Towards a Living Lab to support evidence-based educational research and innovation

Adolfo Ruiz-Calleja[1], María Jesús Rodríguez-Triana[1,2], Luis P. Prieto[1], Katrin Poom-Valickis[1], and Tobias Ley[1]

[1] Tallinn University, Narva mnt 29 - 10120, Tallinn, Estonia
[2] École Polytechnique Fédérale de Lausanne, 1015, Lausanne, Switzerland
{adolfo,mjrt,lprisan,katrinpv,tley}@tlu.ee

Abstract. Living Labs represent a promising approach to bridge the gap between evidence-based educational research and sustained innovation. This position paper presents our initial work related to educational Living Labs. It describes a model of the research and innovation processes that we aim to support. It also presents the preliminary results of a pilot study in which a Living Lab supported a researcher and two teachers to introduce Learning Analytics in their classroom.

Key words: Living Lab, educational innovation, evidence-based research, innovation adoption

1 Introduction

During the last few years, we have witnessed the rise of Learning Analytics (LA). This emerging field promotes the collection, managing, and processing of educational data to understand and improve learning processes [9]. Many researchers adopted LA and foresee how it can be useful for educational practitioners to enhance evidence-based reflection and decision making. However, educational practitioners are far from embracing LA as a technology to assess innovations and make decisions in the learning processes they orchestrate [10, 19].

One of the barriers that hinder LA adoption by practitioners is the need for a cultural change towards more evidence-based decision making [14, 19]. Educational practitioners could be influenced by researchers but it is typically the case that these communities are not so well connected. In fact, even if researchers and practitioners may share common interests, it is not easy to coordinate their activities so that educational research and innovation processes feed back to each other. Another adoption barrier is the lack of guidance and support for practitioners to carry out the data collection, managing, and processing. Currently, it is typical that a Learning Management System (LMS) gathers data automatically, which is later on processed and analyzed without much teacher intervention. In this sense, technical, theoretical and practical support should be offered to pave the way for practitioners to adopt LA technologies. This is especially important in situations where multi-modal LA are considered, as the active participation and knowledge of teachers is often required (e.g., [16]).

We propose a Living Lab approach in order to overcome these two issues. Living Labs are user-centred open-innovation ecosystems that integrate research and innovation processes [5]. Our proposal is to exploit Living Labs as adaptable platforms where researchers and practitioners collaborate to carry out evidence-based research and innovation on educational processes. Additionally, we also understand Living Labs as settings to be researched on their own, that allow us to get further insight into evidence-based research and innovation processes. Thus, our proposal uses Living Labs to support educational research and innovation processes while collecting data about the innovation process itself.

The rest of this position paper further describes our proposal. Section 2 presents the state of the art regarding Living Labs for education. Section 3 describes the research and innovation processes that we intend to support with Living Labs. Then, section 4 briefly describes a preliminary pilot study that is being carried out at Tallinn University. Finally, section 5 summarizes the implications and future work in this research line.

2 Living Labs for educational research and innovation

There is still a gap between educational research and innovations in schools. Some of the research in educational and cognitive science does not find its way into school practice. At the same time, innovations that are introduced in classrooms are often not evidence-based, meaning that their effectiveness is not empirically tested. Moreover, out of the many successful pilots that research on how ICT is best employed in learning, only a few are able to be sustained [1]. Our claim is that this problem has to do with the ineffectiveness of how research and innovation are connected in education. There is currently a large gap between research and the practices that lead to sustainable change. In fact, in a recent policy communication [2] it is strongly suggested to design strategies for a common understanding between researchers and practitioners. They also propose an interesting model that is built on the ideas of a strong interaction of basic and applied research and co-creation with societal stakeholders.

This gap between research and sustained innovation is not exclusive to education. In order to overcome it in different domains, Living Labs were proposed as "open innovation environments in real-life settings in which user-driven innovation is the co-creation process for new services, products, and societal infrastructures" [5]. Living Labs have been exploited to support open research projects where stakeholders played a key role [8, 11]. In other cases, they are simply used as a way to gather and structure data that can potentially be exploited by researchers [6]. In the education domain, there have been attempts to apply such approaches [3], although they focused more on computing and user experience rather than on facilitating evidence-based educational innovation *per se*. With the advent of big data and LA, there is a resurgence of the interest in large-scale approaches to educational data gathering and innovation that leverage these new possibilities (greater ICT penetration, better instrumentation of learning software to gather traces, availability of wider variety of sensors and

other alternative data sources) for the improvement of education in authentic settings (e.g., [4, 15]).

However, as we know from many successful (and not-so-successful) cases of adoption of LA [10, 14, 19] and teacher inquiry [7], such change in the everyday practices of our classrooms are fraught with difficulties: from the resistance to changes in the local culture of teachers and learners, to issues of institutional leadership, the difficulties of assessing the impact of analytics innovations or the rigid time and effort constraints that characterize the hectic life of schools and universities. The added difficulties of achieving enough data literacy for teachers and students to collect, analyze or interpret LA, or of fulfilling such analytics processes in an ethical and privacy-conscious manner, highlight even further the need for specific support to conduct such innovation processes in a Living Labs kind of setting.

3 Envisioned support offered by a Living Lab

In order to understand the support that a Living Lab should provide, we firstly gathered data from local teachers that work at Tallinn University. Teachers that had experience in LA were firstly interviewed and, later on, we organized a focus group with a broader group of teachers. After that, we reviewed the literature related to Design Based Research [17] and informal learning at the workplace [13] to better understand the relationships between research processes and adoption of innovations. After this exploratory phase, we propose the model depicted in Figure 1 -which represents the innovation and adoption processes- to be supported by Living Labs.

The model depicted in Figure 1 defines several phases and arranges them into two iterative cycles. The first cycle includes phases related to an educational research process, as defined by the Design Based Research [17]: `Problem Understanding and Shared Vision`; `Intervention and Evaluation Design`; `Enactment`; `Evaluation` and `Reflection`. The second cycle includes phases related to scaling up informal learning at workplace, as defined by [13]: `Reflection`; `Dissemination`; `Social Validation`; `Use of Collective Knowledge` and `Engagement`. We can see that these two cycles are interconnected: the reflection that emerges in the research process should be disseminated and validated by a bigger community of teachers; at the same time, this social validation may engage new teachers to participate in further iterations of the research process.

Our Living Lab also approach entails an open set of tools to support the model depicted in Figure 1. Some of these tools will be general-purpose, such as collaborative text editors or forums; others will be purpose-specific, such as collaborative meaning-making tools or data repositories. Additionally, a data infrastructure is needed in order to coordinate all these tools and to share data and learning artifacts among them. This infrastructure should also collect data related to the use of the different applications, which can then be analyzed in order to assess the research and innovation process that occur in the Living Lab.

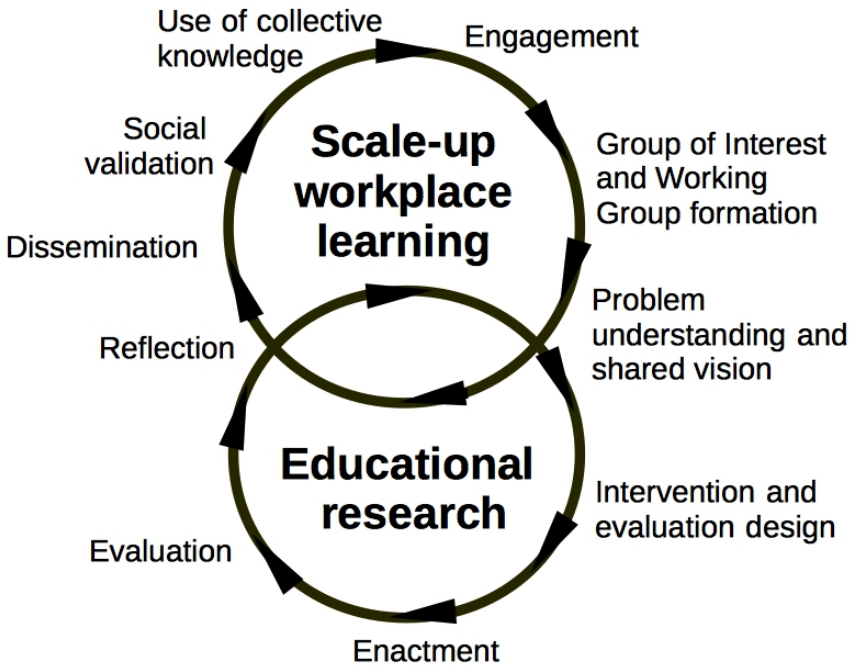

Fig. 1. Model of research and innovation adoption processes.

The support of evidence-based research also adds further requirements. First, some guidance will be needed in the `Intervention and evaluation design` for researchers and teacher to introduce LA techniques in the classroom. These guidelines should support them to take decisions related to LA, such as how to collect data, how to integrate it or ethical considerations. Data collection and processing applications will be required to enhance the `Enactment` and `Evaluation` phases. The data collected during the `Enactment` phase should also be disseminated to a larger group during the `Dissemination` phase for them to be able to validate it later on.

4 Preliminary pilot study

We are currently carrying out a preliminary study pilot where a Living Lab supports a researcher and two teachers to introduce and adopt LA techniques into a course. The course is "Research Methods" and is taught at master level in Tallinn University. The researcher has broad experience in LA and in qualitative and quantitative research methods. Regarding the teachers, they are experienced teachers and also familiar with LA.

For this pilot study, we are using GRAASP[1] as a technical platform to support the lifecycle depicted in Figure 1. GRAASP is a knowledge management system used both for learning and for supporting communities of practice [20]. It integrates several well-known applications and provides data management and processing functionalities that have already been used for LA [22, 21]. Additionally, Google Drive[2] is used as a way to create and share documents between the researcher, the teachers, and the students, and as a data gathering tool (questionnaires sent to the students during the course).

As the researcher and the teachers knew each other beforehand, the engagement phase and the creation of the working group were easy processes. In fact, they discussed the problem face to face to reach a shared vision. Hence, our support with GRAASP focussed on the `Intervention and Evaluation Design`, `Enactment`, `Evaluation` and `Reflection` phases. As the `Intervention and Evaluation Design` phase is the only one that has been completed as of this writing, the rest of this section will only focus it.

We embedded an evaluation framework into GRAASP to support the `Intervention and Evaluation Design` phase. The main idea was to propose a questionnaire that guided the researcher and the teachers during the following phases. The questionnaire was based on the Hopscotch model [12] and on frameworks of LA teacher-led innovations [18, 7] (it can be accessed at `https://goo.gl/fvFm0b`). The support provided by GRAASP allowed the researchers and the teachers to answer the questions collaboratively, thus encouraging their shared understanding about the answers.

We did not impose any restriction on the users (the researcher and the teachers) regarding how to use GRAASP or the questionnaire. They decided that the researcher would first go through the questions and the teachers would later on enrich the answers or provide another point of view if needed. The three users interacted with the questionnaire without any remarkable problem. We recorded the interactions between the users and the questionnaire using the think aloud protocol. Additionally, we took notes about any relevant incident when the users were using GRAASP. When the `Intervention and Evaluation Design` phase finished, we interviewed the users about their experience.

Up to now, we obtained some preliminary findings from the data we collected. Some of the comments invited us to further reflect on our approach to the Living Lab. We imposed how practitioners should behave and which technology they should use. Regarding the technology, future versions of the Living Lab should integrate applications that are already in use by the practitioners, thus enhancing the Living Lab adoption. Regarding our model, its current version considers that the practitioners design the intervention and the evaluation before collecting any data. However, it is sometimes the case that some data is unsystematically collected and analyze later on. There should, hence, be room for *a posteriori* analyses of previous experiences that can trigger complete loops in the future.

[1] `http://graasp.eu`
[2] `http://drive.google.com/`

Some other comments were related to the questionnaire, which can be grouped into three main aspects. First, additional guidance is needed to answer the questions, especially those where the users are invited to reflect on the data gathering and processing techniques. Sometimes it is not clear for them why some questions are relevant, what are their answers going to be used for or even what are possible answers (e.g., what are possible data gathering techniques?). Second, the questionnaire should be simplified and some questions should be merged (e.g., questions related to the goals or the ones related to similar innovation processes). Third, the users would like to count on evaluation and interventions designs, so that they can find examples in other related research works or innovation processes that aimed for similar goals.

5 Conclusions and future work

This paper describes our vision towards a Living Labs to fill in the gap between educational research and innovation sustainability. We propose a model to support the collaboration of researchers and teachers for evidence-based educational research and innovation. We also presented an ongoing preliminary pilot study and several preliminary lessons learned.

We envision Living Labs as complex learning ecosystems. From the theoretical point of view, we understand Living Labs as a mix of two worlds: they combine research processes, needed to propose and assess educational innovations; and workplace learning processes, needed for teachers to adopt these innovations. From the technical point of view, Living Labs are open ecosystems where different applications and technologies can coexist. A software infrastructure will also be required to orchestrate the different technologies involved and to collect data from participants' behavior. From a practical point of view, we can expect cultural constraints from the teachers' community when adopting innovations.

In addition to the pilot presented in section 4, six additional ones will be carried out during 2017. These pilots will cover the whole lifecycle presented in Figure 1. For these new pilots, we will collaborate with Estonian primary school teachers who are not so familiar with LA to introduce new methodologies in their classrooms. Then, we aim to explore how Living Labs can be exploited to support innovation processes that scale up from the classroom to educational institutions and even to national policy level.

Acknowledgements

This research has been partially funded by the European Union in the context of CEITER and the Next-Lab (Horizon 2020 Research and Innovation Programme, grant agreements no. 669074 and 731685).

References

1. Technology and Open Educational Resources as opportunities to reshape EU education. Technical report, Communication of the European Commission, 2011.
2. Productive interactions: societal impact of academic research in the knowledge society. Technical report, LERU position paper, 2017.
3. G. D. Abowd. Classroom 2000: An experiment with the instrumentation of a living educational environment. *IBM systems journal*, 38(4):508–530, 1999.
4. C. Aguerrebere, C. Cobo, M. Gomez, and M. Mateu. Strategies for data and learning analytics informed national education policies: the case of Uruguay. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference*, pages 449–453. ACM, 2017.
5. B. Bergvall-Kareborn and A. Stahlbrost. Living Lab: an open and citizen-centric approach for innovation. *International Journal of Innovation and Regional Development*, 1(4):356–370, 2009.
6. A. De Masi, M. Ciman, M. Gustarini, and K. Wac. mQoL Smart Lab: Quality of Life Living Lab for Interdisciplinary Experiments. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct*, UbiComp '16, pages 635–640, New York, NY, USA, 2016. ACM.
7. V. Emin-Martínez, C. Hansen, M. J. Rodríguez-Triana, B. Wasson, Y. Mor, M. Dascalu, R. Ferguson, and J.-P. Pernin. Towards teacher-led design inquiry of learning. *eLearning Papers*, (36), 2014.
8. M. Eriksson, V.-P. Niitamo, and S. Kulkki. State-of-the-art in utilizing Living Labs approach to user-centric ICT innovation-a European approach. *Lulea: Center for Distance-spanning Technology. Lulea University of Technology Sweden: Lulea*, 2005.
9. R. Ferguson. Learning analytics: drivers, developments and challenges. *International Journal of Technology Enhanced Learning*, 4(5-6):304–317, 2012.
10. R. Ferguson, A. Brasher, D. Clow, A. Cooper, G. Hillaire, J. Mittelmeier, B. Rienties, T. Ullmann, and R. Vuorikari. Research evidence on the use of learning analytics: Implications for education policy. Joint Research Centre Science for Policy Report EUR 28294 EN, Joint Research Centre, 2016.
11. A. Følstad. Living labs for innovation and development of information and communication technology: A literature review. *eJOV: The Electronic Journal for Virtual Organization & Networks*, 10, 2008.
12. I. M. Jorrín Abellán. Hopscotch Building: A Model for the Generation of Qualitative Research Designs. *Georgia Educational Researcher*, 13(1):Article 4, 2016.
13. T. Ley and B. Kump. Which user interactions predict levels of expertise in work-integrated learning? In *Proceedings of the 8th European Conference on Technology-enhanced Learning (EC-TEL)*, pages 178–190, Paphos, Cyprus, 2013. Springer.
14. L. P. Macfadyen and S. Dawson. Numbers are not enough. why e-learning analytics failed to inform an institutional strategic plan. *Educational Technology & Society*, 15(3):149–163, 2012.
15. I. Molenaar and C. K. van Campen. Learning analytics in practice: the effects of adaptive educational technology snappet on students' arithmetic skills. In *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge*, pages 538–539. ACM, 2016.
16. L. P. Prieto, K. Sharma, P. Dillenbourg, and M. J. Rodríguez-Triana. Teaching analytics: towards automatic extraction of orchestration graphs using wearable sensors. In *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge*, pages 148–157. ACM, 2016.

17. P. Reimann. Design-based research. In L. Markauskaite, P. Freebody, and J. Irwin, editors, *Methodological choice and design*, 9, pages 37–50. Springer Netherlands, 2011.
18. M. J. Rodríguez-Triana, A. Martínez-Monés, and S. Villagrá-Sobrino. Learning Analytics in Small-scale Teacher-led Innovations: Ethical and Data Privacy Issues. *Journal of Learning Analytics*, 3(1):43–65, 2016.
19. Y.-S. Tsai and D. Gasevic. Learning analytics in higher education—challenges and policies: a review of eight learning analytics policies. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference*, pages 233–242. ACM, 2017.
20. A. Vozniuk, A. Holzer, S. Govaerts, J. Mazuze, and D. Gillet. Graspeo: a social media platform for knowledge management in NGOs. In *Proceedings of the 7th International Conference on Information and Communication Technologies and Development*, pages 63–66. ACM, 2015.
21. A. Vozniuk, M. J. Rodríguez-Triana, A. Holzer, and D. Gillet. Combining content analytics and activity tracking to identify user interests and enable knowledge discovery. In *Proceedings of 6th International Workshop on Personalization Approaches in Learning Environments (PALE)*, pages 1–7, 2016.
22. A. Vozniuk, M. J. Rodríguez-Triana, A. Holzer, S. Govaerts, D. Sandoz, and D. Gillet. Contextual learning analytics apps to create awareness in blended inquiry learning. In *International Conference on Information Technology Based Higher Education and Training (ITHET)*, pages 1–5. IEEE, 2015.