

# Adaptive Lifelong Learning for an Inclusive Knowledge Economy



The Calhoun Center for Higher Education Innovation  
Virginia Tech Publishing  
The International Academic Forum  
Future Talent Council

**This is a draft of the report**

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**The full report will be available for free download on August 15 2020 at  
<https://honorscollege.vt.edu/cdp/center.html>**

# Adaptive Lifelong Learning for an Inclusive Knowledge Economy

## *List of co-authors and participants*

This report was compiled by 60 co-authors and contributors engaged with adaptive lifelong learning across different sectors. The team worked together remotely over 12 months and also met for a two day in-person workshop in October 2019. Starting in August 2020 the report will be further developed through working groups with different learning communities and stakeholders

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# Adaptive Lifelong Learning for an Inclusive Knowledge Economy

## EXECUTIVE SUMMARY

In January 2019, the Calhoun Center for Higher Education Innovation at Virginia Tech launched a multiyear project designed to explore the connections between adaptation and inclusiveness in learning. Our thesis was that a full-fledged commitment to adaptive learning has the potential to diversify the emerging knowledge economy while also making it more inclusive. Moreover, increased diversification and inclusiveness can enhance socioeconomic sustainability and enable our society to engage all pertinent voices when approaching complex problems.

To test this thesis, we first explore an adaptive and inclusive approach to defining what we mean by learning and knowing. A dynamic definition allows us to then openly explore adaptation to specific aspects of learning including: i) How is learning realized? ii) When is learning delivered? iii) Who is included in learning?

Our first step was to bring together sixty individuals, each with significant direct experience with adaptive learning. These individuals came from 30 different organizations representing a range of sectors: higher education, K-12 education, industry, and non-profit. Together, we collaboratively developed a three-stage plan:

- Stage 1: Record emerging practices in a preliminary report and discuss them during a two-day workshop in Washington, D.C. (March 2019 - October 2019)
- Stage 2: Synthesize the outcomes of the research and discussions into a report that summarizes emerging practices and provides an agile framework of recommendations for further development of adaptive and inclusive lifelong learning. This report concludes the second stage. (November 2019 - August 2020)
- Stage 3: Launch working groups to further explore and test the recommendations of this report. These working groups can be found at the end of this report. They are launching in August 2020 and are open to participation by entities and individuals interested in the project. (August 2020 - August 2021)

While implementing the second stage of our project, a number of world events intervened, which only served to amplify the urgency of our mission. One such event, COVID-19, is already showing the speed with which scientific and technical knowledge can be developed, shared, and advanced as never before. This, of course, has profound implications for the development of life-saving treatments. At the same time, COVID19 has laid bare the social disparities inherent in 21<sup>st</sup>-century socioeconomic structures and highlighted the challenges we face as a society in coordinating handling of complex issues. Entire segments of the population are effectively excluded from participating in, and reaping the benefits from, the knowledge-based economy. Individual achievement is being disconnected from social progress. What is clear is that we must do a much better job of bringing together diverse individual perspectives and experiences if we expect to produce collective action that is both wise and equitable.

This report begins with an *Introduction* that defines what we mean by inclusive knowledge and explains how our proposed definition expands some of the traditional understandings of knowledge. First and foremost, we conceptualize knowledge not as a fixed product or outcome—something stored in our

brains, computers, books, or institutions that we access as needed. Nor do we separate the mind (cognition) from the body (action). Rather, we see knowledge as inclusive, dynamic, and evolving. This report takes a “knowledge in action” approach where knowledge is an emergent, pragmatic, situated, and historical process that is practiced collectively in the classroom, on the job, in the neighborhood, on the road, on the internet, and at home.

Our understanding of “knowledge in action” as relational comes from the fact that knowledge exists in many different contexts, and those contexts vary from one individual to the next. To have relational knowledge, we also need to account for personal knowledge; active and embodied knowledge-making by individuals. Because human beings have unique life experiences, their accumulated knowledge, learning preferences, and pathways will also be unique. Adapting our learning practices to fit diverse needs and experiences will increase our capacity to be inclusive. Inclusive participation will benefit all learners as they discover how to engage with multiple perspectives. Over time, they will come to value, leverage, and embody difference, which in turn will make them agile learners with the ability to intuitively combine their expertise with the diverse expertise of others and structure collective intelligence for addressing complex societal tasks and challenges.

In *Chapter I*, we review literature that establishes adaptive development of domain-specific, domain-general, and life skills as key to training diverse, versatile learners for a collaborative 21st century economy. Learners who develop all three layers of skills in interconnected fashion are able to transfer knowledge across different relational contexts. This in turn enables them to connect their diverse experiences to multiple professional pathways and collaborative contexts and adjust their stock of skills to changing workforce needs.

Chapter I also highlights several organizations that have developed agile training frameworks in an effort to address 21<sup>st</sup>-century proficiencies. In some cases, organizations are also providing on ramps for nontraditional learners who may be under- or unemployed. A key takeaway is that co-creation processes enable learners who are at risk of being left behind to acquire integrative multilayer skills that are needed in the 21<sup>st</sup>-century economy.

*Chapter II* focuses on ways to adapt existing best practices to better serve the needs of learners as they develop and expand their multilayer skills across professional and personal contexts. As we explain, educators and employers must first acknowledge that learners already possess unique skill sets that simply need to be tapped into. Educators and employers must then find creative ways to partner with learners, enabling them to connect existing skill sets and aspirations to future career pathways and acquire the additional skills necessary for these individualized pathways.

The way we propose to facilitate this partnering is to structure learning experiences as networks of short modules that utilize different learning modalities and connect through multiple pathways to allow learners to develop skill proficiency and connectivity precisely when it is needed and in the most efficient customized manner. Structuring pathways of short modules allows just-in-time information to emerge in the course of learning such that a learner’s pathways can change and evolve to reflect the new situation. Utilization of different learning modalities (e.g. experiential, theoretical, in-person, asynchronous, blended, etc.) helps to address the needs of a truly diverse body of learners and cover the full range of knowledge types. We conclude the chapter by discussing a number of existing and emerging technological tools and technology-assisted processes that facilitate adaptive learning. These include intelligent/cognitive tutors combined with interactive content; the Internet of Things and paired

technologies such as AR/VR and robots for embodied interactive learning; and multidimensional data analytics for assessment of progress and adaptation of learning.

In *Chapter III*, we survey a number of adaptive learning programs currently being implemented in academia, industry, and communities. As we show, these programs are increasing access to learning by employing multiple delivery modalities, alternative cost structures, holistic support mechanisms for diverse learners, transferability of learning, and transparency of learning outcomes across institutions. We show how these programs are mobilizing people to learn whenever and however they require it regardless of barriers that may exist at the individual, social, or cultural levels. We also consider new approaches to cross-sector learning and credentialing that increase access and reduce cost while allowing for the learning record to stay with the learner rather than with the institution.

In *Chapter IV*, we propose advancing inclusive and integrative adaptive learning through cross-sector cooperative communities organized around transdisciplinary themes of societal impact. As envisioned, these communities value and engage all aspects of knowledge in action, rely on inclusive and non-hierarchical participation and promote integrative, multilayer skill development for all participants. We further propose expanding these communities by developing Point of Need Learning Platforms (PNLPs) that allow diverse learners to explore the mapping of their existing skills to current and emerging training and employment pathways. PNLPs provide efficient individualized pathways for immediate learning needs while guaranteeing that learning is transferable to other contexts and situated within integrative professional and personal development. PNLPs contain interconnected, modular content that has been developed by all participating sectors and that accommodates all types and levels of learning need. Many of the modules integrate multiperspective learning and bring diverse learners together to explore complex problems. PNLPs use high dimensional analytics to continuously adapt to societal and individual needs and provide a lifelong learning record owned by the learner.

PNLPs can be developed by adopting, experimenting with, and evolving many of the recommendations presented in this report. The model of institutional change proposed in this report is the result of integrative discourse between a radical paradigm shift (inclusive transdisciplinary communities supported by PNLPs) and the gradual change processes embedded in existing institutions.

*Appendix A* summarizes the Calhoun Discovery Program (CDP) at Virginia Tech. CDP focuses on the development of versatile and collaborative lifelong learners through adaptive and integrative training of domain-specific, domain-general, and life skills. The learning is embedded in cross-sector transdisciplinary communities focused on sustainable and equitable sociotechnical innovation.

In closing the report, we propose the establishment of nine *Working Groups* with learners and learning professionals working in and across sectors (K-12, Higher Education, Industry, etc.). Taking place in the second half of 2020 and Spring of 2021, the groups will collect more information on emerging adaptive learning practices and engage participants in reflexive dialogue on their experiences with various learning models and approaches. The insights gained from these groups will be analyzed and incorporated into a draft of a cross sector PNLP for Industry 4.0 and Sustainable Development. The findings of the working groups will also be presented in a digital book published by Virginia Tech Publishing at the end of 2021.

We thank you for reviewing the report and welcome questions and suggestions as well as inquiries for participation in the working groups. Please contact us at [cchei@vt.edu](mailto:cchei@vt.edu).



# Adaptive Lifelong Learning for an Inclusive Knowledge Economy

## *Working Groups*

In August 2020, we will be launching a series of *working groups* with learners, educators and professionals across sectors (K-12, Higher Education, Industry, etc.). Organized around specific themes, these groups will explore, critique and evolve the recommendations of this report. We envision working groups as opportunities for participatory assessment of the report as well as bridges to form partnerships for actionable items such as grant funded pilot programs and new education modules, tools and platforms. Although working groups will begin virtually, we anticipate the possibility of holding in-person workshops in the Spring 2021. The insights gained from these events will be analyzed and incorporated into a digital book on *Inclusive and Integrative Point of Need Learning* to be published by Virginia Tech Publications in the second half of 2021.

*Participation in working groups is open through application. Participants lists given below are therefore continuously updated. If you are interested in participating please contact the Calhoun Center at [cchei@vt.edu](mailto:cchei@vt.edu)*

### **Proposed working groups include:**

1. **From School, to Manufacturing Employment, to Lifelong Learning** (with a focus on pathways in advanced manufacturing)  
Coordinator: Amy Arnold  
Current Participants: Dave Hare, Kristin Wingfeld, Chip Blankenship, Robert Smith

This working group will leverage knowledge from a number of initiatives mentioned in Chapter III to i) bring together people and entities that have successful experiences in these types of learning pathways, ii) leverage ongoing work in places like the Academies of Louisville and FAME for developing adaptive pathways in high school curricula that can lead directly to successful employment in advanced manufacturing (AM) for learners from various backgrounds, iii) begin to define a Point-of-Need approach for lifelong learning in AM that can provide upskilling and career development opportunities to all levels of workers. This group will synergize with the Future Talent Council Advisor Boards on the Future of Talent in Manufacturing and Employer & Educator Relationships.

2. **Adaptive and Integrative Learning in Global Academia** - *International Academic Forum (IAFOR), the Association of Public and Land-grant Universities (APLU) and Future Talent Council (FTC)*  
Coordinators: Joseph Haldane, Shari Garmise, John Flato, Jared Keyel  
Current Participants: Daniel Kjellsson, Paul Heilker, Dale Whitaker, Juliet Greenwood, Rebecca Clark-Stallkamp

This working group will engage a wide group of educators and scholars from around the world with a focus on the IAFOR, APLU and FTC networks. The group will gather emerging practices in developing adaptive and integrative professional and personal development curricula across the globe and form partnerships for exchange of lessons learned and/or coordination of efforts across institutions. The group will also look in faculty and staff development issues as well as technology adaptation and

development issues for delivering adaptive lifelong learning. The group will focus on the enabling technologies discussed in Chapter III and the combinations of gradual and transformative change discussed in Chapters III and IV.

**3. Adaptive and Integrative K-12 Preparation in Underserved Areas - Trusting the Young Learner**

Coordinators: Owen Cardwell, Chrystal Harris, Chris Glover, Scott Bess, Karen Eley Sanders, Amy Arnold

Current participants: TBD

This working group will bring together people and entities that have successful experiences in implementing adaptive and integrative learning in K-12 with a focus on underserved areas. The goal is to make recommendations and build partnerships for scaling this work. The group is also planning a workshop on collaborative self-discovery exercises that can expose young learners to an adaptive learning framework, help them discover their strengths and allow them to have some ownership of the adaptive learning process by connecting these strengths to future aspirations through customized pathways. This working group would bring together two focus groups of fifty 10th grade students from Newport News and Lynchburg.

**4. Cross-sector Summit on Adaptive Learning for an Inclusive Workforce at the Intersection of Humans and Technology**

Coordinators: Renee Schlechta, Michael Richey, Jay Chance, Shahab Shagheb, Amy Arnold, Catherine Amelink

Participants: By invitation

In manufacturing and engineering industries, several key technologies are impacting the workforce's knowledge development. These include: robotics and automation; industrial Internet of Things and advanced sensing; digital twins (corresponding data packages for each design and part); cyber security for production systems; augmented and virtual reality, e.g. for inspection tasks; and additive manufacturing (AM) technologies; among others. Taken in total, these technologies are posed to transform the manufacturing capabilities, enabling greater operational flexibility (in the forms of reconfigurable production assets) and strategic flexibility (in the form of granular, data-driven business intelligence) and advanced knowledge management (in the form of knowledge graph and data lakes).

Development and implementation of these technologies within a systems context of the five Ps (People, Peace, Planet, Prosperity and Partnership) can facilitate much needed socio-economic sustainability. This summit will focus on the structuring of partnerships that can coordinate the commitment of significant resources towards sociotechnical systems approaches that increase manufacturing capability and flexibility while also advancing inclusive and equitable growth of human capital. The summit will bring together experts from industry, academia, government and community to explore training and production systems that leverage cyber-human intelligence to tackle these complex goals. The summit will also explore the potential of cross-sector Point-of-Need Learning Platforms (PNLP), as presented in this report, for educating, reskilling and upskill all related members of the current and future workforce to utilize and leverage these technologies. Since PNLPs advance targeted domain-specific skills while also leveraging and advancing diverse domain-general and life skills, they can become a key mechanism for enhancing the professional and personal development

of human capital and driving the five Ps of Sustainable Development Goals. The summit will be hosted at the Boeing Leadership Center in St Louis, Missouri.

**5. Integrating IPPD Adaptive Learning in Current Higher Education Structures- Calhoun Discovery Program**

Coordinators: Lisa McNair, Amy Arnold, Jared Keyel, Thanassis Rikakis, Shahabedin Sagheb, Mike Kretser, Alkan Soysal, Robert Smith, Chip Blankenship

This working group will focus on a three year assessment of the Calhoun Discovery Program (CDP) as a pilot for an IPPD based adaptive learning curriculum within existing structures in higher education.

**6. An Inclusive Workforce Development Workshop with Virginia Mayors - Focus on Industry 4.0**

Coordinators: Anne Khademian, Scott Weimer, Jared Keyel

Current participants: TBD

The overarching goal of this working group is to ask mayors across cities of varied sizes and demographics to identify: i) current skills that exist in their community built through both formal training and life experiences, ii) current and future skills needed in their community, iii) training mechanisms (including learning mechanisms and support structures) that can leverage existing skills to train an inclusive workforce for the future in their city. The working group will focus on mapping diverse “knowledge in action” skills that exist in current cities to an Industry 4.0 workforce.

**7. Institutional Partnerships with Local Employers in Rural Settings**

Coordinator: Catherine Amelink

Current participants: TBD

Starting in summer 2020, this working group will explore how student internships with local employers in a rural setting coupled with project based classroom work provided by local employers can help provide opportunities for adaptive learning and further expansion of this model to other communities and learning contexts such as community colleges.

**8. Transdisciplinary Relational Knowledge for Integrative Development and Revaluing of Humanities and Arts**

Coordinators: Sylvester Johnson, Ico Bukvic, Catherine Amelink, Thanassis Rikakis, Roger Reynolds

Current participants: TBD

This working group will explore structured trans-sector, transdisciplinary discourse as a relational context for advancing inclusive definitions of knowledge and promoting adaptive and integrative learning. The working group will also explore how transdisciplinarity as a relational context for IPPD can bring forward and revalue humanities and arts as applied learning experiences that develop critical, domain-general and life skills in tandem with inclusive collective intelligence.

## 9. **Towards a Point-of-Need Platform for Inclusive and Sustainable Industry 4.0**

Coordinators: Thanassis Rikakis, Sylvester Johnston, Jena Joo, Randy Swearer, Robert Smith, Mike Kretser, Anne Khademian, Kim Carslon, David Tegarden, Michael Richey, Chip Blankenship, Andrew McCoy, Mukul Kumar, Ronan Mac Domhnaill, Tazio Grivetti, David Tinnapple, Jared Keyel, Amy Arnold

Current participants: TBD

This working group will leverage work in all other working groups to draft a model of a Point-of-Need Learning Platform that can advance an inclusive approach to workforce training and overall sustainable development for Industry 4.0. The group will address:

- A systems approach that advances point of need learning that places technology development within the five Sustainable Development Goals of Industry 4.0
- Dynamic cross-sector workforce analytics that explore domain specific, domain general and life skills involved in competencies for Industry 4.0 and Sustainable Development
- Cross-sector development of modular, just-in-time training content that leverages knowledge mapping of existing integrative skills of all types of learners to emerging Industry 4.0 needs
- An Industry 4.0 credentialing system that is owned by the learner and tracks and details all Industry 4.0 related experiences and knowledge of each learner from various activities in work, education, and community interaction
- Technologies and computational tools for supporting a PNLP for Industry 4.0 with a focus on Industry 4.0 enabling technologies as discussed in Chapter III
- Cross-sector collaborations to reduce cost and increase access
- Applications of Industry 4.0 PNLP to smart construction/construction 4.0