

An Education Framework for Leadership in Environmental and Digital Innovation towards Sustainability

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Executive Summary

- There remains a digital and sustainability literacy gap across many sectors, risking the acceleration of on-going environmental and social challenges.
- The Leadership in Environmental and Digital innovation for Sustainability (LEADS) program is a unique graduate training program that addresses this gap and draws on the science of the current sustainability crisis to identify where and how digital tools can be used to accelerate the transition to global sustainability.
- LEADS entails a constellation of actors, including four major universities, nonprofits, and industry partners that work together to deliver an interdisciplinary and bilingual program in Montreal, having already reached over 50 graduates across 10 different disciplines since inception in 2020.
- The LEADS Program structure includes a Speaker Series on Sustainability in the Digital Age, a Summer school, an internship, and a Leadership workshop, with a flexible stipend structure to support students with academic financial burdens, conference fees and internships.
- This White Paper presents a framework, based on lessons learned from LEADS, to design inclusive, collaborative, and interdisciplinary programs aimed at tackling increasingly complex and interconnected sustainability challenges.

Preamble

*The Coalition for Digital Environmental Sustainability (CODES) is a global hub for policymakers, academics, technology companies, and NGOs to lead and contribute to digital sustainability. CODES recognizes three Shifts toward digital sustainability - **Shift 1 (Enable Alignment)** calls to align the vision, values, and objectives of the digital age with sustainable development, **Shift 2 (Mitigate)** calls to reduce the negative impacts of digitalization, and **Shift 3 (Accelerate Innovation)** calls to direct innovation efforts towards digitalization for sustainability. To catalyze action towards these Shifts, CODES launched nine **Impact Initiatives**. For more information visit www.codes.global*

*This white paper supports Shift 1 of the CODES agenda and falls under **Impact Initiative 3, Education for Digital Sustainability**. This work is the first of an intended white paper series that demonstrates replicable and innovative frameworks for education and capacity building at the interface of digital innovation and sustainability.*

1. Introduction

Since 2019 progress on the global Sustainable Development Goals (SDGs) has plateaued ([Sachs et al., 2022](#)). Urgent action and systematic transformations across all sectors are crucial if the world is to achieve the SDGs by 2030. This requires holistic governance that moves away from siloed sector-based approaches and focuses on changing societal mindsets, decentralizing decision making, and changing power dynamics ([Luers et al., 2020](#)). Digital technologies such as online platforms, drones, satellite imagery, machine learning, and more, have the potential to transform governance of environmental, social, and economic systems by increasing efficiency, transparency, accountability, decentralization, and connectivity between actors ([Chuard et al., 2022](#)). However, when doing so, strong governance frameworks must be in place to minimize the risk that digitalization contributes to further environmental degradation, global warming, and social inequalities ([Galaz et al., 2021](#); [Anderson et al., 2021](#)).

The Coalition for Digital Environment Sustainability (CODES) defines *digital sustainability* as the use of digital tools to accelerate environmental and social sustainability while mitigating risks. CODES recognizes the importance of digital and sustainability literacy amongst all key actors and leaders working in technology, sustainability, and governance as an important enabling condition to achieve digital sustainability (CODES, 2022).

However, literacy and awareness at this intersection remains insufficient (Del Río Castro et al., 2021; CODES, 2022; Future Earth et al., 2022;), while demand for these interdisciplinary skills grows. For example, digital skills are among the top five skills used by sustainability professionals as identified in a survey conducted by Microsoft and Boston Consulting Group (Microsoft, 2022). Furthermore, the 2021 Digital Skills Gap Index by Wiley identified digital communications as the second highest hard skill in demand by employers and lists Education and Training as the sector with the widest gap in digital skills, followed by the Public sector (Wiley, 2021).

The Leadership in Environmental and Digital innovation for Sustainability (LEADS) program, initiated in partnership with Future Earth and hosted at Concordia University (Montreal, Canada) is a unique graduate program that addresses this need by training students and young graduates in digital sustainability leadership through experiential learning. By equipping participants with competencies at the emerging intersection (see Figure 1) of digital innovation and diverse knowledge systems (e.g. Indigenous knowledge, climate science, interdisciplinary perspectives and more) trainees are empowered to contribute to transformational change and to drive new and inclusive research, policy and training initiatives.

This white paper explores the processes undertaken to design, develop, and implement this transdisciplinary program and discusses lessons learnt along the way. We present a framework that educators and other interested stakeholders around the globe can adopt to develop contextualized education programs that strengthen digital sustainability literacy in an inclusive and collaborative manner.

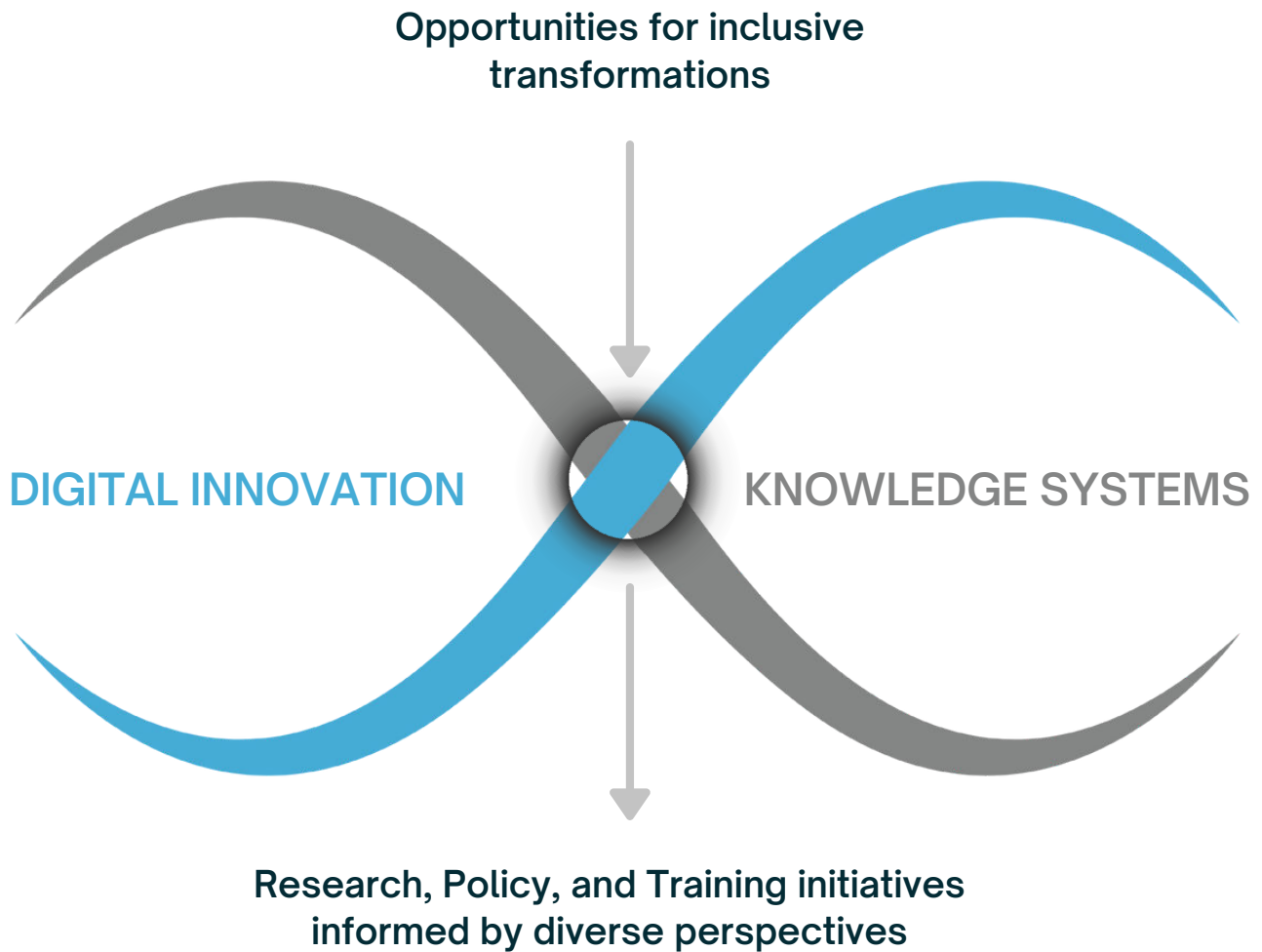


Figure 1. Bringing together diverse communities to drive system transformations towards sustainability. Illustration: Future Earth Canada.

2. LEADS: Origins & Funding Context

Origins and development process

LEADS has been operational since 2020, hosted at Concordia University in Montreal, Canada. LEADS began via a nine-month process of background research, outreach to collaborators, and an application to the Canadian federal government for funding. First, an initial landscape analysis was conducted via desk research, to understand comparable existing programs on the theme of leadership for sustainability in the digital age. This was followed by a needs assessment where potential program collaborators and administrators discussed possible program focus areas, set-up, and envisioned challenges.

The needs assessment was followed by outreach to a small group (5-10) of first potential collaborators. A concept note was circulated and discussions were held with the initial group to refine further. Outreach (emails, meetings, informal discussions) continued with many more participants within the local sustainability and digital ecosystem. A final proposal for submission to a funding call included 10 co-applicants (involved in program leadership) and 20 collaborators (involved in program implementation), all of whom were involved in writing up the funding application to various extents. At the same time, discussions were held with the hosting institution (Concordia University) in terms of administrative support and logistical needs for the physical intake of students and more (See Figure 2 for an overview of the actors involved in the LEADS program).

The funding application was successful and LEADS was awarded CAD1.65 million in funding, to be distributed over six years, from the Natural Sciences and Engineering Research Council of Canada (NSERC)'s Collaborative Research and Training Experience (CREATE) program.

Constellation of actors involved in LEADS

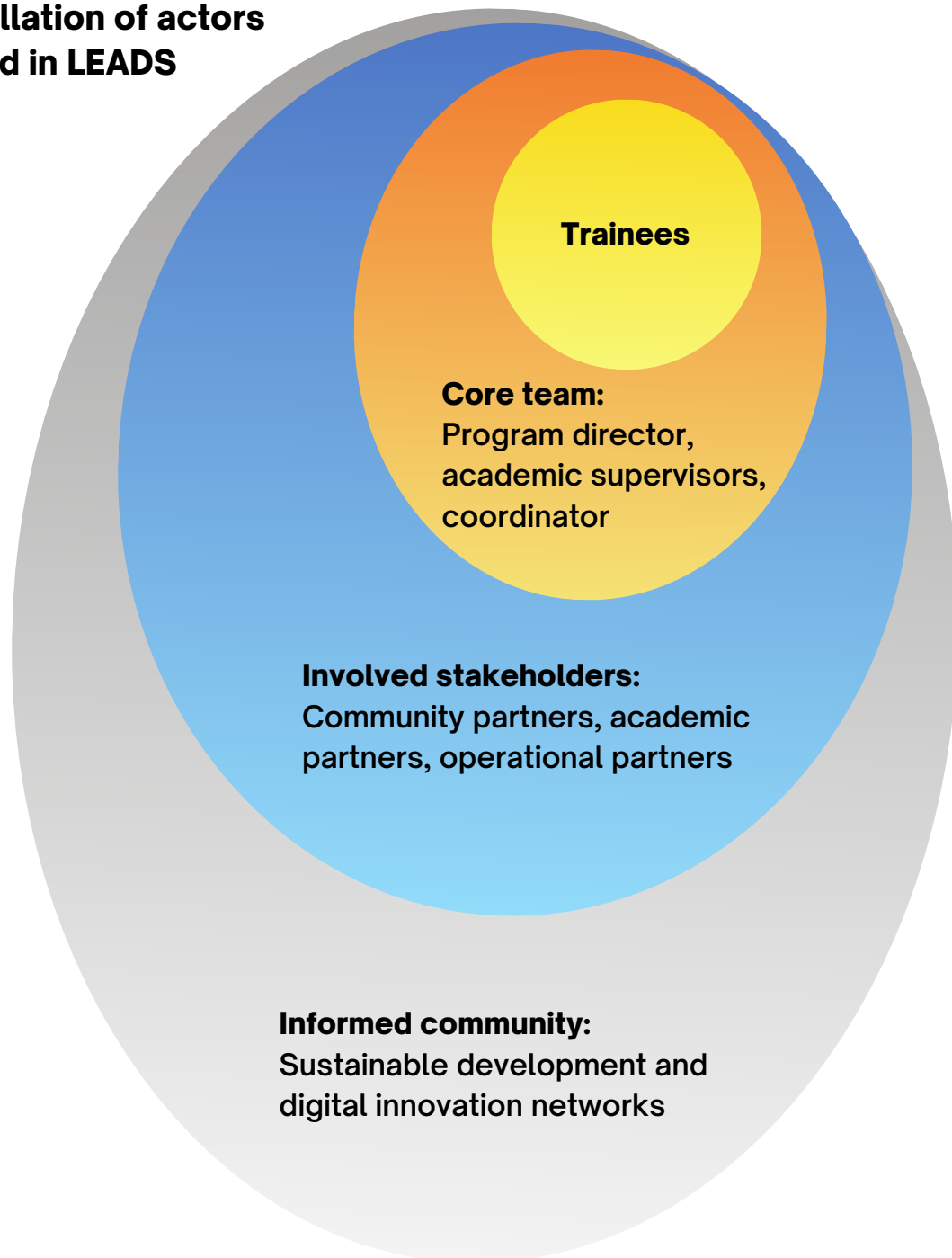


Figure 2. Constellation of actors involved in LEADS. With **Trainees** as central actors in the system, the LEADS program encompasses a **Core team** responsible for programming and administration, **Involved stakeholders** or partners from many sectors who host LEADS interns, conduct workshops and seminars and contribute occasionally to programming, and the **Informed community** that encompasses many peripheral networks working in digital innovation and/or sustainable development.

Box 1. Opportunity for improvement - a reflection on program set-up:

During the initial needs assessment, time and resource constraints prevented direct consultation with potential trainees (i.e. graduate students in environment, computer studies, engineering, other relevant fields). Gathering perspectives and expectations from the point of view of future trainees would have provided highly valuable input at this early stage. In consequence, the launch and first year of the program (also coinciding with the early days of the COVID-19 pandemic) experienced some trial and error in best meeting the expectations of students for training activities. Therefore consultations and outreach with trainees, in addition to other stakeholders, is recommended as a future practice.

Funding context in Canada

The NSERC CREATE program that supports LEADS provides funding for the development of innovative training programs that focus on the training and mentoring of teams of highly qualified students and postdoctoral fellows that encourage collaborative and integrative approaches and address significant scientific challenges associated with Canada's research priorities. In recent years, Canada has seen an increase in federal funding opportunities for improving digital literacy at large (ISEDa, 2023) and an increased federal focus on interdisciplinary, collaborative and international approaches to research (ISEDb, 2023).

The NSERC CREATE program provides funds for six years of operations, in support of both student stipends and program activities. Combined with institutional support from Concordia, LEADS has been able to support program staff, refine research themes, scale-up student cohorts and internships, and create lasting collaborations among staff and students. However, we are finding that the given funding and timeline is often not adequate to overcome some key challenges that are encountered with such highly interdisciplinary programs. These include integrating conflicting perspectives from different disciplines, navigating traditional versus emerging teaching models and tools (like virtual reality, chatGPT and more), and ultimately finding funding to continue growing the many novel ideas that are emerging from LEADS (Ventimiglia et al., 2023).

3. Current Structure & Learning Models

Current structure

As described above, collective reflections on the current state of education led a diverse group of professors and subject matter experts to develop LEADS as an inter-university and interdisciplinary program at the forefront of digital sustainability education, funded by the NSERC CREATE program. This funding is exclusively allocated to the achievement of the program's objectives, with a system of regular reporting obligations.

The LEADS program is designed to equip participants with a diverse set of skills in digital sustainability spanning interdisciplinarity, computer science and collective leadership, achieved through a range of complementary deliverables (refer to "*LEADS' components - How?*", p. 10). Financial support, in the form of stipends, is also provided to participants contingent on the successful completion of mandatory program deliverables.

LEADS has instituted a flexible stipend structure. It's up to the discretion of affiliated professors to allocate bursary stipends to supervised students based on their needs, and up to a certain maximum amount. The stipends encompass:

- Bursary stipends: Financial support to alleviate the participants' academic financial burdens;
- Conference stipends: Financial support to participate in events to grow soft skills and build meaningful networks;
- Internship stipends: Financial support to complete an internship with one of the program partner organizations.

Admission to the program is open to students from Montreal's four major universities – Concordia University, McGill University, Université de Montréal, and Université du Québec à Montréal – who are supervised by program-affiliated professors. The program prioritizes genuine curiosity and a proven interest for sustainability in the digital age over exceptional grades or academic backgrounds. It is run as a bilingual program, as it gathers trainees from both English-speaking and French-speaking universities and offers activities in both languages. Student enrollment is aligned with their degree schedule (e.g. Masters for 2 years).

In the present academic year 2023-2024, the LEADS program includes 42 active graduate students and postdoctoral trainees. The current LEADS cohort is composed of 2% postdoctoral scholars, 60% doctoral students, and 38% master's students (see Figure 3).

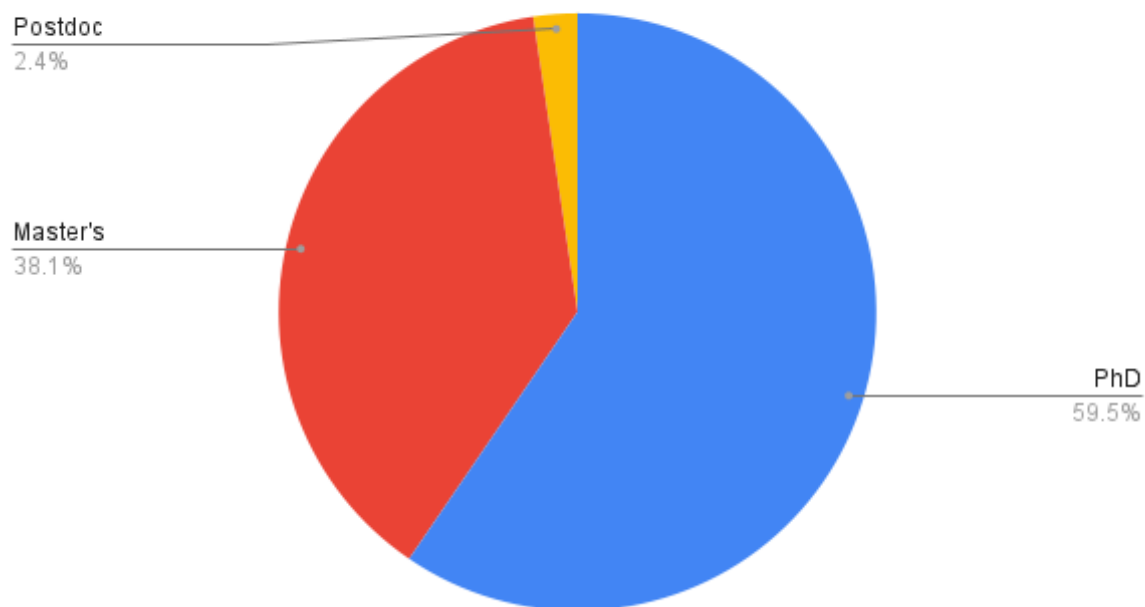


Figure 3. Education levels of LEADS participants in 2023-2024.

One of the key assets of LEADS is the interdisciplinarity of the program participants and learning modules. For example, since 2020 LEADS trainees boast a diversity of disciplinary backgrounds including computer science, environmental studies, physics, sociology, and fine arts (see Figure 4 below). Training activities like the LEADS summer school and internships provide hands-on experience that spans and transcends scientific disciplines, with topics ranging from sustainability, science communication, social justice to machine learning, coding, and climate modeling.

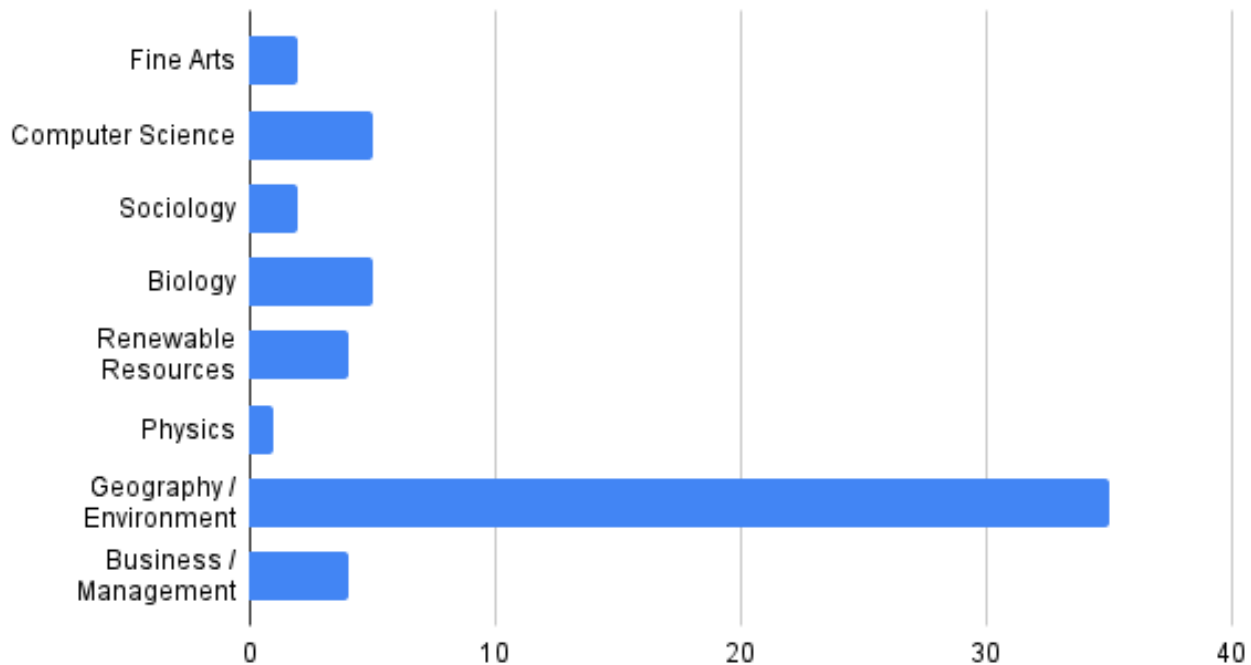


Figure 4: Programs of study of LEADS participants.

The LEADS program is structured around four key deliverables: the annual summer school, the internship, the Speaker Series on Sustainability in the Digital Age and the Leadership Workshop. These components provide a complementary experience to the regular academic curricula that the trainees follow through their respective host universities. An optional monthly activity further ensures that the program is adaptable to the participants' availability and academic commitments.

LEADS' components – How?

The main goals of LEADS are to foster open-mindedness towards different disciplines and methods, to promote a holistic understanding of society and the relationship between sustainability and digital innovations, and most importantly, to equip participants with appropriate tools and transversal skills, including:

- Interdisciplinarity
- Policy communication
- Systems thinking
- Collective leadership

To achieve these goals, the program revolves around four complementary components:

- (1) Speaker Series on Sustainability in the Digital Age:** Approximately 5 times per year, LEADS convenes a virtual and/or in-person speaker session, during which one or several experts from various sectors and disciplines are invited to talk about their work. Often, these sessions also include practical or reflective exercises followed by networking opportunities. By covering the multiple aspects of sustainability, ranging from the analysis and treatment of environmental data to the range of social and societal issues of emerging technologies, these workshops provide students with a 360-degree view of sustainability in the digital age.
- (2) Summer school:** Every year in May, the LEADS summer school takes place over a two-week period and features lectures and workshops led by experts across multiple scientific disciplines; students receive three credits applicable to their academic studies. The aim of this deliverable is to expose LEADS trainees to a diversity of methods and approaches, such as machine learning, science communication and public policies, and to provide the opportunity to apply newly gained knowledge and skills to their respective research projects.
- (3) Internship:** Each trainee participates in a 200-hour internship during the program, and has the option to carry out their internship with one of LEADS' partner organizations, such as Future Earth and Sustainability in the Digital Age, or a relevant organization of their choice. This approach ensures that learning extends beyond the boundaries of the university and into different sectors of society, where real issues and challenges can be tackled.
- (4) Leadership Workshop:** This annual workshop is designed to connect different areas of expertise and approaches to sustainability and science communication to help students communicate their vision for the future in a clear and impactful way. [Click here to read more about this year's Leadership Workshop.](#)

LEADS – an evolving interdisciplinary education model

Ever since the launch of the program, numerous discussions have been held with colleagues from Future Earth and Sustainability in the Digital Age, but also with professors from other Canadian universities regarding the significance of the LEADS program. These discussions reinforce the idea that interdisciplinarity in education is effective in preparing future professionals. Feedback from students in the program has similarly been predominantly favorable. It is often reported to the program coordinator that trainees are very satisfied with the experience of interacting with students from other disciplines who have knowledge complementary to theirs. Additional research will be conducted to collect data on student satisfaction and to assess the program's effectiveness in achieving its broader goals.

While the current LEADS structure has demonstrated success, the program remains in constant evolution to ensure its alignment with the needs of students and the evolving landscape of technologies and the expectations of society. Despite the well-known benefits of interdisciplinary approaches for addressing current societal issues, the lack of interdisciplinarity and practical work on concrete issues in curricula has been a long-standing issue. Numerous studies dating back to 2010 and before highlight that “Most institutions are not sufficiently outward looking to exploit the power of networking and connectivity for mutual strengthening.” ([Frenk et al., 2010, p 1950](#)).

The emergence of LEADS and similar programs are progressively changing this outdated landscape. They represent a real solution to building the future leadership needed to foster deep transformative change in policies, regulations, and people's thinking and behavior patterns.

Box 2. Opportunity for improvement - a reflection on program completion:

While students can collect three credits through the LEADS summer school program, we believe that an official certificate upon achievement of the LEADS program and all its mandatory deliverables will add further value and recognition to the program. This additional accreditation recognizing the skills obtained throughout the program could positively influence the employability of the program participants and might incentivize more students to join the program.

4. LEADS keys to success

Based on three years of experience with the LEADS program so far, lessons learnt and keys to success were identified to help develop a framework that others may use to replicate the program or to draw inspiration from it. Figure 5 below represents a step-by-step roadmap for such a purpose.

- (1) The first step is the **identification of the educational gap** requiring special attention in the program. In the case of LEADS, there was a real interest from students from different fields to receive additional training in the fields of digital sustainability, but no program offered this specialty at that time. This observation naturally resulted from informal dialogues between professors, their students and eventual other actors.
- (2) The gap identification leads to the **characterization of the landscape** of the program, and the identification of successful existing programs from which to draw inspiration from. This step can lead to several strategic questions:

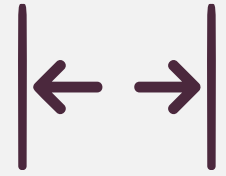
Who would be involved in the program? How will the program be financed? What are the other similar programs that exist?

The first two steps may be thought of as linear and intuitive, while the steps following become cyclic, and should be revisited throughout the existence of the program. Needs and interests evolve in step with social, economic and environmental change, requiring constant adaptation from the program.

- (3) Formal discussions replace the informality of the first two steps when the **actor's interest and societal needs are defined** to start developing the program. This is also the moment where **partnerships are cemented**, and the idea becomes a project.
- (4) Step 4 is the **definition of the program's structure and goals**. As seen within LEADS, the program's structure evolved over time, and some of the workshops changed to better fit the requirements of the students.

1. Identify the educational gap

Informal discussions with interested actors



2. Characterize the landscape

Identify existing programs, potential funding, trainees, and other key actors (see Constellation map)



3. (Re)Define actor interests and societal needs; cement partnerships

Consultations with trainees, community, academic, and operational partners

4. (Re)Define program goals and structure

Align the goals of the program with the needs of trainees and society; Establish program deliverables

6. Implement program



STEP BY STEP



5. Apply for funding

Match program goals and structure to funding mechanism

Figure 5: Roadmap to interdisciplinary program design

- (5) Closely tied to the fourth step is the **funding application**, playing a crucial role in shaping the structure and goals. Depending on the fund's requirements certain deliverables and conditions might be privileged over others. This creates a two-way relationship between these steps.
 - (6) All these steps lead to the operational **implementation of the program** and continues back and forth to re-define interests, needs goals and structure.
-

5. Conclusion

This paper draws on the experience of the LEADS program, including lessons learnt, to outline recommendations and best practices for similar interdisciplinary programs around the globe. LEADS success to date is attributed to its flexibility to evolve over time and to incorporate feedback from program participants and stakeholders. There is no one-size fits all when it comes to education, hence the importance to reflect on context-specific societal needs, cultural norms and the current educational landscape when designing other programs.

Expanding the ecosystem

Scaling up digital leadership programs such as LEADS could be achieved by connecting to and building on the networks and resources of other similar leadership programs. For example the NSERC CREATE funding program supports other interdisciplinary education efforts in various fields. Some examples are the [INTER-MATH-AI \(MA\) program](#) in Ottawa (mathematics and Machine learning), the [Fin-ML program](#) in Montreal (finance and machine learning), and the [Responsible AI program](#) in Toronto (artificial intelligence).

Such networks for students may be combined with networks that are designed to enhance leadership skills among mid-career academic researchers and scientists (such as the former Earth Leadership Program and the Leopold Leadership Program), to drive systems change in the real world. The vast web of alumni that is created from programs like these includes young professionals, established academic professors, and thought leaders who have a demonstrated passion and commitment to driving change.

These alumni may often be inclined to share their knowledge, connections, and expertise to support and scale interdisciplinary leadership programs. By leveraging their networks, which include other sustainability leadership programs at institutes, colleges, and universities across Canada and around the world, there is an opportunity to share successes and lessons learned from existing model and to learn from the experiences of other leaders and programs in turn.

Final reflections

A close look at the literature and the current global political landscape demonstrates the increasing recognition of interdisciplinary skills and a holistic understanding of systems change as necessary to tackle complex societal challenges. Education has the power to train future generations in accordance with these emerging paradigms. It remains important to promote flexibility and interdisciplinarity in education, to advocate for a continued increase of public investment, and to sustain private sector and philanthropic funding for digital education and sustainability.

As described in the CODES Action Plan, LEADS embodies a decentralized approach to develop literacy and education on digital sustainability with a focus on understanding and critically analyzing the benefits and harms of digitalization. Any similar program in development should be needs-based, localized and contextualized. The focus must be on leveraging research and building skill sets needed to advance digital sustainability, whether that be within academic curricula, vocational training, or professional associations.

In our experience, digital leadership programs such as LEADS can play a vital role in contributing to the development of innovative inter- and transdisciplinary initiatives that go beyond conventional sector-based approaches. They equip current and future generations with the skills and knowledge necessary to leverage digital tools to tackle climate change, advance progress towards the SDGs, and address many other complex challenges requiring collective action.

6. References

- Andersen, A. D., Frenken, K., Galaz, V., Kern, F., Klerkx, L., Mouthaan, M., Piscicelli, L., Schor, J. B., & Vaskelainen, T. (2021). On digitalization and sustainability transitions. *Environmental Innovation and Societal Transitions*, 41, 96–98. <https://doi.org/10.1016/j.eist.2021.09.013>
- Chuard, P., Garard, J., Schulz, K., Kumarasinghe, N., Rolnick, D., & Matthews, D. (2022). A portrait of the different configurations between digitally-enabled innovations and climate governance. *Earth System Governance*, 13, 100147. <https://doi.org/10.1016/j.esg.2022.100147>
- Coalition For Digital Environmental Sustainability (CODES). (2022). *Action Plan for a Sustainable Planet in the Digital Age*. Zenodo. <https://doi.org/10.5281/ZENODO.6573509>
- Del Río Castro, G., González Fernández, M. C., & Uruburu Colsa, Á. (2021). Unleashing the convergence amid digitalization and sustainability towards pursuing the Sustainable Development Goals (SDGs): A holistic review. *Journal of Cleaner Production*, 280, 122204. <https://doi.org/10.1016/j.jclepro.2020.122204>
- Frenk, J., Chen, L., Bhutta, Z. A., Cohen, J., Crisp, N., Evans, T., Fineberg, H., Garcia, P., Ke, Y., Kelley, P., Kistnasamy, B., Meleis, A., Naylor, D., Pablos-Mendez, A., Reddy, S., Scrimshaw, S., Sepulveda, J., Serwadda, D., & Zurayk, H. (2010). Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *The Lancet*, 376(9756), 1923–1958. [https://doi.org/10.1016/S0140-6736\(10\)61854-5](https://doi.org/10.1016/S0140-6736(10)61854-5)
- Future Earth Canada, Sustainability In The Digital Age, & Canadian Science Policy Centre. (2022). *Canada's Sustainable Future – Creating a Digital Action Plan*. Zenodo. <https://doi.org/10.5281/ZENODO.7293172>
- Galaz, V., Centeno, M. A., Callahan, P. W., Causevic, A., Patterson, T., Brass, I., Baum, S., Farber, D., Fischer, J., Garcia, D., McPhearson, T., Jimenez, D., King, B., Larcey, P., & Levy, K. (2021). Artificial intelligence, systemic risks, and sustainability. *Technology in Society*, 67, 101741. <https://doi.org/10.1016/j.techsoc.2021.101741>

- Innovation, Science and Economic Development Canada (ISED). (2023a). *Report of the Advisory Panel on the Federal Research Support System*. Innovation, Science and Economic Development Canada. <https://ised-isde.canada.ca/site/panel-federal-research-support/en/report-advisory-panel-federal-research-support-system>
- Innovation, Science and Economic Development Canada (ISED). (2023b). *Government of Canada announces funding for training to help thousands of Canadians get online*. <https://www.canada.ca/en/innovation-science-economic-development/news/2023/02/government-of-canada-announces-funding-for-training-to-help-thousands-of-canadians-get-online.html>
- Luers, A., Garard, J., St. Clair, A. L., Gaffney, O., Hassenboehler, T., Langlois, L., Mougeot, M., & Luccioni, S. (2020). Leveraging Digital Disruptions for a Climate-Safe and Equitable World: The D²S Agenda: [Commentary]. *IEEE Technology and Society Magazine*, 39(2), 18–31. <https://doi.org/10.1109/MTS.2020.2991495>
- Microsoft. (2022). *Closing the Sustainability Skills Gap: Helping businesses move from pledges to progress*. Microsoft Corporation. <https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE5bhuf>
- Sachs, J. D., Kroll, C., Lafortune, G., Fuller, G., & Woelm, F. (2022). *Sustainable Development Report 2022*. Cambridge University Press. <https://doi.org/10.1017/9781009210058>
- Ventimiglia, A., Joblin, O., & Matthews, D. (2023). *Addressing critical societal challenges requires increased support for boundary organizations to enhance interdisciplinary education and research outcomes*. CSPC. <https://sciencepolicy.ca/posts/addressing-critical-societal-challenges-requires-increased-support-for-boundary-organizations-to-enhance-interdisciplinary-education-and-research-outcomes/>
- Wiley. (2021). *Digital Skills Gap Index 2021*. Wiley. <https://dsgi.wiley.com/wp-content/uploads/2021/10/DSGI-whitepaper.pdf>



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