

Living Labs Through Wenger's Conceptual Lens: A Literature Review

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**Living Labs through Wenger's conceptual lens:
A literature review of the empirical foundations for lab practices**

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Abstract

Living labs are increasingly positioned as social learning environments. This literature review applies Wenger's Community of Practice framework as a theoretical lens to generate a first insight into what is known about the complex collaborative processes of living labs. We explore this model with insights from the literature on labs and then we set out to understand higher educational living labs. The findings show that current research on lab practices is limited, the field is scattered and there is hardly any combined perspective across disciplines. A clear indication is given for more research on the actual social processes in labs. Only then can living labs hold their promise of integrating learning and innovation in higher education institutions to serve society.

Keywords: living labs, higher education, stakeholder collaboration

**Living Labs through Wenger's conceptual lens:
A literature review of the empirical foundations for lab practices**

Living labs are increasingly proposed as social learning situations where different stakeholders can interact and learn while also fostering innovation (Schipper et al., 2022). Universities view living labs as optimal environments that integrate research and education, reflecting policymakers' desire to position labs as core transformation instruments to achieve applicable innovations for knowledge economies, higher education, and lifelong learning (Ministry of Education, 2019; Prime Minister's Office, 2006). Scholars also embrace the living lab approach due to the belief its transdisciplinary setting is ideal for impactful innovation, achieved by involving a heterogeneous mix of stakeholders (Paskaleva & Cooper, 2021). In educational contexts, students are described as an untapped resource for research in complex problem-solving, and labs also provide experiences to prepare for the job market (Evans et al., 2015; Rogers et al., 2021). Higher Education labs are mostly positioned toward the edge of university organisations, as part of larger network structures, that hold open innovative, collaborative processes in real-life environments through the inclusion of multiple stakeholders from business, society, and academia (Ballon & Schuurman, 2015; Burbridge, 2017; Chron er et al., 2019; Hossain et al., 2019). These network structures imply the 'horizontal adoption' (Burbridge, 2017, p. 1726) of innovations, or create innovations through changed work practices.

The collective social learning by different types of stakeholders yields a multi-disciplinary evidence base, reaching across higher education research, innovation management studies, and studies about successful (student) learning in complex contexts. While studies can be found in each of these fields, they hardly combine perspectives across disciplines. Collectively, the studies seem to primarily focus on two perspectives: first, the interaction between universities, governments, and market and how living labs fit into this system (Almirall & Wareham, 2011; Greenwood et al., 2017), also known as the triple or quadruple helix. The second perspective focuses on the elements that make up living labs, such as participants, funding, and coordination (Westerlund, Leminen, & Habib, 2018; Westerlund, Leminen, & Rajahonka, 2018). This second perspective remains descriptive and lacks a practical approach to the interaction of living lab elements in actual labs (see also Chron er et al., 2019; Compagnucci et al., 2020, pre print).

Whilst the current literature study can be positioned in line with the second approach, aiming to understand the what and how in labs, our intention is to reach beyond the elements of living labs into their innerworkings, and is based on what is empirically known about the processes of living labs in current academic literature. This approach follows the call by Hakkarainen and

Hyysalo (2016) to provide guidelines for practitioners, and by Hossain et al. (2019) who note the limited reference models for developing and managing living labs.

Defining living labs

A Living Lab is a concept that has various definitions and interpretations across knowledge fields and practices. Generally, it is described by two core characteristics: co-creation, and real-life experimental environment with user participation (Hossain et al., 2019). The term was first used in the 1990s to describe user testing in smart living homes. Since then, its meaning has evolved from an R&D methodology to encompass a broader definition, such as 'user-centric innovation mileu built on every-day practice' (Bergvall-Kåreborn et al., 2009, p. 3), an 'open innovation environment' (Mulder & Stappers, 2009), an 'ecosystem' (Hossain et al., 2019) or as 'interaction spaces' (Leminen, 2015). While research studies provide a high level definition of a living lab, its definition remains elusive in practice.

When students are the core stakeholder in a living lab, they are called "educational Living Labs". These have gained popularity, but their meaning can also vary widely, often with a preference of 'authenticity' over 'real-world experimentation' as a key component (Miltenburg & Weerheijm, 2018). Co-creation and multi-disciplinary teamwork varies in its application in practice. Each lab differs in its set-up, structure and goal. Students work together within a single discipline, or across multiple disciplines, and practitioners and users are involved in various ways. Innovation is often seen as a by-product of student learning, rather than a value for other stakeholders in the lab, whilst benefitting all stakeholders is considered crucial for integrating learning, innovation, and providing a sustainable practice (Burbridge, 2017).

Although a clear multiplicity in lab definitions can be seen, collaboration is overall considered a key component (Kalinauskaite et al., 2021). Labs are essentially posed as transdisciplinary collaborative "[...] interaction spaces, in which stakeholders from public-private-people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders, all collaboration [...] in real-life context" (Leminen, 2015, p. 15). This commonality provides a united focus as we look how practice and collective learning might be shaped in the body of knowledge on labs.

Therefore, labs are here defined as inherently social processes characterized by the in-lab mechanisms in which stakeholders simultaneously learn and innovate. This takes place in a setting where stakeholders collaborate and co-create meaning, new perspectives, and knowledge (Zenk et al., 2021, p. 2). The lab brings together stakeholders from different backgrounds who identify and feel accountable to different communities of practices (Kubiak et al., 2014). As a result, stakeholders

must learn how to collaborate and form a community of practice together, which can be “a messy reality of historical, social, and political relationships that are charged through and through with power” (Kemmis, 2005, p. 400).

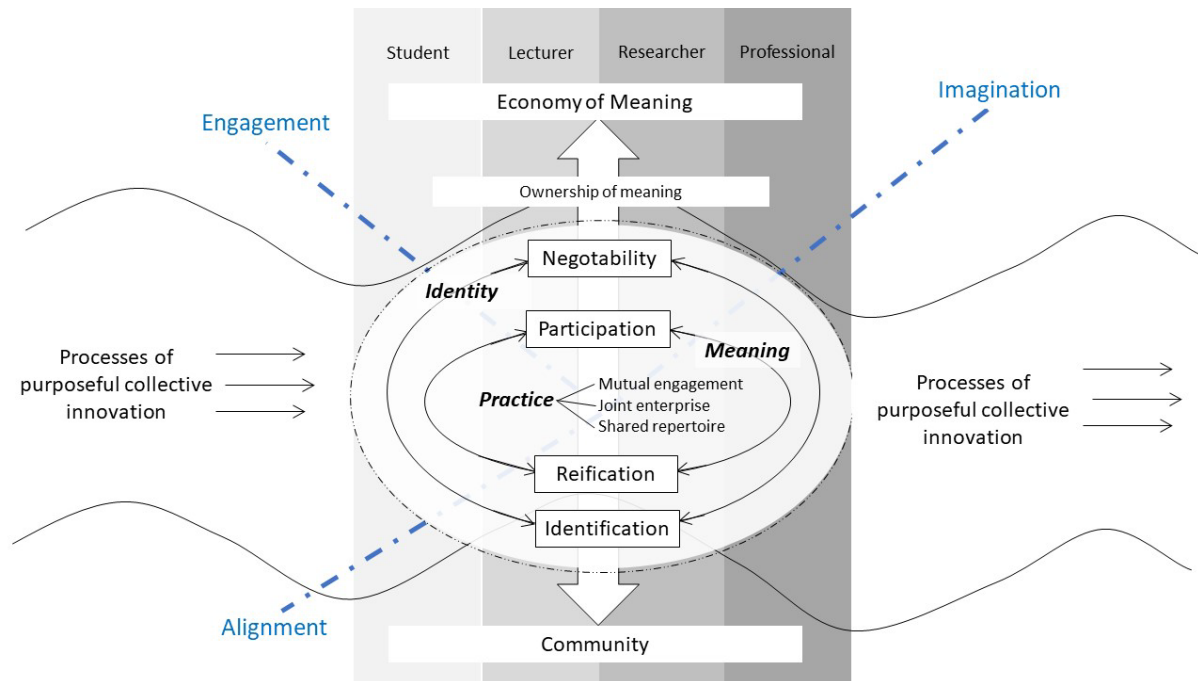


Figure 1: Think model of Living Labs through the lens of Wenger's CoP variables (Wenger, 2019 (1998)).

Approach in this study

The afore description of living labs suggest that the lab can be seen as a practice community, characterized by its social process as described by Wenger (2019 (1998)). To be able to provide such a rich description of collaboration and collective learning in living labs, we position Wenger's Community of Practice framework (2019 (1998)) as a theoretical lens in this literature review. Wenger's framework is widely used in various settings, such as in workplace learning (Gijbels et al., 2001), and in learning across organizations (Mavri et al., 2021). Its variables can describe processes in living labs following the integration of foci on practice, community, identity, and meaning (Wenger, 2019 (1998), p. 5) as also depict in Figure 1. In this visual, we have applied the characteristics of CoPs to higher education labs. The four key stakeholders of students, lecturers, researchers, and non-HE professionals were included as representations of distinct practices that often intersect in higher education lab environments. Some individuals may embody multiple practices. The variables in this figure are applied to describe the current body of knowledge on living labs from two perspectives. First, the variables in the center of the figure outline the current knowledge about living labs in general and focus on the concept of "Practice". According to Wenger practice in a CoP is built upon 3 dimensions: joint enterprise, mutual engagement, and shared

repertoire. Of these three dimensions, **joint enterprise** is a defining feature of labs: a collective negotiation process focused on a common goal or purpose. Other than in CoPs, this joint enterprise in labs is an actual collective project – not a metaphorical one – on which stakeholders work collaboratively. This requires a more intense negotiation of the practice in labs (Mørk et al., 2010). Similarly as in CoPs, **Mutual engagement** refers to the communication and social relationships, while **shared repertoire** is about having a collective narrative for sharing ideas, concepts and building a history of tradition. Then, 'Participation' is the process of taking part in a practice. All 'meaning' is negotiated in practice through an interwoven process of participation and reification, in which the latter is the creation of artifacts such as in writing or objects as part of practice.

These labels will be applied to structure and conceptualise the findings in this article, at the level of detail provided by the body of knowledge found. This will be done firstly with a general focus on living labs, and secondly with a focus on living labs in higher education. In the latter, the body of knowledge has shown particular relevance of the combined processes of practice, meaning and identity into perspectives of the economy of ownership, which seem to shift when the focus in living labs alters its core focus from innovation to (student) learning.

Our adapted version of the Wenger framework provides us with a more integrated view of the living lab process as a social constellation of which "learning is their practice" (p. 95), as has been done before for other social settings such as on collaboration in multidisciplinary project teams (Hildreth & Kimble, 2004). It is important to note that living labs deviate somewhat from Wenger's traditional definition of CoPs. Labs are often a formal entity with a specific start date, and frequently include an assigned topic, while CoPs are more continuous in nature. However, other studies have already applied CoPs to more formal organizational structures (Hildreth & Kimble, 2004). Furthermore, labs align with Wenger's view that learning is a source of social structure (Wenger, 2019 (1998), p. 96), and that structure is emergent, not a separate entity. As such, both CoPs and living labs involve an open negotiation of meaning and are both constantly changeable, balancing stabilizing and destabilizing forces (Wenger, 2019 (1998), p. 97). In both settings learning drives the practice in an emergent manner.

For this literature review, the current body of knowledge in scholarly literature on the topic was gathered and presented using an integrative literature method. This method was chosen as it effectively crosses disciplinary boundaries in new or emerging topics (Torraco, 2016). The focus of the literature review was to understand how labs integrate learning and innovation through collaboration processes. The literature was initially sourced using keywords and synonyms of 'educational living labs' and 'living labs', with the additional keywords of students, learning, and innovation, and was limited to the English language. The literature was deemed relevant if it

contributed to the understanding of the collaborative social processes within living labs. Additionally, relevant literature was identified through snowballing and structured using the CoP lens. The aim of this study is not to be comprehensive, but to generate initial insight into the complex collaborative processes of living labs and identify any remaining gaps in knowledge. Although this type of review has limitations, such as non-reproducibility and possible cherry picking, it is preferred for exploratory research (Greenhalgh et al., 2018).

The current understanding of lab processes

In this section the more generic findings on living labs are presented. In the next section the findings on higher education living labs will be described.

The most important general finding of this literature review is the rather limited body of empirical knowledge on the social processes within labs (Kalinauskaite et al., 2021; Paskaleva & Cooper, 2021), this despite a sharp increase in number of publications on living labs since 2015 (Greve et al., 2020). Generally, the empirical studies on labs found do not position collaboration and social practices center stage, even if these processes are conceptually considered essential to its function in many of these studies. Mostly is focused on exploring common characteristics or discuss the possible benefits of living labs (Nesti, 2018).

The lack of focus on the workings of collaboration in living labs, as confirmed by Kalinauskaite et al. (2021, p. 614), seems in line with a wider tendency to reduce complexity in empirical innovation studies, as also observed by Hoholm and Araujo (2011) who see a focus on case studies and usage of non-descript variables such as 'structures' or 'culture', and the exclusion of too diverse actors as seen by Mäenpää et al. (2016). Still, this complexity is integral part of the daily routine in labs and empirical research should therefore consider it and its absence poses serious challenges in advancing living lab research and practice.

What was found in the current body of knowledge is a clear recognition of mutual engagement as a crucial component of successful collaboration in laboratory settings. According to (Wenger, 2019 (1998), p. 95) mutual engagement involves establishing relationships, defining identities, and determining roles and expertise among stakeholders. Additionally, some scholars, like Mäenpää et al. (2016) state that teamwork can only happen when there is a mutual understanding and common knowledge shared among stakeholders, which is in line with Wenger's (2019 (1998)) notion of a shared repertoire among stakeholders, including routines, language, tools, and ways of doing things as part of a group's practice. While it is essential for the understanding of lab practices to unpack these practice elements further, studies mostly focus on alignment between stakeholders from a process standpoint (Kalinauskaite et al., 2021). In that is merely noted that language and

cultural barriers can intervene in knowledge exchange among the labs' stakeholders, or that a high level and interwoven shared competence among stakeholders can provide effective collaboration (Fam, 2017). Similarly, Johansson and Lundh Snis (2011) found that creating 'temporary' mutual understanding between stakeholders during co-creational workshops was sufficient for in-lab collaboration.

With a similar abstractness is acknowledged that collaboration among stakeholders can be challenging and complex (Hakkarainen & Hyysalo, 2013; Hakkarainen & Hyysalo, 2016). Studies indicate that conflict and tension often arise when stakeholders from different organizations and with different roles co-create together (Hakkarainen & Hyysalo, 2013; Hakkarainen & Hyysalo, 2016; van Geenhuizen, 2016, 2018). Although these studies do not explicitly discuss the importance of mutual engagement in understanding these processes of tension, Wenger (2019 (1998)) suggests that disagreement and tension can be a natural part of prolonged interpersonal interaction, especially in heterogeneous group processes, such as those found in laboratory settings. Members of a heterogeneous group strive to balance their alignment to the group with their other communities of practice, which can lead to multiple instances of tension throughout the lab process (Kubiak et al., 2014).

Contrary to efforts to reduce tension, studies have suggested that tension can be essential for innovation, disagreeing opinions give more knowledge, and the transdisciplinarity that underpins this diversity also provides the foundation of lab constructions (Wannenmacher & Antoine, 2016). Essentially this also follows from Wenger's (2019 [1998], p. 84) notion that "[...] mismatch interpretations or misunderstandings need to be addressed and resolved directly only when they interfere with mutual engagement. [...], they [...] provide] occasions for the production of new meaning." Scholars (Kalinauskaite et al., 2021; van Geenhuizen, 2016) have observed that these tensions result in a balancing act for labs to manage interactions and engagement of all stakeholders. Labs, therefore, focus on avoiding imbalances in power and creating an equal and flexible environment for all stakeholders (van Geenhuizen, 2016, p. 84). To achieve this aim an upfront discussion of values and differences among stakeholders is recommended, for instance as a reflective layer around lab collaborations to monitor, maintain and guide stakeholder alignment (Kalinauskaite et al. (2021). Many scholars note that establishing a shared focus, or a joint enterprise, is not only a core characteristic of labs as we here defined it, but also key for successful lab processes (Kubiak et al., 2014).

Overall can be said that the meaning-making for learning or innovation in labs is suggested to be fundamentally based on the tension in meaning making among stakeholders of different backgrounds, including the power plays that underpin this tension. However, so far this functional

tension mainly seems to be a conceptual or even 'romantic' notion, as the empirical underpinning currently is lacking, as is the instruments needed to manage its development. Research considering the full complexity of collaborative processes in living labs are needed for an evidence-based design.

Higher educational living labs

In this section the particular characteristics of practices in higher education labs are presented. Generally it is suggested that higher educational labs offer explicit potential for integrating innovation and student learning, following the potential of the integration of education and research in (applied) universities. Van Geenhuizen (2018) describes how apart from teaching students, these labs involve a large variety of actors, including researchers, industry partners, and community members.

The living lab literature shows a clear division, in which students in living labs are commonly viewed in pedagogical terms, with labs as a tool for students to learn about societal issues or professional development (Dabaieh et al., 2018), rather than as settings for innovation. The pedagogical discourse provides a focus on student learning only, leaving out information on the perspectives or practices of other stakeholders involved. In contrast, studies on innovation in labs hardly discuss the learning or practice of students, who are thereoften portrayed as mere future workers. Both sides of the division contradicts the transdisciplinary nature of innovation processes, where all stakeholders should be involved in meaning-making (Gibbons et al., 1994), to achieve innovative tension as afore described. Van Geenhuizen (2018) also describes that maintaining common interests among the diverse activities and stakeholders involved, both on and off-campus, is crucial for effective management of higher educational labs. In that context is balancing the needs of all stakeholders while ensuring meaningful participation and shared ownership considered particularly challenging compared to other types of labs. It is however not explicated why this is the case, other than the suggestion that with students yet another group of stakeholders is involved.

Student Autonomy

Students are the core element in educational labs. Creating a balance in the mutual engagement and joint enterprise of students and other stakeholders in labs is addressed in the more conceptual studies. Practitioners and researchers frequently cite partnership and shared ownership as essential aspects (Blom et al., 2013; Miltenburg & Weerheijm, 2018; Veltman et al., 2021). However, studies that focus on the participation of students have shown that they may not always feel like equal partners in labs (McLaughlan & Lodge, 2019; Schrevel et al., 2020). The notion of autonomy of

students seems to be debatable between stakeholders, in which researchers may be reluctant to trust the quality of student work and may aim to reduce student autonomy to increase the quality of collective output. In turn, educational programs often require high levels of autonomy for sound assessment, which is an argument outside of the direct lab work. The findings however reveal that achieving such a level of autonomy to generate learning is difficult for students, with significant tension and efforts made by them to reduce or omit the lab complexity (Veltman et al. (2021), with feelings of exclusion as an result (Schrevel et al., 2020). Such difficulties can lead to less optimal learning outcomes and reduced innovation effects (Veltman et al., 2021), minimizing the collective learning process.

Additionally is shown that providing fit-for-purpose student autonomy is crucial for both establishing partnerships in labs and students' intrinsic motivation (Reeve & Jang, 2006). Again this is considered a balancing act, also related to students' expectations. While some students may fully engage with the lab, others may view their engagement in minimal terms (Fenton-O'Creedy et al., 2014), feeling uncomfortable with high levels of responsibility (Mørk et al., 2010), making it challenging to encourage high levels of lab engagement related to sufficient amounts of autonomy. To solve this difficulty, Fenton-O'Creedy et al. (2014) suggests two modes of participation for students - the 'tourist' and the 'sojourner'. The 'tourist' only engages superficially with the community's practice and is unaffected in terms of identity, while the 'sojourner' partially identifies with the lab's practice and competence regime, focusing on understanding these aspects to function well within the community. Fenton-O'Creedy et al. (2014, p. 45) regard the 'sojourner' mode of participation as a "profound opportunity for learning". The difficulty was also reflected in comments by lab practitioners at the ISPIIM conference in Valencia 2021, who found student motivation to be a significant challenge.

Lab Authenticity

A second element that is posed to characterise potential student learning in lab situations is the lab's 'authenticity', which yields meaningful mutual engagement between stakeholders and their practices as in real life settings, beyond just acquiring skills or knowledge (Fenton-O'Creedy et al., 2014). Lab authenticity presumption of labs require all stakeholders to occupy a potentially uncomfortable space and "practice the skills required for epistemic fluency themselves" (McLaughlan & Lodge, 2019, p. 93). This authenticity is presumed a prerogative for a transferable innovation. For authentic learning by students in labs, sufficient autonomy and equal footing among stakeholders are presumed essential (Blom et al., 2013). It is this notion of authenticity that provides the lab appeal as learning environment to educationalists, while it might be easier to design labs in

which students are the knowledge gatherers, and other stakeholders guide, provide feedback, and manage the process toward innovation. Drawing on Wenger's theoretical framework, one could argue that for learning to take place, the collective practices and meaning making needs to be characterised by at least a sufficient level of ownership. This collective ownership then shapes the direction of the joint enterprise, creates mutual engagement, and provides all with influence on the shared repertoire. The answer as to what entails this level of ownership remains lacking.

The Paradox Role of Assignments

The final element central to educational labs are the assignments (and exams) given to students to fulfill their educational tracks. Following from both the debates on autonomy and authenticity, these assignments play a paradoxical role in the living lab literature. On the one hand, assignments serve the educational purpose of providing a predictable, assessable learning outcome and therefore reduce the autonomy of students as part of the lab process. They are however also posed as means to align the needs of stakeholders and guide their participation by providing a partially predetermined end to solve the tension between autonomy and quality, by reducing the autonomy of all participants equally (Schrevel et al., 2020; van den Berg et al., 2019; Veltman et al., 2021). This paradox is not yet solved in the current body of knowledge.

What does become clear is that if an assignment is not mutually shared by all stakeholders involved, as with pedagogical assignments, unequal ownership of the lab process is created (Schrevel et al., 2020). Lab practices have therefore tried to address this issue by developing collective assignments that take into account the expectations and interests of all stakeholders, including students and the related educational programs (Crosby et al., 2018; Veltman et al., 2021). However, it has shown that this approach requires intensive teamwork since participants in the lab may bring different discourses and behaviours to the negotiation (Crosby et al., 2018). One can also wonder if this approach not only results in a reduction of stakeholders' autonomy but also detract from lab authenticity, as essentially a pedagogical discourse interferes with a professional lab process (Markauskaite & Goodyear, 2017).

The question, remains if higher education labs can foster this level of ownership and learning for all collaborating stakeholders, including students, when the latter may experience disjunction between the professional setting of a living lab and the pedagogical setting they need to oblige to (Fenton-O'Creevy et al., 2014, p. 61). One can wonder if this can indeed create a lab authenticity presumed essential for learning and innovation at the same time.

Discussion

In this paper, we have explored the inner workings of labs and have proposed a conceptual framework derived from Wenger's Community of Practice perspective to consider lab practices. Based on that perspective we suggest that rather than focusing solely on system and design characteristics, a focus on the full complexity of lab practices is essential to understand how labs operate and to identify areas for improvement. Establishing lab practices using Wengers notions of joint repertoire, mutual engagement and joint enterprise, and exploring the process of meaning-making, ownership and inclusion, highlights that most studies have not thoroughly explored the lab as a social practice with its complexities. We argue that only when this complexity is considered by empirical research proper evidence-based guidelines can be made for lab practioners. Moreover, only then can the higher education system be sure that a living lab is the authentic learning environment that many promiss it to be.

This literature review indicates that current research still offers a limited and conceptual understanding of meaning-making among stakeholders in labs. Comparing previous work, such as (Fam, 2017) and (Johansson & Lundh Snis, 2011) illustrates that the level and type of mutual understanding required for succesful collaboration may differ between contexts. It is crucial then to further learn its qualities to facilitate successful lab collaboration among stakeholders. Further research should aim to understand these processes of collective meaning making including overcoming barriers of language, culture and norms that resonate from stakeholders own contexts, such as professional fields, and educational assignments.

In line with Wenger's conceptual framework, the results suggest the importance for the succes of labs is learning by all stakeholders, not only students, and therefore an conceptual and practical integration of learning and innovation. The notions of autonomy, authenticity and ownership by stakeholders that conceptually underpins learning and innovation in labs, have so far not been sufficiently teased out practically, resulting in less than satisfactory results – or so it seems reading between the lines of sometimes rather abstract descriptions. Possibly, Wenger's (2019 (1998)) notion of 'legitimacy' can be helpful in reaching beyond these separate concepts into a more integrated theory and practice on what characterises collaboration in living labs. Wenger poses that only with enough legitimacy can stakeholders inevitable stumble into opportunities for learning, rather than reasons for dismissal, neglect, or exclusion. A legitimate participation of stakeholders considered from both the inside of the living lab processes, as well as the outside – such as what legitimizes these practices from a professional field or educational assessment - could at least bring them in a single lab-related narrative. Only future practice and research can show whether this is a sensible way forward.

This study has however made clear that a more sound and integrated evidence-base is highly needed, even more because of the still increasing enthusiasm for living labs in innovation and student learning. Lab processes are not yet brought to empirically solid grounds. Frameworks, as the one here based on Wenger's work, can only assist in gaining a more comprehensive view on complex collaborative practices such as living labs.

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