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# Next Level Learning Environments for Next Level Work: Applying the Learning Sciences to Technology-Enabled Training

*Applying Learning Sciences Research to Learning and Workforce Development for Next Level Learning Brief Series*

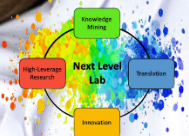
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# Next Level Learning Environments for Next Level Work: Applying the Learning Sciences to Technology-Enabled Training

*“No one is born fully-formed: it is through self-experience  
in the world that we become what we are”  
-Paulo Freire*

## Executive Summary

The vision for workforce training described in this series of briefs is powerful and ambitious: supporting agentive learners to transfer their skills and knowledge across contexts, to gain the dispositions to handle turbulent change throughout their careers, and to equip them with expertise but also the capacity to apply it flexibly in varied contexts. Achieving this vision calls for equally ambitious and innovative approaches to designing learning environments for workforce training and creatively leveraging digital tools to enable hands-on learning in varied contexts.

In this brief, we set forth such a vision. We describe four instructional design principles that enable Next Level Learning for the future of work: contextualization, reflection, agency, and feedback. Applying these principles to the affordances of digital technologies, we illustrate ways workforce learning environments can move beyond a focus on transmitting content knowledge to workers to holistically supporting their development. Specifically, we discuss the ways virtual reality, online learning, and video games can provide rich and varied contexts, interactivity, and adaptive feedback that may be difficult to engineer in traditional classroom or workplace learning environments.

## Framing Questions:

- How can we envision the future of workforce learning environments to meet the needs of the future of work?
- What are the learning design principles that will impart Next Level Learning outcomes that all people need for the future of work, including adaptive expertise, dispositions, and transfer?
- What are the affordances of digital technologies that can enhance workforce development for Next Level Learning?

## Introduction

Imagine being able to train a future healthcare worker in dozens of contexts in which they may find themselves throughout their career, including hospitals, patients' homes, small pediatric offices, and emergency medical treatment settings. They could gain hands-on experience working with patients, applying what they learn in the classroom to working with healthcare equipment in authentic circumstances, balancing making decisions under time pressure, and comforting patients while treating them. What if they could practice those skills over and over again, pausing to reflect and receiving real-time feedback on their performance to help them improve each time, all without ever worrying about hurting a patient? Emerging technologies and sound instructional design can help to achieve this vision, providing new ways of learning that have been difficult to implement in traditional education settings.

Such hands-on training opportunities would support learners in developing the skills, knowledge, and dispositions outlined in the briefs in this series, a vision for workforce development to support *agentic learners to transfer their skills and knowledge across prior and future contexts*, to gain the *dispositions to handle turbulent change throughout their careers*, and to equip them with *expertise but also the capacity to apply it flexibly in varied contexts*. This ambitious agenda provides a fresh perspective and a roadmap for designing innovative training and workforce development programs to achieve this vision.

Digital tools have many affordances to facilitate these types of learning experiences. They can broaden the number of contexts a learner can practice in, provide real-time feedback, and give the learner just-in-time information and opportunities for reflection. But the success of a training experience to achieve Next Level Learning outcomes such as adaptive expertise, transfer, and dispositions for lifelong learning, hinges not on the technology itself but its learning design. In this brief, we discuss four principles for designing learning environments that can be applied to any training experience, but which may be particularly aided by digital tools:

- **Contextualization:** Knowledge and skills cannot be taught devoid of context. Training should situate learning within varied and authentic tasks, environments, cultures, and scenarios to which it applies.
- **Reflection:** Learning requires engaging in significant reflection to connect new knowledge and skills to one's prior knowledge, skills, attitudes, and dispositions, and how to apply them to future work.
- **Agency:** Trainees must be given ample agency and control over their learning to set goals, make their learning relevant to their interests and needs, and actively leverage the context for their learning.
- **Feedback:** Learning activities must prioritize providing deep feedback that promotes learning from mistakes and channeling into future work, developing "feedforward" thinking.

Further, we discuss digital technologies that can enable training environments to incorporate these principles, including immersive technologies like virtual reality, online learning environments, and educational video games. The technological affordances of these tools can bring highly contextualized, interactive, adaptive experiences to workforce learning environments. However, they require revolutionary design for learning that integrates teaching skills and knowledge with experiences that foster dispositions and adaptive capabilities. In this brief, we discuss instructional design principles to create learning environments for Next Level Learning in workforce development, illustrating how digital tools could be used for fostering agency, adaptive expertise, dispositions, and transfer, and highlight remaining questions and areas for future work.

### **A Vision of Next Level Workforce Development: Virtual Healthcare Training for the Real Future of Work**

You enter a hospital room to check on a patient who is recovering from her recent procedure. Approaching the monitor next to her bed displaying a host of vitals, including blood pressure and heart rate, you barely notice as she wakes up and begins to stir. Engrossed in the monitor's controls to find the data you need, a warning message appears in front of your eyes, cueing your attention to a missed step: *How is Ms. Cabrera doing today?* You turn to her and say, "How are you doing, Ms. Cabrera? It looks like you're a bit uncomfortable." After rearranging her pillow, the monitor beeps a warning for you to check her vitals, another helpful cue. As you compare her last blood pressure to this one, Ms. Cabrera starts to tell you about her daughter, who should be visiting this afternoon. While telling her you will send her daughter in as soon as you see her, you make a quick calculation to assess the new reading and adjust the IV dose. As you move to exit the room, another warning appears: *What is Ms. Cabrera's pain level right now?* You turn around and ask her pain score, record it on the chart and assure her it is a good sign that the pain is easing. You leave her to rest up.

The simulation is reset. You're back in the hospital room, but you're not a nurse. Your perspective is now from the bed, through the eyes of Ms. Cabrera. You begin to feel upset; this nurse is ignoring you as she fumbles with the monitor. Is there a problem? You're uncomfortable, scared, and a little lonely. She eventually asks you how you are, fixes your pillow, and you start to feel better. You remove your virtual reality (VR) headset and review the recording of the simulation you just completed. The system pauses at specific moments to ask whether you performed adequately. You record a reflection and say that next time you want to greet Ms. Cabrera immediately, make mental calculations while discussing Ms. Cabrera's pain at the same time, and remind yourself that her treatment includes care as well as medication. You note these goals and remind yourself of all the goals you've set and achieved so far. Feeling confident you can do better this time, you put the headset on and prepare to enter the simulation again.

In your next simulation, you visit an elderly patient at his apartment. When you review the tasks for today, you remember that when your grandmother was injured, she always preferred to bathe after her physical therapy exercises and get the vitals out of the way immediately. Hence, you order Mr. Smith's task list that way. When you help him out of bed, he winces, and a warning of his leg injury appears where you put your hand. You apologize and move to his other side.

Next time you enter the simulation, you are in an emergency room hallway facing two doors. You quickly read the patients' information on the screens by each of their doors: one, a motorcycle crash victim with multiple injuries, the other, a heart attack. Your heart pounds as the system prompts: *Who will you treat first? What is the first step?* You will repeat this scenario many times in different places throughout the hospital, helping you refine your practice in different contexts. Each time your stress level decreases, and your confidence increases.

You are training for a healthcare career, and this program helps you learn not only the skills you will need in one specific setting but uses virtual simulations to expose you to many contexts and prepare you with the hands-on experiences that help you learn more than just skills and knowledge but also ways of thinking and working you will need in any healthcare job.

At your next class, your cohort maps the similarities and differences in the care provided to Ms. Cabrera, Mr. Smith, and in the emergency room, identifying common skills for success. In the group, you discuss your experiences helping your injured grandmother and how that made the scenario with Mr. Smith an easier task for you. Together, you reflect on the choices you made and their consequences, whether your own biases or assumptions influenced your care, and identify ways to correct mistakes you made across the scenarios.

Ultimately, you find yourself entering the office of a large hospital's hiring manager. To your right, you look in the mirror, and to your surprise, you stand three inches taller than your real-life self. Suddenly, you feel more confident. You stand up straight and lean in to shake your interviewer's hand. You answer all of her questions as directly as you can, but it trips you up when she asks about your vision for five years from now. You want to improve this. After the simulation, you watch and discuss with your coach how you can better answer that question to tailor your message about yourself as an innovative worker who looks forward to advances in technology that will help you improve the care you provide. You prepare to undergo another virtual interview, this time with a small pediatric office, and you feel ready to tackle this next challenge.

This vision for virtual training environments that provide such rich learning opportunities may sound like science fiction, generations away from the tools we have today. Yet much of what we describe as a vision for the future of workforce training is possible with today's technologies. Indeed, Accenture Extended Reality (XR) and companies like Strivr<sup>1</sup> (see Callout Box: Pioneering Virtual Reality for Workplace Learning), which develops simulations to train workers in industries from retail to professional athletes, are already utilizing such immersive technologies for innovative workforce training.<sup>2</sup>

What is revolutionary about this vision is how the virtual training experiences are designed and used to provide highly contextualized hands-on experiences that offer learners agency, feedback, and opportunity for reflection, taking different perspectives, and practicing adapting knowledge to new scenarios. The Next Level Lab series of briefs has outlined a powerful and ambitious new vision for workforce training and development that calls for innovative approaches to learning environment design. The healthcare training simulations described above leverage virtual environments and are just one example of how we can design training to meet such Next Level Learning outcomes, namely, agency, adaptive expertise, dispositions for lifelong learning, and transfer across contexts.

Collectively, the briefs set forth a vision for workforce development that fundamentally alters the position of learners and the definition of instruction, in that the learner is agentive and self-regulating, and the environment is malleable and responsive to learner effort and performance, described in Grotzer and Forshaw's *How Next Level Learning Enables A More Powerful Vision for Transfer*.<sup>3</sup> The vision is for dispositional learners to possess abilities and the sensitivity to opportunity and agency to employ those skills, as Dede and Etemadi discuss in *Why Dispositions Matter for the Workforce in Turbulent, Uncertain Times*.<sup>4</sup> It calls for developing deeply situated subject knowledge while focusing on adaptive expertise, which Grotzer, Forshaw, and Gonzalez explain in *Developing Adaptive Expertise for Navigating New Terrain: An Essential Element of Success in Learning and the Workplace* is a flexible capacity related to the ability to learn and transfer knowledge within and between contexts.<sup>5</sup> The briefs emphasize the importance of situated learning and agency that invites learners to bring their physical, social, emotional, and cognitive assets to bear on their contexts, as discussed in Grotzer, Gonzalez, and Forshaw's *How Fast Fish Sink or Swim: Adopting an Agentive View of Learners*.<sup>6</sup> On balance, the briefs argue for the necessary transfer supports to leverage learning forward and backward between contexts such that learners develop the flexible capacities associated with adaptive expertise.<sup>7</sup> By focusing on learning in workforce development, they make a unique contribution to the increasingly urgent call for solutions to rapid change in the labor market. Next Level Learning charts a fresh perspective to ensuring all workers thrive in the future of work by being more explicit about the breadth of skills, knowledge, and dispositions workers want and need and how to achieve them.

This brief extends the discussion of how to achieve Next Level Learning in workforce development initiatives by describing how to design learning environments informed by learning sciences. The principles can be applied to workforce development programs but also have much broader applications to support workers of the future in many contexts. While the aims described in the other briefs are ambitious and certainly call for significantly different instructional practices, they also provide a roadmap of research-backed solutions and ways digital technologies can provide new tools to enable Next Level Learning.

First, we briefly review key concepts related to learning environments and instructional design and then discuss key principles for designing next level learning environments. Next, we highlight the ways technologies can be designed and used in learning environments to embed these learning design principles in ways that can foster Next Level Learning, namely the ways immersive technology can promote contextualization, new tools that can encourage learners to engage in reflection, and the ways educational video games provide learners with ample agency and feedback. Finally, we conclude with further questions and areas ripe for future research.


This represents a first step in identifying the practical applications of instructional design and affordances of technologies to workforce development learning environments. However, it is not a comprehensive or systematic review of the evidence of these principles in the context of training programs but an inspiration for charting a new path in workforce development.

## Key Concepts for Learning Design

This brief focuses on designing learning environments grounded in how people learn to enable all people to thrive in the future of work. We use the term *learning environment* rather than a training or workforce development program because it better encompasses the anytime and anywhere nature of learning. *A learning environment is a broad term for a context in which learning occurs* and can encompass formal and informal venues for training, including classroom-based courses and on-the-job opportunities where employees learn more implicitly. For this brief, we will discuss learning environments engineered to help people achieve dispositions, skills, and knowledge that occur in a wide variety of contexts and structures.

Many assume technology-enabled training refers to online learning environments or those that are conducted entirely remotely. However, most learning environments, including those conducted face-to-face, incorporate digital tools in some way. Here, we refer to *any training experience that leverages a digital tool as a technology-enabled learning environment*, for example, an in-person course that uses PowerPoint slides, an online module, or a hands-on training session that uses a virtual reality experience. We focus on digital technologies because (a) they present learning opportunities difficult to engineer in traditional workplace or classroom settings, and (b) evidence suggests they are often underutilized or misapplied resources in training and workforce development. In this brief, we focus on the affordances of different technologies, their potential uses, and capabilities. However, technology alone is no silver bullet. The affordances of these tools must align with their use in a sound instructional model.

Not every learning environment must use technology to support agency, adaptive expertise, development of dispositions, and transfer. Indeed, for decades, workforce development programs have been designed to support a breadth of skills, knowledge, and dispositions with low or



no-technology approaches. What we discuss here represents one way of innovating in learning environment design by using digital tools, but it certainly is not the only way.

Designing an effective learning environment requires articulating the goals of a learning experience and considering activities the learner will engage in to help them achieve those goals. *Instructional design principles provide a useful framework for identifying the learning objectives and then creating the conditions and experiences that will best support trainees in achieving those objectives, connecting the external experiences and activities to the individual's internal learning process.*<sup>8</sup> This approach considers the broad range of activities entailed in designing a learning experience beyond what is typically thought of as instruction or teaching. This is indeed important for workforce development and training; many studies have shown a learning environment's instructional design is more important than its surface features (e.g., delivered in person or online).<sup>9</sup>

One common challenge in designing for learning is to balance multiple goals and objectives. In workforce development, program goals are often articulated as instrumental outcomes, such as obtaining employment or higher wages, and less often articulated as specific learning outcomes.<sup>10</sup> Further, when learning outcomes are determined and measured, they may be limited to the direct knowledge or skill the training addresses, such as retention of content captured in a multiple-choice assessment. To thrive in the future of work, it will be necessary to consider Next Level Learning goals. In this brief, we aim to emphasize how *learning environments can be designed to achieve multiple learning goals in tandem so that training can support learning specific skills and content knowledge while also fostering important dispositions, developing adaptive expertise, and honing the ability to transfer that learning across contexts.*

## **Learning Design for the Future of Work**

Consider the healthcare training program described at the start of this brief. Using VR simulations of many environments allowed the trainee to learn skills as a health aide or nurse across several contexts, giving them agency within the training to practice repeatedly, receive feedback, and prompt reflection at key moments to solidify their learning. These training features align better with how people learn both skills and knowledge as well as dispositions and adaptability. Compare this learning environment with a typical online course, in which a trainee will watch lectures, read articles, and answer multiple choice assessments. Such typical learning environments decontextualize the skills and knowledge to be learned, presenting it in an abstract format. They also do not promote the learner's agency, instead placing them in a passive role to internalize and reproduce what has been presented. And they typically do not encourage deep reflection or provide the rich feedback that a hands-on experience can engender.

Here we describe these four principles in more detail: contextualization, agency, reflection, and feedback. These principles are by no means exhaustive but serve to illustrate some of the elements of effective instructional design for Next Level Learning.



**Contextualization: Knowledge and skills cannot be taught devoid of context. Training should situate learning within varied and authentic tasks, environments, cultures, and scenarios to which it applies.**

Across education and training of all kinds, a narrow focus on teaching skills and content misses an opportunity to foster Next Level Learning because they are taught in a decontextualized way, often relying on activities that drill knowledge and skills without meaningful integration.<sup>11</sup> *Decontextualized* instruction assumes "a separation between knowing and doing, treating knowledge as an integral, self-sufficient substance, theoretically independent of the situations it is learned and used."<sup>12</sup> *Contextualized* learning environments, conversely, recognize that knowing and doing are inextricable and that how one learns something determines what they learn and how they can use it in the future. This goes beyond considering context as a setting or physical location to further encompass thinking, practices, cultures, and social environments.<sup>13</sup> In the healthcare training simulations, learning skills such as reading patients' vital signs are contextualized in various environments and in tandem with other tasks such as caring for a patient's comfort and making treatment decisions under time pressure. A traditional training program may instead present the procedure for taking and assessing vitals in a decontextualized format such as a lecture or classroom demonstration, without encouraging transfer or reflection on how it applies to their own lives and work.

Grotzer and colleagues describe how context is key when designing for transfer<sup>14</sup> and adaptive expertise.<sup>15</sup> Learning is contextually tied; it cannot be assumed that what is learned in a classroom will be applied as intended in the workplace. Additionally, the learning environment must be designed in a way that recognizes its cultural context and invites diverse learners to bring their knowledge, skills, and cultures to bear on their learning. Training activities must be situated in a way that supports developing expertise without knowledge and skills being too rigidly tied to one domain to promote learners' adaptability.

**Reflection: Learning requires engaging in significant reflection to connect new knowledge and skills to one's prior knowledge, skills, attitudes, and dispositions, and how to apply them to future work.**

To achieve Next Level Learning objectives, learning experiences need to embed activities that help people connect their new and prior thinking, attitudes, and behaviors, engaging trainees in reflection to make meaning of their experiences. In the healthcare training VR simulations, reflective activities were embedded at specific moments to facilitate this process, allowing learners the opportunity to connect their prior experience to future goals within the training. Doing so can support learners' processes of identifying the deep structures of what they are learning, rather than focusing on surface features. When engaging in varied tasks across contexts, reflection is key to support trainees in making analogical comparisons that uncover the complexity of how they apply their skills and knowledge. Additionally, effective reflective activities encourage trainees to consider how what they are learning relates to themselves as learners or workers, prompting new ways of thinking about their work and identity in relation to new skills and contexts. Hands-on experiences can be especially powerful for such contextualized learning but are maximized when trainees plan their learning aims before the experience and are given time for ample reflection following it.<sup>16</sup> These reflective activities must be embedded within the core training activities and be structured to ensure trainees engage in the intended meaning-making process.

**Agency: Trainees must be given ample agency and control over their own learning to set goals, make their learning relevant to their interests and needs, and actively leverage contexts for their learning.**

As Grotzer and Forshaw describe, too often, trainees are seen as passive recipients of information rather than active participants who leverage the resources available to them to construct their expertise and chart their path.<sup>17</sup> In the healthcare training VR simulations, the learner plays an active role both within the VR scenarios, as they interact with the responsive virtual environment, and outside of it, as they set their own goals for future practice, connect their performance to their prior work, and chart their path in the training program.

Learning environments can draw on trainees' intrinsic motivation to learn if they encourage their sense of autonomy and control and make learning relevant to their lives and interests. The internal drive people have to learn new things versus the external rewards they receive for accomplishments can be described as intrinsic versus extrinsic motivation.<sup>18</sup> Extrinsic motivators include money, grades, or points, which are rewards people receive for completing a task or job. In contrast, intrinsic motivators include having a sense of autonomy or control, feelings of competence, and seeing work or learning within a meaningful context.

Developing trainees into active and independent workers who can take ownership over their work requires the kind of agentive contexts called for by Grotzer, Gonzalez, and Forshaw that invites adaptation and creativity rather than aim to standardize performance. Trainees should be given ample choice and be supported in path-building, in which they set and monitor progress toward their own learning goals. Agency and relevance support learners in becoming self-regulating and proactive and creating a learning environment that motivates them to persist and be successful. Instructional designers can face tensions when creating agentive learning contexts, as they must balance each learner's interests, needs, and goals with the goals and constraints of the training program.

**Feedback: Training activities must prioritize giving deep feedback that promotes learning from mistakes and channeling into future work, developing “feedforward” thinking.**

Becoming an adaptive expert who leverages skills and knowledge across varied contexts takes effort and repeated practice, with ample opportunity to fail and learn from mistakes. In the healthcare training VR simulations, learners are provided many such opportunities, receiving feedback in real-time from the system, following the completion of a simulation, and from a trainer or coach who can observe their performance over time in the simulations. Learning environments must provide trainees such targeted and continuous feedback that they can use to work through mistakes, iterate, and apply to their future work to develop their “feedforward thinking.”<sup>19</sup> This learning design also facilitates the development of cognitive flexibility and metacognitive self-regulation because it requires productive struggle, in which learners engage in an effortful process to find solutions when they are not immediately known. A learning experience of any kind, fully online, in a classroom or workplace, can incorporate these instructional designs but require giving trainees active experiences over time to apply their learning, make mistakes, and leverage learnings in the next application.

## Applying Educational Technologies With Sound Learning Design

Different digital tools provide different affordances (see Callout Boxes: Technology for Learning), which may be more or less suited to achieving certain learning goals. Here we describe the ways immersive technologies, online learning, and video games may facilitate the contextualization, reflection, agency, and feedback necessary for learning environments to support Next Level Learning. The applications described here do not represent a comprehensive view of the affordances of these technologies, nor all of the various ways learning design can foster Next Level Learning, but rather serve as examples of some of the ways technologies can be designed and implemented to ensure all learners thrive in the future of work.

### Technology for Learning: Virtual Reality and Immersive Technology

Virtual reality (VR) refers to a technology that surrounds the user in a digital image, typically by wearing a head-mounted display that replaces external aspects of the physical environment (visual and auditory) and provides a 360° virtual field of view. The chief affordance of VR is that the *immersion*, or feeling of being surrounded in a realistic digital space, provides “the strong illusion of being in a place despite the sure knowledge that you are not there,” termed *presence*.<sup>20</sup> For example, while using a VR experience that simulates walking a plank high above a canyon, despite knowing they are standing securely on the floor, users physically demonstrate signs of fear, or looking in a virtual mirror and seeing a different body, they adapt their behaviors to correlate to the virtual appearance.<sup>21</sup>

VR experiences create the feeling of presence through a sensorimotor illusion facilitated by the technology. Images update as the user moves and responds, complemented by symbolic features, including narrative and sound.<sup>22</sup> VR not only simulates real experiences but also those that are not possible in real life. For example, a pilot can learn to land in a realistic environment without risking lives or damaging airplanes; a history teacher can transport their students to ancient Rome to experience the sights and sounds of the Colosseum when it was a gladiatorial battleground.



VR is not the only technology that can create an immersive experience. Simulations and video games on computers can also create digital environments that make the user feel immersed in a two-dimensional virtual world. Augmented reality (AR) layers a digital image on top of the user’s physical environment and can also immerse them in an environment that mixes the real and virtual. And mixed reality (MR) applications combine elements of virtual and physical worlds.

## Immersive Technologies for Rich and Varied Contexts

The need to contextualize learning by situating it in authentic tasks, environments, and communities is a challenge for traditional classroom-based training and education, which, unlike apprenticeships or internships, often occur outside of the contexts in which learning will ultimately be applied. Immersive technologies like VR, AR, and MR provide possible solutions by implementing highly contextualized training experiences in classroom contexts. (See Callout Box: Affordances and Applications: Virtual Reality and Immersive Technology). For example, VR provides low-stakes opportunities to practice skills, allows for scenarios specifically designed to elicit a response, and can collect data on users' behavior that provide feedback for their development. Beyond learning knowledge or skills, VR has been shown to help people explore their own identities and is also an effective tool for changing attitudes on everything from meat consumption to implicit racial and gender bias.<sup>23</sup>

While situating workforce development in authentic contexts often relies on apprenticeships, bringing “hands-on” immersive experiences into training provides an advantage. For one, the context can be engineered in a way that physical contexts cannot. This helps trainees connect their prior experiences, skills, and cultures, aiding them in seeing phenomena difficult to perceive in physical environments, and allowing practice opportunities well suited to the learning goals. For example, the First Impressions VR experience trains business students at NC State University in intercultural competencies by simulating a meeting with participants from different cultures, allowing the student to be “in the head” of various members of the meeting in repeated scenarios, hearing their thoughts and reactions to events.<sup>24</sup> VR can also be engineered to help those with deeply held expertise and ingrained ways of thinking or working to “unlearn” some of their habits by tweaking virtual contexts, building their cognitive flexibility.<sup>25</sup>



## Pioneering Virtual Reality for Workplace Learning

One pioneer of using VR in learning for work is Strivr, a company founded by former Stanford football coach Derek Belch with the head of Stanford's Virtual Human Interaction Lab, Jeremy Bailenson, who initially partnered to help athletes train in VR simulations. The company now develops and deploys VR to support a wide variety of learning applications, from helping Walmart employees learn about new equipment, simulate customer service scenarios for Verizon, and support new managers as they practice having difficult conversations and giving feedback to their team.<sup>25</sup> These applications take advantage of the affordances of VR to simulate realistic environments, give learners opportunities to practice in low-stakes environments, and their clients report trainings are more efficient when incorporating VR. Another pioneering application is AVenueS, an Accenture Extended Reality program that supports new and seasoned Department of Child and Family Services caseworkers learn how to manage complex challenges of evaluating cases during home visits and prompting their reflection on their own practices and biases. The immersive scenarios are filmed as immersive 360-degree videos in which learners can interact to make decisions within the situation.<sup>26</sup>



Additionally, apprenticeship programs may be challenging and costly to provide to trainees at scale. An apprenticeship at one employer may not provide the varied contexts learners need to transfer their learning across many settings and tasks. Immersive technologies can provide many and varied experiences, and once developed, can be deployed infinitely to those with the hardware. For example, several state Departments of Children and Family Services (DCFS) are beginning to offer trainees VR experiences to better understand the experience of conducting a home visit, a sometimes chaotic and emotional situation (see Callout Box: Pioneering Virtual Reality for Workplace Learning).<sup>28</sup> The training could include varying environments in which a trainee must respond, addressing different types of family situations they may encounter. Or consider training for customer service roles using immersive simulations, such as managing frustrated customers, facing a store robbery, or learning inclusive practices for diverse workplaces (see Callout Box: Pioneering Virtual Reality for Workplace Learning).<sup>29</sup> This type of training may be akin to a medical student's clinical rotations, allowing every trainee the opportunity to work in varied contexts before taking on a new role.

Unfortunately, many immersive experiences used for training only focus on a limited application that does not take advantage of their affordances for fostering such learning and leveraging the rich context it provides. A recent review of training applications of VR finds results reported in terms of changes in trainees' knowledge or skills,<sup>30</sup> but not more complex dispositions, adaptive capacities, or opportunities to transfer across contexts. The research base on which features of these immersive contexts are most important to achieve Next Level Learning remains thin and needs further work.<sup>31</sup>

## Technology for Learning: Online Learning

Online learning has become ubiquitous in education and training. Even before the CoVID-19 Pandemic moved nearly all aspects of life online, we witnessed a proliferation of digital platforms aimed to meet the needs of trainees and training providers. Online learning has many affordances. Most often, it is used



to increase accessibility, reaching a mass scale of potential learners. Online courses also offer flexibility in that they can be accessed at will, and many offer a self-paced option in which learners can choose how slowly or quickly to move through the material. They can provide adaptability, utilizing software that responds to an individual's

performance to suggest the next activity or lesson they should complete and embedding opportunities to practice skills or apply their knowledge immediately. They can use tools of creation and can provide high levels of flexibility and customizability. The internet also allows students to interact and communicate across vast distances.

A common challenge with online learning programs is they suffer from a contradiction between these affordances and how instruction is designed. *While the technology offers the learner greater agency and interaction, courses and programs often focus on providing content and treat the learner as a passive recipient.*<sup>32</sup> (See Callout Box: The Wide Spectrum of Online Learning.)

## Meaningful Reflection at Scale

Digital tools can build opportunities for learners to reflect on their learning, notice features of a task or environment that relate to other contexts, map the deeper structures of what they are learning to different problems or work environments, and even apply those to a new context immediately. In a virtual environment, this analogical comparison can be seamlessly integrated into the experience “just in time” by prompting trainees to consider instances when their skills or knowledge has been or could be applicable in different contexts, capitalizing on the best moments to reflect on the mental models they are using as they engage in varied tasks.

For example, in the First Impressions intercultural business VR training referenced above, the user can be prompted to identify the differences in each participant's thoughts and how that relates to what they would say or do in other scenarios with such a diverse group. Accenture's training for DCFS case managers can prompt learners to pause and reflect on the features of their environment that are influencing how they approach the problems they need to solve, compare that to how they reacted in other settings, and adjust their practice to ensure they are applying their

knowledge as best they can. This process facilitates the transfer of Next Level Learning by *cueing* participants to notice how their learning could be applied to different tasks or settings, *mapping* and ultimately *applying* the deeper structures of learning across those contexts.

## The Wide Spectrum of Online Learning



Not all online learning opportunities are the same. Many online courses and programs have focused on simply digitizing content, creating resources and modules for learners to view that content. LinkedIn Learning (formerly Lynda) exemplifies these resources as a repository of video lessons consisting of narrated PowerPoint presentations and quizzes. Many Massive Open Online Courses (MOOCs), hosted by universities on platforms

like EdX and Coursera, do the same, providing little more than a reading list and lectures recorded from the back of the classroom. This learning design prioritizes content retention as the primary goal. Still, it does not consider how to support the learner more holistically, nor does it consider the Next Level Learning goals trainees need to succeed in the future of work. The “massive” quality of MOOCs can also alienate many learners,<sup>33</sup> resulting in wide gaps in success between more- and less- advantaged users.<sup>34</sup>

Some online learning environments, particularly in computer science and programming, leverage its affordances to be adaptive, embed practice, and increase social connections. Computer science MOOCs from MIT, for example, offer opportunities to apply the concepts immediately during lessons, embedding a coding environment into the course videos so that participants must complete an exercise correctly, getting feedback on their mistakes before moving on. The Flatiron School online coding bootcamp prioritizes social connections, pairing students with a cohort for study groups and a mentor, connecting learners across distance.<sup>35</sup>

Less immersive technologies can also aid in reflection, particularly when it is difficult to scale deep discussions between instructors and trainees. Any digital course materials can embed reflective exercises that require learners to stop and consider what they are learning and how they will apply it. Doing so can even make online learning environments more inclusive and aid learners in persisting.<sup>36</sup> Increasing peer engagement via digital tools may facilitate more meaningful reflection, or trainings can leverage AI-based tools. University courses have piloted automated

teaching assistants,<sup>37</sup> which could be used to encourage students to engage in a reflective chat and help evaluate the depth of their reflection with new textual analysis tools. Other applications leverage the power of narratives and virtual roleplaying to prompt user reflection on competencies and dispositions.<sup>38</sup> In all of these digital tools, trainees can be prompted to reflect at key moments to maximize their learning, which can be difficult to achieve in classroom or workplace settings.

## Technology for Learning: Video Games

While video games are primarily seen as media for entertainment, they also represent powerful learning environments that can be leveraged for education and training. James Paul Gee has researched and written extensively on the affordances of video games for learning and the features that make them exemplar learning environments, even those that are designed solely for entertainment.<sup>39</sup> Many games are complex and require players to learn specialized skills and knowledge to be successful, but learning and playing are one and the same. Video games do not provide extensive instructions to novice players but instead drive players to learn within the game, tackling



progressively difficult challenges with unlimited opportunities to learn from failure. Novices instead start in what is called a “sandbox,” a pared-down version of the real game environment, through which they receive information and guidance “just-in-time” to help them learn the basics. There is no “remedial” instruction, and each player works through their

learning trajectory, with agency over progress and goals (see Gee (2004), p.74-75 for a full list of principles of games that align with learning sciences).<sup>40</sup>

## Moving From Novice to Expert With Games

Many digital technologies have affordances for designing agentic learning environments that provide ample feedback, but no technology may better encompass the principles of teaching adaptive expertise than video games. As Gee writes, a key principle of video games is that “‘experienced’ doesn’t need to mean ‘expert’; it can mean that one is well prepared for future learning.”<sup>41</sup> The affordances of video games that integrate learning into gameplay that continuously requires players to improve their skills in increasing challenges represent an environment well suited to supporting learners in developing adaptive expertise (see Callout Box: Technology for Learning: Video Games).



There is widespread interest in using games in the context of training and workforce development,<sup>42</sup> which can provide an opportunity to design training experiences that teach skills and knowledge for specific roles and industries while also fostering adaptive expertise across a wide variety of domains. For example, roleplaying games like Elderquest and America's Army (see Callout Box: Technology for Learning: Video Games) allow learners to learn skills and knowledge specific to their future roles, while also practicing applying them at their own pace. Video games like these can address some of the puzzles of learning design that balance providing individual learners agency while also addressing the goals of the training, and how to provide ample feedback to learners at scale. Within a video game, learners exercise choice and can work autonomously while still achieving the learning goals intended by the designer. Further, the mechanics of games rely on feedback, so well-designed games support learners in channeling their successes and mistakes as they work through levels. In many training environments, it may be challenging to show learners multiple paths and skill levels that characterize novice through expert performance. Still, video games can be designed to highlight the complexity of expertise and varying skill levels on the way. From this, patterns in trainees' behavior and performance in games can be used as "stealth assessments," measuring their skills, knowledge, and dispositions without the need for standalone tests.<sup>43</sup>



## Videos Games for Medical and Military Training

There has been wide interest in using video games to teach skills and dispositions for work that support learners in applying their learning to authentic problems. For example, Elderquest is a 3D video game set in a medieval fantasy world and used by medical students to apply principles of geriatric care including managing patients' medication, making diagnoses from cognitive and behavioral data under time pressure, and working in a team-based model.<sup>44</sup> Students play the game in a first-person perspective as a medical student, and must complete challenges that involve applying the Association of American Medical Colleges competencies in geriatric care, such as diagnosing an elderly apothecary who has become delirious, potentially developing both their content knowledge of the standards and understanding how to apply it.<sup>45</sup> Similarly, the United States military uses the video game America's Army to train recruits in military tactics, simulating single- and multi-player missions in which the player takes on the role of a special operations soldier and completes missions that mirror real-life Army scenarios, allowing recruits to learn about tactics and apply them by designing their own missions.<sup>46</sup>

This represents a departure from how “gamification” is currently applied in training contexts, however, which tends to focus on incorporating extrinsic motivators into training activities. For example, Larson describes gamification in corporate training such as Deloitte's online executive training program that awarded points and rewards to participants for completing more training activities, and a call center program that gave employees points and badges for shortening their calls and ranked them on a leaderboard.<sup>47</sup> These types of extrinsic rewards are simply like dangling a carrot on a stick in front of trainees. They do not leverage the affordances of games to create rich learning environments that foster adaptive expertise. Games should be used in education to help learners develop their goal-setting abilities and mastery orientation through increasing their agency, providing opportunities for them to struggle through challenges, and leverage the constant feedback they receive to build cognitive flexibility.

### **Summary: Principles of Technology-enabled Learning Environments for the Future of Work**

The Next Level Lab series of briefs set out an ambitious and innovative agenda for workforce development to meet the needs of the future of work, one that requires fundamental shifts in the goals and processes of workforce development. We suggest an equally ambitious vision of what such learning could look like with emerging technologies, such as highly contextual and varied VR-enabled experiences. Underpinning this vision are several principles for designing learning environments that can be applied to any learning experience, but which may be particularly aided by digital tools:

- Contextualization: Knowledge and skills cannot be taught devoid of context. Training should situate learning within varied and authentic tasks, environments, cultures, and scenarios to which it applies.
- Reflection: Learning requires engaging in significant reflection to connect new knowledge and skills to one's prior knowledge, skills, attitudes, and dispositions, and how to apply them to future work.
- Agency: Trainees must be given ample agency and control over their learning to set goals, make their learning relevant to their interests and needs, and actively leverage the context for their learning.
- Feedback: Training activities must prioritize providing deep feedback that promotes learning from mistakes and channeling into future work, developing “feedforward” thinking.

We have also emphasized the ways digital technologies can enable training environments that incorporate these principles, whether in-person, digital, or a combination.

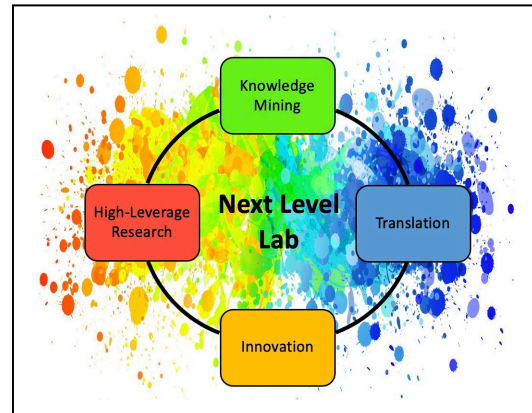
- Immersive technologies and simulations: Opportunities to design rich and varied contexts that are typically difficult to bring into the classrooms and which provide authentic tasks and opportunities for repeated practice and reflection.
- Online learning environments: Adaptive, flexible, and interactive learning opportunities to provide learners information and prompt reflection just-in-time, all while connecting people from distant locations.
- Educational video games: Draw on learners' intrinsic motivation by providing them agency to chart their own path and accomplish increasingly challenging tasks through continuous feedback.

## Remaining Questions and Future Work

While this brief represents a summary of key principles of instructional design grounded in the science of learning, more evidence is needed on how and in what ways they can be applied to workforce training contexts. In particular, the increasing interest in using VR for training presents an opportunity to foster Next Level Learning. Yet, today's technology applications rarely use their full affordances for contextualized learning that supports agency, adaptive expertise, dispositions, and transfer. While the vision of VR training offered at the start of this brief may sound like science fiction to some, the technology is nearly here, but what remains to be seen is how it can be effectively employed. We call for further research on VR's potential to improve Next Level Learning, especially focusing on how features of different applications foster different learning outcomes, accounting for differences in learners' prior experience and skills. This will contribute to the evidence on VR and help support appropriate and effective uses of the technology, rather than seeing VR used in a limited way that merely replicates training models and teaches narrow skills or content.

## About the Next Level Lab:

This work was developed through the Next Level Lab: Applying Cognitive Science for Access, Innovation, and Mastery (AIM) at the Harvard Graduate School of Education (HGSE) with funding from Accenture Corporate Giving (ACC). Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the funder. The Next Level Lab is pursuing this work as we articulate the findings from research in cognitive science, neuroscience, and learning sciences that inform approaches to education and workforce development. Our work sits at the intersection of mining extant research of promise; conducting research questions with the potential for high-leverage impact; translating research on learning and the mind for public use; and innovating in the space of technology and learning to develop new visions for what is possible in developing human potential.



We are a small research lab. We view our mission as one of providing purpose and guidance to the field. Buckminster Fuller talked about the power of small influences in his description of a trimtab in this quote.

*“Something hit me very hard once, thinking about what one little [person] could do. Think of the Queen Elizabeth again: The whole ship goes by and then comes the rudder. And there’s a tiny thing on the edge of the rudder called a trim tab. It’s a miniature rudder. Just moving that little trim tab builds a low pressure that pulls the rudder around. It takes almost no effort at all. So I said that the individual can be a trim tab. Society thinks it’s going right by you, that it’s left you altogether. But if you’re doing dynamic things mentally, the fact is that you can just put your foot out like that and the whole ship of state is going to turn around....”* -Buckminster Fuller.

It is our hope that our small lab can function as a trimtab to create better outcomes for humankind.

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