CHAPTER 39

Space, Time and Uncertainty

Hayo Reinders
King Mongkut's University of Technology Thonburi, Bangkok, Thailand

Artem Zadorozhnyy
Education University of Hong Kong, Hong Kong SAR

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Abstract
We argue in this chapter that at the heart of our field is a largely ignored and unexplained series of phenomena. Just as 'dark matter' constitutes most of the universe yet remains invisible to our instruments (Sutter, 2022) these forces interact with and directly influence all aspects of language learning. Without stretching the analogy too far, we refer of course to the many spaces learners occupy in their lifelong and lifewide language journey. Respecting these spaces, we find ourselves spatially and temporally far beyond the ubiquitous language classroom, which nevertheless remains the focal point of most language education and research. In this divagation, we make a modest attempt at interrogating what we believe to be the epistemological and pedagogical impact of our field's collective myopia and offer an alternative lens through which more authentically and comprehensively to observe the language learning journey.

Keywords: spaces, time, epistemology, learning beyond the classroom, lifelong learning, lifewide learning

Introduction

Our field has historically adopted a limited perspective on language learning and teaching; one that places the instructional component at the heart of our understanding of language acquisition. For decades research has placed in-class spaces at its core, despite the fact that the majority of learning takes place outside of formal education (Cross, 2011). As a result, it is perhaps not surprising that in some ways we have made little headway in understanding how people learn another language and

how they can best be supported in this. Yes, we can claim that the n^{th} variation of a task design will have a minor impact on some minor aspect of language production (Reinders & Ellis, 2009), and yes we can identify that neuronal activity around 400mhz indicates the brain has perceived a linguistic anomaly (Osterhout & Holcomp, 1992), but a deep understanding of how and why language develops differentially between learners (or why learners learn in the first place, especially beyond the compulsory years) has largely eluded us.

And then there are the multiple elephants in the (class)room: for example, the general paucity and poor quality of the input in formal education (Bley-Vroman, 1989), the limited opportunities for L2 output (Swain & Lapkin, 1995), and the often poor outcomes of language education programmes (ACTFL, 2022). We contend that this is largely due to the fact that we ignore much of what happens in learners' lives as they develop their additional language (and concomitantly culture, identity, personality, etc). Language education has temporally and spatially limited itself to the here and now, with little regard for developing learning skills (as opposed to language skills) to benefit future, or lifelong learning. It has demonstrated an equally impressive oblivion to learners' needs and personal interests and by extension their daily lives with its manifold and rich environments for language learning, i.e. lifewide learning (Reinders, 2023). This begs the question why so much of our collective effort is expended on formal education.

We argue that instead we should adopt a learner- and learning-first approach that places the individual at the heart of our 'weltanschauung', the way we view the world. In other words, a paradigm shift that considers language development as journey through multiple dimensions; an organic, dynamic and interconnected process that spans a learner's life in all its facets at any one time, occupying numerous spaces, each with its own affordances, or potential benefits, of which the classroom is only one.

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Epistemological uncertainties

Our field's narrow focus on formal education has left a vast "dark" metaphorical space of learning, necessitating a shift towards structuring the "unstructured" and uncovering the dynamics of learning beyond the classroom (Benson & Reinders, 2011; Toffoli et al., 2023). Recent work has enabled us to model (some of) the factors influencing learning beyond the classroom, explore connections with language outcomes, and at least partially appreciate the role of individual differences in these processes (Lai & Sundqvist, 2026). However, despite this progress significant epistemological gaps remain.

First, current perspectives frame learning beyond the classroom as the antithesis to formal learning, creating arbitrary boundaries that emphasize their contrasts rather than explore their continuities. For example, a romanticized view of informal spaces as inherently open and democratizing is juxtaposed with formal classrooms as boring and restrictive (Berman, 2020). Neither is correct. In fact, the dichotomy is entirely artificial; a result of an obsession with structure and control as imposed by national and institutional policies, curricula and societal expectations around examinations as 'evidence' of development. The results are pernicious, impacting how

learners view the classroom and how teachers ignore what lies beyond. In reality, the myriad interconnections between the formal, non-formal, and informal spaces have been increasingly brought to light in recent years. For example, we now have evidence that teacher encouragement (affective support) about technology's value for learning strengthens students' belief in its usefulness. This enhanced perception then motivates students to engage with technology independently for language learning outside the classroom (Lai et al., 2015). Similarly, recent research into the psychology of language learners has shown that when teachers fulfill students' basic psychological needs in the classroom, this satisfaction extends beyond institutional walls to fuel the diversity of productive and receptive informal language learning activities (Zadorozhnyy & Lee, 2026).

However, such research is still a drop in the ocean of homogeneity where authenticity and value are marginalised in favour of controlling variables in predictable environments. In addition, the insights from one environment are seldom transferred to another, thus eschewing potential synergies. Equally importantly, by treating the domains in isolation we are only completing a puzzle that has already changed by the time that we manage to slot in another piece. This fragmented inquiry limits our ability to understand learning as a continuous, dynamic process, one that resists confinement to a single space or timeframe. As a result, studies fail to connect informal or incidental instances of learning to broader patterns of peer learning, self-directed learning, flexible learning, community learning and many others. At the same time, we overlook how these activities are shaped by years of prior development and connected to future learning trajectories, severely limiting our understanding. How does prior use of a language exchange app affect in-class participation? What mechanisms allow learners to transfer knowledge gained through fanfiction to classroom writing? How does formal language test preparation affect informal talk outside the classroom? These limitations are particularly noticeable when considering adults, whose extensive learning experiences are often overlooked when returning to formal education later in life (Castañeda, 2017). By dissolving the dichotomy and embracing the interdependence of these spaces, we can reimagine learning as a dialogic process, characterized by adaptive, integrative, and boundary-crossing attributes, where learners navigate, negotiate, and reshape their environments.

This necessitates developing a much deeper understanding of the human at the heart of the process, not merely analytically as a learner, but holistically as a social, cultural and emotional being. Developments in the area of the psychology of the language learner have shown us that motivation, emotions and identity are dynamic and context-sensitive systems that shape and are shaped by learners' goals, backgrounds and environments (Benson, 2021; Prior, 2019). Similarly, earlier studies on language learner histories have provided deep insights by discovering that learners' self-analysis of their narratives helps them make sense of their experiences by linking their past, present, and future, with their future goal visions being especially important for long-term development (Mercer, 2013). Among more recent studies, the study of Mendoza and others (2025) showed that students in classrooms with higher-achieving peers tend to improve their English language skills better. However, those who actively participate in class and genuinely enjoy learning are especially receptive to absorbing the successful study habits and motivated attitudes of their high-performing classmates.

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At last, more recent developments including technology-supported experience sampling methods and long-term learning analytics allow capturing ecologically valid, high-frequency, in-situ data on learners' language exposure and use (Arndt et al., 2023) and learners' behavioural patterns (Geng & Yamada, 2022). The issue, however, is a lack of connection between these and a holistic research agenda that can synthesize insights across temporal and spatial boundaries, informing our understanding how they coalesce into the complex, lived reality of language learning.

Moving forward requires new methodologies, not merely of a multidisciplinary or interdisciplinary nature, but truly transdisciplinary approaches that transcend traditional knowledge bases (Hays & Reinders, 2020). Much like applied linguists began to adopt ideas and methods from cognitive psychology in the 1960s and 1970s, we need to embrace advancements in neuroscience, educational psychology, computational linguistics, and AI (amongst many others) to capture all of a learner's interactions with the target language. We can, for example, imagine building learning models that proactively monitor students' cognitive load in real time (Gkintoni et al., 2025) or to guide parents and caretakers in supporting out-of-class learning (Leong et al., 2025). By processing vast, longitudinal data streams from a learner's entire ecosystem, from formal assignments to informal chats and gaming sessions, AI can move beyond analyzing the product of learning to mapping the process. It can log hesitations, track self-corrections, and identify patterns of avoidance, creating a dynamic, highly detailed profile of a learner's evolving interlanguage. This information can then help predict a learner's development, forecasting when they are likely to struggle or when occasional mistakes may turn into permanent errors. This in turn enables teaching to become proactive and tailored to learners' future needs, not just their current ones. In so doing, we can start to reveal the 'dark matter' of individual learning.

Third, our understanding of 'learning' has too often been constrained by what lends itself to immediate measurement: linguistic output, test performance, or other discrete classroom outcomes. Yet these represent only a fraction of the processes that shape language development. Much of the real work of learning occurs in subtle, often invisible moments; when learners hesitate and self-correct, silently rehearse, or draw on emotional responses or prior experiences to interpret new ones. These processes extend across time and space, from deciphering a street sign abroad to resolving misunderstandings in online exchanges or crafting a personal story for an unfamiliar audience. Such acts highlight that language learning is not merely about accumulating quantifiable skills but about weaving those skills into lived, meaningful practices. By shifting attention from static benchmarks to dynamic experiences, we begin to see learning as a lifelong, lifewide process of negotiation, an integrative, human-centered journey rather than a series of isolated achievements.

Pedagogical uncertainties

Formal education is structured in order to reduce ambiguity, but language development thrives in the space between order and chaos. Linguistic hypotheses are formulated and tested, meaning is negotiated, and cultural and identity-based assumptions are challenged. Operating at this interface requires moving away from the duality between 'teaching' and 'learning' to something more akin to a

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dance where two partners come together to find temporary balance in the pursuit of a creative 'continuous falling.' Teaching then becomes supporting, pushing, observing, letting go - and of course enjoying. Teaching is thus freed from its temporal and spatial prison; it becomes a dialogic process spanning many spaces across multiple timespans. It becomes responsive rather than prescriptive, continuous rather than occasional, personal rather than generic, and – importantly - ever so slightly more 'risky,' and thus more real.

This challenges the traditional notion of 'teaching' as the provision of structured instructor-led activities and 'learning' as the resulting acquisition of knowledge and skills. Even something as ordinary as recommending an instructional YouTube video blurs the roles of teacher and learner. The teacher did not explicitly 'teach,' but the act of sharing creates a learning opportunity shaped entirely by the recipient's curiosity and time. Similarly, watching a film with subtitles, or toggling the automatic translation on or off, shifts the locus of control to the viewer, making acquisition a by-product of entertainment rather than instruction. This dynamic is even more pronounced when a social media algorithm becomes an 'accidental tutor,' transforming a learner's passive scrolling into a continuous, personalized stream of L2 vocabulary or listening practice (Yamamoto, 2025). Here, the teaching-learning dynamic vanishes, leaving instructional content to drive acquisition, often unintentionally. Knowledge exposure becomes an accidental, fragmented by-product of a data-driven feedback loop curated by non-human entities. To call this ambient, algorithm-driven process 'learning' is to stretch the word to its breaking point, as it fails to capture the spontaneous and unstructured way knowledge is acquired.

Next, formal learning is often portrayed as being carefully planned, structured, delivered and evaluated. In reality, this is hardly ever the case. Lessons frequently go off-script due to unexpected classroom dynamics, such as debates or questions revealing gaps in prior knowledge, while assessments often fail to capture broader learning, overlooking vocabulary picked up from video games or slang learned from viral Instagram reels. In-class peer discussions frequently shift to topics unrelated to classroom subjects when students share personal experiences. While these moments may seem disconnected from the curriculum, they can profoundly shape a student's learning journey in unexpected ways. In fact, what often stands out from collaborative activities with peers is not just the academic content, but the human element of the exchange. What is remembered is the personal story someone shared, the emotion we felt when reading a book, or the joke told by a friend, precisely because these emotions can become powerful hooks for remembering the associated content. These incidental, unplanned, and spontaneous learning moments enrich the overall educational experience (Markee, 2005) yet, they remain a blind spot in most discussions of formal educational approaches.

Further, with technology's ability to generate answers instantly, teaching increasingly involves (guiding learners in) asking the right questions. This new pedagogy must embrace what Kapur (2015) calls productive failure - not simply letting learners fail, but orchestrating challenges where they explore solutions to tackle problems before receiving explicit instruction. It is in this unguided struggle that deeper understanding emerges, where resilience takes root, preparing learners for the inherent ambiguity of real-world communication. In these situations, the teacher becomes less

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instructor and more curator of experience, helping learners discover the narrative threads that connect their formal learning, informal passions, and even accidental algorithmic encounters. This recognises learning as an unbounded process, revealing how knowledge has always moved fluidly through human experience.

Finally, the institutional architecture of teacher education itself often widens this disconnect. Preservice programs and mandated curricula remain tied to a traditional model of education, one that prioritizes standardized content delivery and high-stakes assessments above all else. In this scenario, language educators are thus trained to become 'technicians' of the classroom, mastering the art of planning lessons, preparing for tests, and following mandated activity sequences within controlled environments. This leaves language teachers ill-equipped and systematically discouraged from recognizing, validating, or weaving a student's rich, chaotic, and digitally-saturated out-of-class existence into the formal learning narrative. Therefore, instead of preparing educators to be agile choreographers of learning, contemporary systems produce guardians of a static curriculum, ensuring a student's authentic, lifewide journey remains firmly outside the classroom door.

Conclusion

To recognise our educational dark matter, we need to become more adventurous in how we conceive of, investigate, and reflect on the many ways language develops. This requires moving beyond the unhelpful binaries of formal versus informal, classroom versus community, or digital versus physical. These categories conceal the ways in which learning flows across boundaries, making the invisible visible only when we learn to look differently.

For researchers, this means embracing fluidity and transdisciplinarity, designing studies that capture fragments, shifts, and contradictions rather than forcing coherence. For teachers, it means curating environments where serendipity, self-direction, and collaboration can flourish, and where what happens outside the lesson plan is recognised as integral to learning.

We argue for the need to seek out new epistemological and pedagogical approaches that not only accept but celebrate uncertainty as being at the very heart of language learning. Like astrophysicists tracing dark matter through its unseen effects, we must learn to notice the invisible forces shaping learners' development. If we fail to do so, our theories will remain partial and our pedagogies incomplete. If we succeed, however, we may begin to chart a more expansive, humane, and sustainable vision of language education.

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