocol studies on conceptual design cognition: Design as search and exploration, Design Science 3 (2017) e10.

[9] K. Halskov, P. Dalsgård, Inspiration card workshops, in: Proceedings of the 6th conference on Designing Interactive systems, 2006, pp. 2–11.

[10] X. Ye, J. Frens, J. Hu, When design collaboration goes remote: Intermediate-level knowledge for empowering remote co-exploration, in: IFIP Conference on Human-Computer Interaction, Springer, 2025, pp. 45–67.

[11] K. Höök, J. Löwgren, Strong concepts: Intermediate-level knowledge in interaction design research, ACM Transactions on Computer-Human Interaction (TOCHI) 19 (2012) 1–18.
[12] P. Dourish, What we talk about when we talk about context, Personal and ubiquitous computing 8 (2004) 19–30.