



# The Living Lab

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## THE UNIVERSITY OF DUNDEE BOTANIC GARDEN, LIVING LAB: THE POWER OF PARTNERSHIPS

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### ABSTRACT

The University of Dundee Botanic Garden, Living Lab, is a co-creative initiative, integrating research and innovation, that presents an opportunity for students, academic staff, professional staff and external bodies to collaborate on projects exploring sustainability problems. It aims to host projects partnering with participants from different backgrounds, to collectively address real-world sustainability challenges by responding to opportunities. These challenges and opportunities include (but are not exclusive to) landscape issues, both green and blue infrastructure, education for sustainable development, nature connection, plant-blindness and nature-based solutions.

The Living Lab has grown out of a new doctoral programme with a focus on forming a cross disciplinary collaboration of established researchers, new post-doctoral students and self-funded PhDs and MSc's that began in January 2021. Partners include local, national and international schools, research-based centres such as the James Hutton Institute and the Royal Society, other universities and various NGOs nationally and internationally. This paper begins by exploring the

concept of a Living Lab, then goes on to review the University of Dundee's Living Lab, based at the Botanic Garden. Drawing on reflective evaluation from stakeholders, this review looks back over the past two years, documenting the Living Lab's germination from a seed of an idea to the flourishing 'sapling' that it has developed into. The paper then refocuses to capture hopes and aspirations for the next phase as we put down our roots and extend our branches further across the University, Dundee, the UK and beyond.

Keywords: Living Lab, sustainability, education, partnerships, research and innovation, botanic gardens

## INTRODUCTION: UNIVERSITY OF DUNDEE BOTANIC GARDEN AND THE LIVING LAB

The University of Dundee (UoD) was founded in 1967 and the botanic garden, approved by the first Principal, James Drever, was opened in 1971. The botanists of the Old Medical School and Biological Sciences Department, together with the garden's first curator Eddie Kemp, established a modern-style garden with a physically and philosophically central native plants area laid out on ecological lines representing the plants associated together in their native habitats (Kemp, 1974). Since that time and 50 years on, the garden has expanded as a visitor attraction with its own visitor centre, garden of evolution and a focus on raising public awareness through engagement and education. The native area was remodelled from early 2014 to better align it with local habitats and their associated plants (Bisset, 1992; Hood and Reaney, 2013). Adopting this more contemporary approach, botanic gardens around the world are looking to nature and community-based solutions to help communities adapt and mitigate for the climate emergency, now based around unique contributions to climate change research, conservation and public engagement (Primack *et al.*, 2021). The UoD Botanic Garden, with the support of a wide stakeholder review, has begun to take forward a new strategy focussed on a nested set of aims and objectives, realigning the garden with the UoD, the City of Dundee and the global challenges of biodiversity loss, increasing urban populations and climate change (Frediani, 2021).

At the UoD Botanic Garden, external interventions are evidenced within the research base of staff and students who together take forward the concept of a 'Living Lab' (*ibid.*), based within the onsite Macro Micro building. The Macro Micro building, being an experimental construction conceived, designed and built by engineering students, staff and external partners, boasts the first zero carbon building in Scotland in 2013 (Burford *et al.*, 2013). The use of 'green buildings' as teaching tools for sustainability, was growing across the sector at the time (Cole, 2014, cited in Dabaieh *et al.*, 2018). At the time of construction in the early 2000s, the concept of a Living Lab was not used in the UoD in this context, however, the main pedagogic philosophy of learning by doing and experimenting in an urban environment, using critical inquiry, process-based learning, community design and community build, resonates with Living Lab ideologies (Salama, 2010; 2015, cited in Dabaieh *et al.*, 2018). Today the Macro Micro building forms the real and virtual home for the UoD, Botanic Garden Living Lab—a research hub established in 2020, now consisting of seven PhD students, an academic cross-university community and a network of primary and secondary schools reaching across Scotland, the UK and out to Jersey. The overarching research focus is 'Education for Sustainability', tightly aligning

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the garden research with the UoD's mission, whilst supporting local community work beyond the garden wall.

### THE LIVING LAB

According to Leminen & Schuurman (2022), the concept of the Living Lab within the context of technology innovation began to take off in 2006. The European Network of Living Labs was formed shortly afterwards. Schuurman & Leminen (2021) perceive Living Labs as mainly focusing on experimenting with novel technologies. In parallel to this technological evolution a pedagogic philosophy was developing, its roots however go back to at least the 1980s, when it was defined in terms of a co-creative process, integrating research and innovation on a given topic. The topic in question focused increasingly on sustainability and the concept, according the 'Alliance for Sustainability Leadership in Education' (EAUC, 2021), was recognised across tertiary education. The alliance goes on to state that, although applied in different ways depending on context and institution, Living Labs aim to establish partnerships connecting academic activities with non-academic partners (EAUC, 2021).

At the UoD Botanic Garden, the Living Lab grew out of a new doctoral programme with an initial focus on developing an interdisciplinary collaboration of established researchers, post-doctoral students, self-funded PhDs and MSc's commencing in January 2021. The idea however, of a Centre for the Environment based at the botanic garden pre-dates, but later morphed into, the current Living Lab, by responding to a series of serendipitous occurrences, coming together in 2019:

- A more active involvement between the garden and the University environment-related teaching.
- Establishing and maintaining a student-facing database on the garden's two ponds, comprising both biotic and abiotic data.
- The earlier development of the Macro-Micro low energy building by the Engineering School at the UoD. The intention was for this building to be available for PhD students and active research. It had remained unoccupied for several years.
- The arrival of the current curator with similar ideas on sustainability, education and outreach.
- Responding to the UoD's drive for 100 PhD projects with the Education for Sustainability, Nature connection and Outdoor Learning initiative.

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- Increased and active interest in the PhD programme and the agreement to launch the Living Lab.

Since early 2020 the UoD Botanic Garden Living Lab has lived up to its name, eminently reflecting the assertions of Waheed (2017), by being a hub or centre where ‘... *real-world sustainability challenges are formally addressed in stakeholder partnerships. The Living Lab initiative hosts projects where participants from all stakeholder groups collectively address real-life sustainability challenges*’ (Waheed, 2017, p.5).

The UoD Botanic Garden Living Lab specifically aims to:

- Provide opportunities for students, academic staff, professional staff and external bodies to *collaborate* on projects, whether academic research or citizen-based outreach, looking at real-life sustainability problems.
- *Host* projects with participants from different backgrounds partnering to collectively address real-world sustainability challenges and opportunities.

With the appointment of the Living Lab Director, in conjunction with the development of a series of outreach and research initiatives stretching across the UoD, reaching out to Dundee, Scotland, the UK and internationally, the Living Lab is progressing at pace; projects are out there to be sought and won, the time was right and still is for outreach, collaboration and development. Partners include local, national and international schools, research-based centres such as the James Hutton Institute (JHI) and the Royal Society (RS), other universities and various NGOs nationally and internationally.

EAUC’s (2021) generic definition for a Living Lab, resonates well with the UoD Botanic Garden Living Lab, its main elements comprise the natural setting at the Botanic Garden: the Macro Micro Building; it is research-focused, but pragmatic in methodology and methods employed, depending upon the nature of the individual projects; it encompasses a diverse stakeholder community comprising academic and non-academic partners; members meet regularly (online and/or face to face when permitting) for knowledge-sharing, support and development. The medium-long term longevity of the Living Lab is assured within the very nature of its research projects. Fig. 1 represents this arrangement.

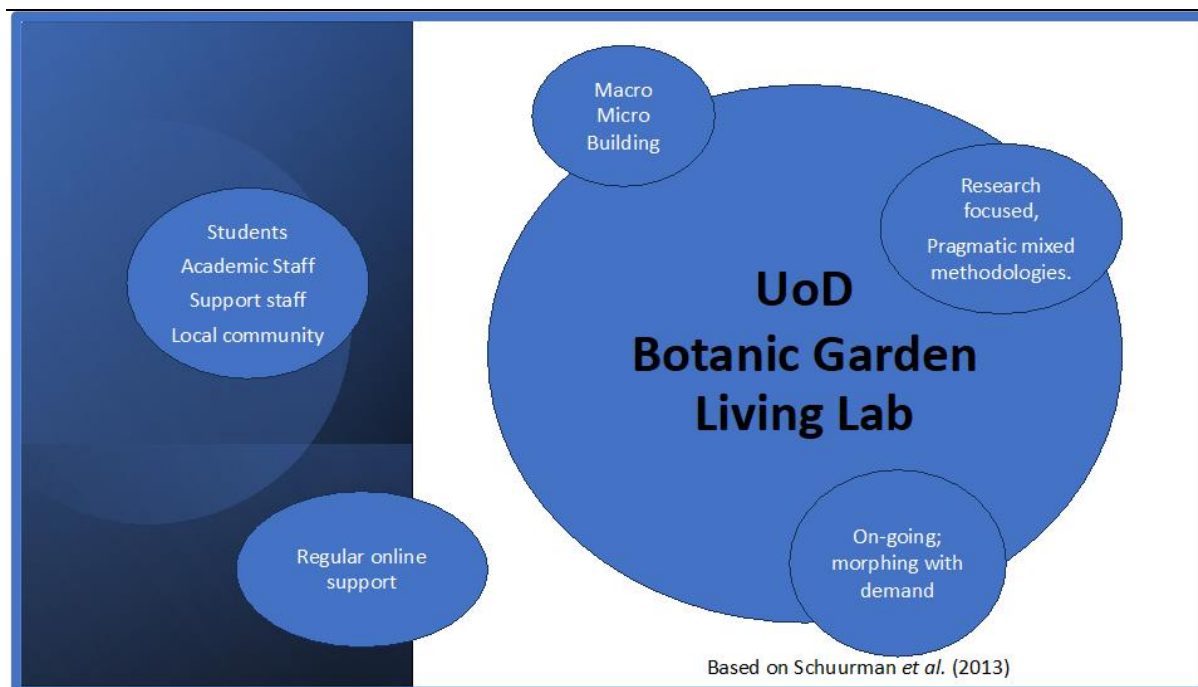


Fig 1: Defining elements of the UoD Botanic Garden Living Lab.

In 2022 following an active recruitment drive, The Living Lab Steering Group was formed. Still in its infancy this group comprises representatives from across the University, stakeholders from the various projects and external representation, for example: Garden Organic (<https://www.gardenorganic.org.uk>). The group acts as 'critical friend', with a view to strategically guiding the Living Lab into its next phase of operation, exploration and development.

## THE STUDENTS

The advert on FindaPhD entitled 'Education for Sustainability, nature connectedness and outdoor learning', was submitted in early 2020. The response to this advert was staggering, generating a wealth of interest and enquiry, as indeed it still does. The limiting factor, however, was always funding. Being a self-funded PhD, it is the student's responsibility to seek and source funding. Several international students had access to various scholarships, however their sources would often not support an education-focused degree. Other students progressed to matriculation whilst applying for Scotland-based funding, the competitive nature of the application was soon realised, resulting in withdrawal from the programme. For all students, juggling work commitments to pay their fees and living expenses, alongside the demands of undertaking a PhD, the pressures are enormous.

By 2021 however four students commenced their studies within the Living Lab. They have since been joined by several others under the Education for Sustainability (EFS) umbrella. Additional students and their supervisors have joined the EFS cluster through their related work, whilst other UoD students involved with the various projects are active participants in this learning community. The PhD projects collectively demonstrate elements of public engagement, collaboration and mutual learning, involving to varying degrees, University students and staff, UK and international schools' students and staff, FE colleges and the wider professional and public arena.

## THE PROJECTS

### *Education for sustainability, nature connection and outdoor learning*

Research undertaken under the auspices of the Living Lab focuses on 'sustainability': an environmental, social and economic approach eschewing the depletion of natural resources to maintain an ecological balance (Lakin, 2021). An understanding of biodiversity (the myriad of organisms and habitats fundamental to sustained functioning of the environment) and our impact on this, is arguably at the heart of sustainability. To place this in context, research adopts an ecosystem services approach to the environment thereby recognising the different services afforded in terms of productivity, ecological support, environmental regulation, and cultural services, including human well-being (*Ibid*). Education and environmental awareness clearly have a role to play in influencing and directing human activity if impact is to remain sustainable. The PhD cluster projects aim to explore the many facets of outdoor learning as a vehicle to development and engage a sense of nature connectiveness and understanding. The context and focus are through statutory and further/higher education activities, as well as public and family engagement in outdoor initiatives such as citizen science projects and facilities including other botanic gardens.

Several small and medium scale research initiatives within this arena have been in operations for several years, for example a series of annual pond dipping sessions at the UoD Botanic Garden that contribute data to a longitudinal database exploring the impact of human activity on the water environment within the garden. So too a small-scale exploration of outdoor learning and nature connectiveness with both initial teacher education students and undergraduate environmental science and geography students. This latter research went on to indicate a tentative positive correlation between outdoor learning and nature connectiveness, suggesting further research and application would be beneficial (Barrable & Lakin, 2019).

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The following research ‘snapshots’ serve to highlight the application and realisation of our aspirations in terms of the Living Lab.

*The daffodil project (<https://www.dundee.ac.uk/projects/scottish-daffodil-project>)*

The venture into the genetic phylogeny of the native daffodil, established in partnership with the RS, is poised for its third year. The eight Scottish High Schools, a secondary school in Jersey and an FE college in England have all completed their practical work before heading into the summer break. JHI and Plant Sciences UK continue to provide a suite of STEM partnerROY(a prerequisite to the funding) and the UoD School of Life Sciences supports the bioinformatics aspects of the programme. The Daffodil Executive group is currently exploring funding opportunities to enable the project to progress beyond the RS start-up funding. This is understandably limited to one academic year plus a possible extension, for any one school. The group is currently in discussions with JHI, Plant Sciences UK and Nanopore (suppliers of the DNA processing equipment). Representatives of the Daffodil Executive group recently presented at a Scotland-based Science Education conference, recruiting three new schools for the next round of the project. A postdoc and STEM partner also presented aspects of the project independently at the molecular biology ‘IonBru’ event, and the PhD student masterminding the whole project was invited to London by Nanopore to contribute to ‘London Calling’; a schools’ event where he conducted a series of Project-related practicals with 60+ schools.

*Social sustainability through sociodramatic play in early childhood education*

The Deputy Sustainability Coordinator and Teacher at a nursery in London, currently in her second year of the PhD, explores the observation that effective and engaged social interactions are vital for sustainable development, within a culture of shared values, behaviours and attitudes. Her empirical work takes this exploration further within the context of Early Childhood Education.

*Primary education and further education*

Two other RUK students, in the preliminary stages of their PhDs, independently explore education for sustainability within their respective fields, whilst establishing appropriate links across the education spectrum.

*Learning for Sustainability—government funded research*

Two Scotland-based students, two years into their PhDs, have recently worked as research assistants to a Scottish Government funded research project into Learning for Sustainability. A valuable



opportunity for them both and staff (several are members of the Living Lab) involved in this very successful project, the mutual benefits were later shared with the PhD Cluster Group.

*The Dundee Wee Forest projects* (<https://www.dundee.ac.uk/stories/wee-forests-make-big-impact-dundee-community>)

This Scottish Government-associated community engagement project, now in its second year, continues to attract small-scale extension funding enabling schools and their local communities to create shared nature-rich environments linking across Scotland through NatureScot

<https://www.nature.scot> and EarthWatch <https://earthwatch.org.uk>.

### *Medicinal plants*

A medicinal plants education resource, exploring the science behind the historic use of plants as medicinal aids, is poised for launch in the autumn 2023. A trail of display boards is currently in production, set to support the resource within the botanic garden. A molecular biology PhD student at the James Hutton Institute (JHI), the creator of the educational resource, continues to engage with the Living Lab community, having established a STEM partner role with Carnoustie High School in Angus. They are in the throes of applying for RS funding for a project that takes the essence of the medicinal plants resource to a molecular level, involving both JHI and the botanic garden, under the auspices of the Living Lab.

### *New projects—the River Garry, a river lost?*

As the PhD cluster continues to flourish and expand new projects, one project is developing in association with archivists and hydrological partners from within and outwith the University. The project begins with the UoD archive data (c. 1969 – 1981) on the River Garry significantly impacted by the construction of the North of Scotland Hydro-Electric scheme. These data recount a story comprising sociological, hydrological and ecological impacts of the construction. The project involves the collation and analysis of this information together with contemporary monitoring in response to the restoration measures in place to revive and restore the River Garry to its former ecological status. The research looks to lessons learnt, whilst identifying mitigating actions that could prevent such impact in other similar national and international schemes. Set within an educational context, this multi and inter-disciplinary study is of relevance to social scientists, ecologists, educationalists and environmental practitioners with an interest in hydrology, human impact and sustainable development.

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*Other opportunities for collaboration*

Part of the philosophy underpinning the Living Lab is one of collaboration and not competition. A recently established collaboration between the Royal Botanic Garden Edinburgh (RBGE), St Andrews Botanic Garden and the UoD Botanic Garden is testament to this philosophy. Hosting the RBGE's Botanical Illustration course in the autumn is a case in point, together with submitting a joint proposal by all three gardens to present at a forthcoming professional conference in Edinburgh on the role of trees in sustainability. From a schools' education perspective, the three gardens continue to explore opportunities for collaborative and cross-fertilisation, with for example the Living Lab's Director being invited to join the Strategy Committee for the RBGE's latest education initiative.

**LIVING LAB SUPPORT AND DEVELOPMENT***Cluster Meetings and the development of SEPAL (Sustainable Environments: Practice, Activism and Leadership):*

Since their inauguration in 2020 the PhD monthly Cluster Meetings steadily transformed from the initial focus on individual projects and aspirations to a more pragmatic approach, exploring skills development and process as needs arose. This change ensued within the first year of the Living Lab development. It became apparent that following individual presentations of profile, research area and research aspirations, external contributions to the cluster were increasingly being invited to present their research. Interesting and valuable as this was, the more immediate individual needs of the students in terms of their research skills, understanding of process and procedures became increasingly prevalent. Cluster Meetings were time limited, so the need for refocusing was evident. Concurrently, discussions were afoot regarding the development of an educational 'research centre' similarly focussing on education for sustainability but with an enhanced emphasis on pedagogy and leadership. Within the spirit of collaboration not competition, this later virtual centre developed into SEPAL (Sustainable Environments: Pedagogy and Leadership), with a strategic research agenda attracting speakers from across the UoD and beyond. The two resources, the Living Lab Cluster Meetings and SEPAL became distinct, with a Memorandum of Understanding established between the two. By 2022, the focus of SEPAL too began to morph, and pedagogy was replaced by practice in the title, and activism was introduced: SEPAL (Sustainable Environments: Practice, Activism and Leadership), continuing to attract its own healthy cross-section of academics and practitioners from across the UoD, Dundee and beyond. Several Living Lab students and supervisors remain regular contributors to SEPAL. An update on Living Lab activities is scheduled at the first input of the new academic year, thereby clearly reiterating the synergy between the two research centres.

**SO, WHERE ARE WE NOW?***Evaluation of The Living Lab, so far ...*

Now two and half years into the life of the Living Lab, it seemed timely to seek evaluative feedback from a sample of stakeholders. This feedback took the form of a single page word document (see Appendix 1), with a 'mood table' of descriptors on a scale of one to eight, and six evaluative free-response questions. The aim was to gain 'real-time' perceptions and reflections from across the Living Lab participants. The document was emailed to all members of the PhD Cluster, students and their tutors; the two internship students, all members of the Steering Group and other participants who either studied or assisted those who studied, under the auspices of the Living Lab. Collectively this constituted a cohort  $n = 29$ , with a return of 24%. The nature of the evaluation was one of quality assurance and therefore did not require ethical approval, however citations from the various respondents required informed consent, which was duly sought and given. The respondents represented the following contributors to the Living Lab (Table 1).

**Table 1:** Nature of Living Lab contributors to the Living Lab evaluation

	PhD student	Staff	Onsite	Remote
EfS	1			1
Psychology	1			1
Arts	1		1	
EfS Supervisor		3		2
Psychology		1		1
Arts				
Steering Group		(2)*	2	

\* One represented under EfL supervisor and the other psychology.

Overall, the collective feedback was positive in terms of relevance, benefits and contribution to personal and academic development, citing 'inspirational', 'motivational' and 'enjoyable' as appropriate adjectives to describe respondents' experience and membership of the Living Lab. Specifics were associated with perceived benefits and 'usefulness', the consensus cited developing a community of belonging that provided networking opportunities as well as a forum to share ideas, experiences and challenges. Students felt they gained motivation and confidence, staff perceived membership more pragmatically than personally.

A more detailed analysis of the feedback follows:

The 'mood-table' sought to capture what the experience of being a member of the Living Lab meant to the respondents, by selecting a number on the continuum between the two sets of descriptors (Table 2).

**Table 2:** 'Mood-table' identifying what being a member of the Living Lab means to the respondents, using a scale of one to eight between two sets of related descriptors.

Descriptor	1	2	3	4	5	6	7	8		Row Total
Unpleasant							<b>14%</b> , 14%	43% <b>28%</b>	Enjoyable	<b>N=7</b>
Not at all useful	1	2	3	4	5	14%	43% <b>14%</b>	<b>28%</b>	Really useful	<b>N=7</b>
Boring	1	2	3	4	5	14%	28%)	<b>57%</b>	Inspirational	<b>N=7</b>
Demotivating	1	2	3	4	5	14%	28%)	<b>57%</b>	Motivating	<b>N=7</b>
<b>Column Total:</b>						3	10	15		<b>27</b> <i>Responses</i>

**Legend:** **BOLD %** are the student contributors and normal font % the members of staff responding.

It can be seen from Table 2 that there is an evidential skew by the students towards the higher-ranking end of the spectrum, selecting the more positive adjectives of 'really useful', 'inspirational' and 'motivating'. Only one student dropped to the slightly lower scale of '7' when describing the nature of the experience in terms of enjoyability. Staff however, appeared more reserved in their responses, with them all except one selecting an 8 for enjoyability but ranging between a 6 and a 7 for usefulness, inspirational and motivational: an aspect of the Living Lab that warrants tighter focus and attention.

Free-response questions yielded a greater insight into respondents' perception of the Living Lab as a research community, and these observations, acumens and future-visions, will be discussed in the following section.

## DISCUSSION

The UoD Botanic Garden Living Lab aims to host projects within the sustainability arena, thereby enabling staff, students and external bodies to collaborate on initiatives within real-world settings, has strong echoes in the evaluations feedback. Even within the timescale of the Living Lab's

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conception early in 2020 to the current day, its emphasis, and hence interpretation, has changed.

This morphing is clearly represented in the feedback. The first cohort of students commenced their studies a couple of months prior to the COVID-19 lockdown in March 2020. At the time, university students were required to work remotely and the facilities at the garden were closed. This, together with recognised sides effects of lockdown, significantly impacted those students who travelled to Dundee specifically for their studies. As lockdown eased and the garden reopened, students were encouraged to use the facilities afforded by the Macro-Micro building. Not only was this opportunity a welcome release from the confines of enforced isolation but it also presented: ‘... *an extremely enjoyable (environment) ... to have a quiet focussed facility to continue with writing and structuring my thesis. The environment is welcoming, spacious and surrounded by a ... useful library, which makes this intense thinking time of crafting the writing an enjoyable process.*’ (On campus PhD student)

This student goes on to state that as a break to distil one’s thought, the garden itself affords a welcome and readily accessible venue (*Ibid.*). For those students who continued to work remotely, the monthly online Living Lab Cluster Meetings represented an invaluable resource for both them and their supervisors. A sense of community, unity and of belonging were echoed by several contributors to the evaluation; mainly students but supervisors also recognised the value of connecting with post graduate researchers (PGRs) engaged in related research projects. Collectively they espoused networking and collaboration opportunities afforded by the Cluster Meeting events: “I have much more information on my field of study and more connection now than I would have had without [the Living Lab Cluster Meetings]” (Living Lab PhD student).

This opportunity to share their work, whilst getting to know others within the cluster was high on the students’ perceived benefits of the community, a sentiment reported elsewhere (Waheed, 2017; Dabaieh *et al.*, 2018, & Zen *et al.*, 2019). Similarly, echoed by staff, was the frequency and regularity of the meetings enabling culture building with impact, within “... green health” sustainability-related initiatives (PhD Supervisor). This testimony is purported by Dabaieh *et al.*, (2018) and others (Zen *et al.*, 2019), espousing the benefits of research, teaching and learning through communities of practice set within a Living Lab philosophy.

In terms of personal development and enhancing study skills, student respondents unanimously reported that being part of the Living Lab community has enhanced their self-development ... “I feel I have gained confidence and motivation” (Living Lab PhD student), whilst another reflects ... “(It has)

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... definitely helped me in the mid and latter stages of my reading and written research. It puts into perspective the artwork that is currently being installed in the garden and allows one to place art, science and educational school visits and research within the wider context of the UoD Botanic Garden and the broader UoD strategy in public engagement” (Living Lab PhD student).

These statements resonate with Waheed’s (2017) earlier claims that students working within the community of a Living Lab become more prepared as agents of change in their professional and personal lives. From the staff representatives, development was evidently viewed from the students’ perspective reiterating the provision of a “venue” for students to gain experience of being involved in a “green health” project (PhD supervisor). Likewise, “... helping with PGR connection and knowledge of current activities” (another PhD supervisor), again suitably reflects Waheed’s assertions (*Ibid*, p.7) regarding real-world sustainability issues and the value of a Living Lab approach. The only staff respondent interpreting the question from a personal perspective in terms of individual academic and professional development, responded singularly in the negative ... “No” (PhD supervisor / Steering Group member). The measure of this response highlights some concern as continued involvement of staff is a key factor to the Living Lab; if there is no recognisable personal value added, this could impact contribution, possibly echoing the more reserved response of staff to the mood-table (Table 2). In his report on Living Labs, Waheed (2017) states that the benefits for academics of working within a Living Lab environment are that it provides a “test-bed” to “... conduct innovative, impactful and transdisciplinary research that involves direct engagement ... implementation and further study of social, environmental and economic issues” (*Ibid*, p.6). I sense from the feedback, that we’re not there yet in terms of staff synergy and ownership. Waheed went on to suggest that success results from collective solutions, ultimately attracting funding for research, rather than “... doing research to attract funding” (*Ibid*, p.6); a position we strongly aspire to, and if achieved would perhaps draw more staff into the fold.

#### *Suggested areas for improvement and further development*

A practical suggestion from an on-campus PhD student regards enhancing the on-site facilities as more students join the Living Lab cluster, was specifically to equip the Macro-Micro building with supportive office-style chairs more conducive to longer term sitting than meetings-style chairs.

Looking to the future, there was a strong emphasis from both staff and students reflecting the early focus and subsequent re-focusing of the Cluster Meetings. Interestingly, all respondents

independently suggested opportunities for dissemination of work to date, for example: “Perhaps, we

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could share presentations of our work after publication in order to gain a better understanding of each other's work and thoughts" (Living Lab PhD student). With an emphasis on the meetings being more pragmatic and process driven over the past few months, we run the risk of losing sight of one of the marked benefits of Living Lab, that of sharing and updating on projects. The sharing of technical skills, tips and procedures remain significant, but are we losing sight of the big picture? As echoed by staff respondents alike: "Wider opportunities for PGRs to engage through relevant topic discussions and opportunities for hosting and /or presenting" (PhD supervisor). Another example being: "Perhaps, method of dissemination of work being done. I know there are plans for a journal, but more informal communications would also be valuable and reach a wider audience" (another PhD supervisor).

The wider audience intimated in the second quote refers to other PGRs with the Division of Education and Society and across the UoD. One possible solution, as suggested by the SEPAL lead, would be to enhance the working partnership with SEPAL, mirroring the practice of regular blogs or news bulletins identifying research projects and opportunities for members (students and staff) to get involved.

Plans for a regular research conference, initially inhouse but with aspirations of being outward facing, are in the early developmental stages, providing an opportunity to celebrate success to date in terms of recruitment and outward recognition. For example, the inaugural members of the UoD Botanic Garden Living Lab have been awarded 'Highly Commended' under the University's Stephen Fry awards initiative. Each participant has a certificate to that effect and will be awarded these at the first conference. This collective celebration, to involve opportunities for research presentation and in-person discussion, will go some way towards making the community more dynamic and progressive.

### *Limitations*

Despite the small return on the questionnaire (24 per cent, n=29) the spread of respondents appropriately represented the stakeholder profile of the Living Lab. This enabled feedback, albeit limited in number and in cases staff represented two roles for example, Steering Group member and supervisor, however the responses gave an eclectic perspective. This was also evident in the students' responses, the diverse background and degree of remoteness (one student was regularly onsite, the others attended remotely) was reflected in their perceptions of the Living Lab, its qualities and perceived value. The questionnaire, adapted from an Education Evaluation sent to

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schools and other users of the garden, afforded a snap-shot response in the 'mood-table' with the opportunity for free-response to targeted questions. This worked well within those aims, however the 'descriptors' on the mood-table were self-limiting, for example 'unpleasant' is an emotive term that could, unconsciously influence a more positive return, indeed 100% of the returns were in the top two categories. Similarly, 'demotivating' is a strong term conjuring significant negative impact. Although this was not perceived by any respondents to be the case, perhaps more neutral terminology to the left of the table would have returned more useful and appropriate information. The aim is to undertake an exit evaluation when the first cohort of students complete their PhDs. Likewise with the stakeholders from the various projects and Steering Group members when they step down from the group. The evaluation questionnaire used for this exercise will be a revision of that employed in this current exercise.

#### *Recommendations*

- Work to ensure that staff within the Living Lab have greater ownership and synergy with the community, thereby forming a more holistic entity, with greater collective value built on individual autonomy and 'buy-in'. To achieve this the Living Lab needs to realise its aspirations of developing a pathway route for PhD and Professional Doctoral degrees and capitalising funding streams for targeted research.
- Equip the Macro-Micro building with supportive office-style chairs.
- Create opportunities annually or two yearly to share progress to date and celebrate success. Orchestrating a research conference in the new academic year is a case in point.
- Enhance collaboration with SEPAL.
- Establish regular online news bulletins/blogs identifying opportunities for research involvement, dissemination and presentation.
- Undertake an exit evaluation when projects are completed and members of the Living Lab step down from their position within its community. Revise the evaluation questionnaire in the light of lessons learnt.

## **CONCLUSION**

The UoD Botanic Garden Living Lab to date evidently goes some way to fulfilling its aims of hosting research projects and providing opportunities for collaboration between UoD staff, students and the wider community. Set within an environment of promoting sustainability and enhanced biodiversity through education, practice and research, it reflects the assertions of Waheed, (2017) who states



that a "Living Lab catalyses change at two different levels. Firstly, it provides direct and relevant benefits to each stakeholder group through its projects and, secondly, it serves as a governance tool that can assist in the greater systemic transformations" (Waheed, 2017, p.5).

As we look to the future, we can respond to lessons learnt by, for example, reviewing the annual programme of the Living Lab Cluster Meetings, to better reflect the student journey by responding to their immediate needs. Other areas for development include ensuring onsite facilities are fit for purpose and endeavouring to support staff in their academic and professional development, as well as developing and encouraging opportunities for dissemination of research, both within the Living Lab, the wider UoD and beyond, whether through publication and/or conference presentation. Thereby continuing to aspire to the aims and aspirations of the Living Lab, our students, and colleagues, as captured in the following quotes: "It is a wonderful opportunity (being part of The Living Lab) not only to get published, but also to learn more and improve different skills during the course of the PhD" and "A wonderful facility, generously offered to the research PhD students. Thank you for the vision" (Living Lab PhD students).

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**Appendix 1: Evaluation of the Living Lab, so far ...****The Living Lab aims to:**

- provide opportunities for students, academic staff, professional staff and external bodies to collaborate on projects, whether academic research or citizen-based outreach, looking at real-life sustainability problems.
- host projects with participants from different backgrounds partnering to collectively address real-world sustainability challenges and opportunities, these include [but are not exclusive] landscape issues both green and blue infrastructure, education for sustainable development, nature connection and nature-based solutions.

Thank you for being part of the Living Lab, to capture what the experience means to you and to ensure it really meets your needs, we'd be grateful for your feedback. To help focus your thoughts please use the following as broad areas for feedback. Thank you.

- Teacher / Lecturer / PhD Student / Student, other, please state [highlight as appropriate]

Please indicate how you feel about being part of the Living Lab by **highlighting relevant numbers** on the continuum between each of the two words:

<b>Unpleasant</b>	1	2	3	4	5	6	7	8	<b>Enjoyable</b>
<b>Not at all useful</b>	1	2	3	4	5	6	7	8	<b>Really useful</b>
<b>Boring</b>	1	2	3	4	5	6	7	8	<b>Inspirational</b>
<b>Demotivating</b>	1	2	3	4	5	6	7	8	<b>Motivating</b>
<b>Column Total:</b>									

Please explain a couple of your selections:

**Other areas for feedback: *Please explain all answers***

- **What do you think are the benefits of being part of the Living Lab?**
- **What were the most 'useful' aspect of being part of the Living Lab?**
- **Has being part of the Living Lab helped or hindered your studies/work?**
- **What aspects of the Living Lab could be improved and how?**
- **List at least 3 things you'll take with you regarding your involvement in the Living Lab**
- **Anything else you'd like to add?**

**Thank you for your time – EJL Dr Liz Lakin**