Executive Summary

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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 explored an adaptive and inclusive approach to defining what we mean by learning and knowing. A dynamic definition allowed 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 60 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, COVID-19 has laid bare the social disparities inherent in 21st century socioeconomic structures and highlighted the challenges we face as a society in coordinating the 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 our meaning of 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 accumulat-

ed 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, learners 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 an 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, as well as 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 21st 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 21st 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 augmented/virtual reality 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 (PNLP) 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 multi perspective 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. The 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 socio-technical 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 this report and welcome questions and suggestions as well as inquiries for participation in the working groups. Please contact us at cchei@vt.edu.