

A New Age of Career Readiness

XR technology is preparing U.S. workers for today's quality jobs and those of the future.

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Today, XR technology is accelerating readiness for quality jobs, and it offers continued promise for the future.

[Jobs for the Future \(JFF\)](#) sees extended reality (XR) technology as a driver of equitable economic advancement for all. Training workers—especially frontline workers—on the job is one of the most promising uses for XR technology and contributes to [quality jobs](#). Here, we explore promising uses for XR in training workers across four industry sectors: health care, skilled trades, manufacturing, and diversity, equity, inclusion, and accessibility.

Key Findings

- **XR adoption is growing;** [23M jobs](#) worldwide will use XR technology by 2030.
- **Immersive learning improves learning retention.** [Retention rates skyrocket to 75%](#) when learning through immersive simulations, as compared to lecture-style learning (5%) and reading (10%).
- **XR training can lower costs.** Investing in training and reskilling [costs less](#) than hiring new workers.
- **Training in XR is growing,** especially in some of the occupations that face challenges in hiring and training.
- **XR makes training accessible,** especially for learners and workers who face barriers to accessing high-quality training.

Our Framing

We looked for use cases along the workforce development continuum. In particular, we emphasized worker training use cases because those are the most promising and readily available.

We focused largely on frontline workers and the jobs that those who have experienced [systemic barriers to advancement in the labor market](#) are more likely to hold.

We captured emerging, promising evidence. But research and studies on XR and [immersive learning](#) are still emerging. We offer some caveats to keep in mind:

- **Limited industry case studies, generally:** Few industry case studies focus on the skills developed from VR training and how these skills contribute to a business's bottom line. Most industry case studies are generalized, focusing on the use of VR (e.g., "VR can train faster and is cheaper") but not on skills, let alone connecting the dots to the return on investment (ROI) for businesses.
- **More attention to scale needed:** The majority of industry case studies are for custom training solutions that might not apply to most businesses because such solutions are designed for a specific business and its context.
- **Business settings not yet well tested:** Many studies and use cases are from academic researchers, whose studies tend to have very specific parameters and test students in a classroom setting.

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Use Cases In

Health Care

01

Health care professionals need continual upskilling, especially for complex tasks requiring a high level of risk.

Major challenges for training include the following:

- Complex environments and equipment make training both expensive and logistically difficult to offer and scale.
- On-the-job training is challenging when work conditions are specific to a particular job.
- Successful care requires both interpersonal and technical skills.
- Access to training can be limited, especially for high-risk skills that require access to specialized, expensive equipment.

Training in XR can offer solutions to those challenges.

- **Accessibility and adaptability:** XR can be tailored to a wide array of conditions and can be delivered remotely and at any time, at low cost, with less demand on administrative personnel.
- **Uniquely well suited to human interaction:** Simulations, especially those with human avatars, effectively prepare health care professionals to interact with patients, families, and other staff members.
- **Repetition of potentially dangerous tasks in a controlled environment:** XR allows for practice of such tasks in a safe environment, at scale, and at reduced cost.
- **Designed with neuroscience at the forefront:** XR technology lends itself well to exploratory medical research and is increasingly a promising modality for rehabilitation services.

Frontline jobs with promise for XR training:

- Registered nurse (RN)
- Emergency medical technician (EMT)
- Certified nursing assistant (CNA)

Promising Use Cases in Health Care

1. Patient Care

- **Building essential skills:** XR is useful for intake, assessment, and intervention, including gathering labs and administering medication; it also allows more [accurate identification of veins](#) under the skin for IV or needle insertion.
- **Developing empathy:** XR builds firsthand understanding of the perspectives of patients with conditions such as [Alzheimer's disease](#).
- **Improving mental health care:** VR is increasingly helpful for [treating military veterans](#) experiencing PTSD.
- **Stroke rehabilitation:** Virtual rehabilitation is a [promising new modality](#) for improving motor rehabilitation after a stroke; VR systems spark cortical activation, which can enhance neuroplasticity and recovery.
- **Better pain management:** XR is also promising for reducing chronic pain, a burgeoning area of study with some [early success](#).

2. Medical Education & Training

- **Responding to COVID-19 demands:** XR offers training in the proper [donning of PPE](#), as well as in how to assess a patient's symptoms or perform CPR while wearing protective gear.
- **Surgical training and support:** XR can improve overall [surgical performance](#), facilitate [more accurate and objective assessments](#) for those in residency programs, and allow for more frequent training and practicing of skills than is possible in typical training workshops, which tend to run just one or two days.

230%

boost in performance in the procedure to repair a fractured tibia, according to a study by UCLA's David Geffen School of Medicine

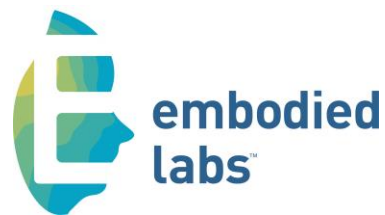
45%

decrease in errors by EMTs in Texas, and a 29% decrease of time on task

83%

less expensive than traditional manikin simulation training for advanced cardiac life support skills in New York

Durable & Technical Skills: Improved Patient Outcomes in Health Care



Embodied Labs

- Immersive training solution that enables caregivers to embody the perspectives and conditions of other people, providing an in-depth perspective on aging
- Trained over 10,000 people in industries including senior services, academic programs, local government, corporate partners, and home-based care



Lifelique

- The first VR training for dialysis technicians; prepares workers for industry-recognized credentials
- Additional training simulations coming for CNAs, HVAC technicians, coders, and advanced manufacturing technicians, as well as “field trip” videos for career exploration as part of [Project SANDI in Nevada](#)

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Use Cases In

Skilled Trades

02

Job openings for skilled trades are on the rise, and companies are struggling to hire talent with the needed skills.

Major challenges for training include the following:

- Companies struggle to secure people to train, often due to misconceptions about the work and the potential for advancement.
- Safety training must be comprehensive and ongoing.
- Technology is growing more sophisticated and changing rapidly, and businesses and workers must keep pace.
- Preparing a multiskilled workforce requires training in many processes, skills, and tools.
- High turnover rates make training more expensive because companies must train more often and wait longer before seeing productivity gains from the new employees.
- Other difficulties are the lack of access to training, its high cost, and the limited time usually allotted or available for completion.

Training in XR can offer solutions to those challenges.

- **Reduced risk for workers:** XR allows workers to practice skills and scenarios in a safe, controlled environment, which is particularly advantageous in dangerous trades such as welding or electrical work, where mistakes can lead to serious injury or damage.
- **More efficient problem solving and repairs:** VR simulations can teach skilled trades workers how to use different types of equipment, while mixed reality (MR), which combines real-world and digital elements, can overlay digital information on physical objects, enabling skilled trades workers to identify and repair equipment more quickly and accurately.
- **Cost savings:** XR identifies design and construction issues early on, reducing the risk of rework and costly delays.
- **More engaging for younger workers:** Training in VR attracts, excites, and engages digital natives while directly addressing the skills gaps in skilled trades.

Frontline jobs with promise for XR training:

- | | |
|-----------------------|---------------|
| ○ Carpenter | ○ Electrician |
| ○ Construction worker | ○ Plumber |
| ○ HVAC technician | ○ Welder |

Promising Use Cases for Skilled Trades

1. Safety Training

- **Reduced on-site risks and accidental injuries:** XR realistically simulates dangerous environments—such as working at heights or in a confined space—without exposure to actual risk and trains workers on safety protocols, reducing accidents on the job. Accidental shocks, for instance, are a grave danger for [electricians](#). VR simulations can teach them how to identify and troubleshoot potential hazards, while augmented reality (AR) can provide them with real-time information on the location of wires and electrical components.
- **Increased safety for operator training:** VR offers a safe and efficient way to practice the proper operation of machinery—such as [forklifts](#)—before doing so on a construction site or factory floor, reducing the risk of injury to workers and damage to the equipment.

2. Quality Control, Inspection, & Maintenance

- **Identify defects and procedural breakdowns.** XR helps construction workers, for example, identify defects and issues in materials, workflows, and processes, which can improve quality control and help identify potential issues before the actual work begins, as has been demonstrated [in other industries](#).
- **Improved maintenance and repair.** XR simulates maintenance scenarios and teaches equipment repair, which can improve equipment efficiency and reduce downtime.

3. Design, Visualization, & Project Modifications

- **Reduced rework:** XR can [reduce rework](#)—a top industry concern—and its associated costs and delays.
- **Bolstered client engagement:** XR enables clients to feel the scale of a space, for example at the start of a new construction project. It is possible to explore design options in live time and align on key project decisions with the client that don't require costly prototypes or having to rework decisions that don't turn out to the client's liking.

4. Culture of Learning Drives Retention

- **Attract talent and improve engagement.** XR use can encourage ongoing learning and career development, which in turn can help [improve hiring and retention](#).

300%

ROI for Intel's VR electrical safety training program over 5 years

25%

Fewer callbacks for HVAC technicians trained in VR at Pennsylvania-based T.E. Spall & Son, resulting in estimated savings of about \$720 per callback

83%

Reduction in time it takes for new techs to go from training to assisting on service calls at Patton Plumbing Heating and AC in Tennessee

Technical Skills: The Future of Skilled Trades



Interplay Learning

- Immersive training solutions for skilled trades that include more than 300 hours of content on HVAC, plumbing, electrical, solar, and driving safety
- SkillMill online course catalog accessible across VR, desktop, and tablet
- ANSI/IACET-accredited and NATE-recognized; includes OSHA and EPA 608 certifications
- Documented reductions in costs and increases in employee retention



Hard Hat VR

- VR training for construction, logistics, energy, manufacturing, and oil and gas
- More than 15 courses of off-the-shelf content (plus customized solutions) that helps ensure safe warehouse conditions, trains for specialized tasks, develops interpersonal abilities, and more

A NEW AGE OF CAREER READINESS

Use Cases In

Manufacturing

03

Workers need to learn increasingly complex skills to keep pace with technological advancements.

Major challenges for training include the following:

- The pace of technological advancements
- The need to teach proper safety procedures
- The shortage of skilled workers
- Language learning
- The high costs for manufacturing training programs

Training in XR can offer solutions to those challenges.

- **Safer training:** Simulations of manufacturing scenarios help workers repeatedly practice responding to hazardous scenarios while in a safe and controlled environment. This reduces training time and minimizes the risk of accidents and injuries.
- **More efficient processes:** XR can optimize manufacturing processes, identify and address bottlenecks, and reduce downtime. This can lead to improved productivity and profitability.
- **Enhanced product design:** Visualizing and testing designs in XR before products are manufactured can reduce the risk of costly design errors and improve quality.
- **Compelling customer experience:** Immersive product demonstrations and experiences for customers can improve customer satisfaction, engagement, and loyalty.

Frontline jobs with promise for XR training:

- Assembly worker
- Engineer
- Machine operator
- Quality control inspector

Promising Use Cases in Manufacturing

1. Safety Training

- **Enhanced worker safety:** Training in XR allows workers to [practice skills in a safe environment](#).

2. Machine Operation

- **Cost savings:** Workers properly trained to use machinery [scrap fewer parts](#) than untrained workers. VR simulation streamlines this process by allowing for repetitive practice before workers operate the actual machine.

3. Maintenance & Repair

- **Deeper understanding of products to be repaired:** Ford wanted repair shops to have experience with the electric Mustang Mach E before it was delivered to showrooms, so [it teamed up with Bosch](#) to create a VR simulation.

4. Complex Assembly

- **Increased accuracy and speed:** AR can overlay images on the working environment to ease assembly, increase speed, and reduce errors. Engineers at [Lockheed Martin](#), for instance, use AR to assemble F-35 aircraft, which has made them work 30% faster, with 96% accuracy.

20%+

year-over-year reduction in injury and illness at [Tyson Foods](#) after VR training

70%

[injury reduction](#) for Ford's 50k+ U.S. assembly line workers using VR training

\$7,200

onboarding cost savings per machinist at [PBC Linear](#) in Illinois

Durable & Technical Skills: The Future of Manufacturing

Augmentir

Augmentir

- AR solution that allows industrial companies to digitize and optimize processes that support frontline workers
- Can digitize complex frontline workflows; simplify operations and maintenance; support remote collaboration for workforce and customers via AR, chat, and live video; and more
- According to Augmentir, 37% of their users report improvement in their productivity and a 76% reduction in their training time

transfr

Transfr

- VR for simulating on-the-job training that can increase job placement and job-retention rates
- Digital coach to guide trainees and provide personalized instruction
- Training for workers in industries such as automotive, aviation, construction, and manufacturing, with partners from education, government, and industry

A NEW AGE OF CAREER READINESS

Use Cases In

Diversity, Equity, Inclusion, and Accessibility

04

DEIA considerations impact every industry. XR simulations minimize the experimentation when the conversations are real and important.

Major challenges for training include the following:

- Resistance to change within the organization
- Lack of awareness about how workers' behavior impacts other workers and the business
- Lack of buy-in from management
- Limited resources
- Unconscious bias

Training in XR can offer solutions to those challenges.

- **Increased empathy:** VR simulations can provide a [first-person perspective on real-life challenges](#), helping workers and learners develop a deeper understanding of different experiences.
- **Safer learning environments:** VR simulations can allow [employees to role-play difficult conversations](#), enabling them to practice their communication skills and gain confidence in interacting with people from different backgrounds.
- **Greater accessibility:** XR technology can increase accessibility to DEI training and learning opportunities, especially for remote workers and others who have difficulty attending in-person training sessions.
- **Increased engagement and retention:** XR technology can make DEI training [more engaging and interactive](#), increasing workers' participation and retention.

Frontline jobs with promise for XR training:

- Customer service representative
- Educator
- Health care professional
- Human resource professional
- Manager/supervisor
- Sales representative

Promising Use Cases for Diversity, Equity, Inclusion, and Accessibility

1. Training

- **Virtual meetings for remote DEI training:** VR can provide a realistic and immersive environment for remote workers to attend [DEI training sessions](#). It can simulate a physical classroom where workers can interact with trainers and one another, providing a more engaging and interactive experience than traditional online training.
- **Improved cultural competence:** AR technology can [provide workers with cultural information and tips](#) on how to interact with people from diverse backgrounds. For example, an AR app can inform workers about the customs and traditions of a specific culture, helping them understand and respect cultural differences.
- **Bias reduction:** VR simulations can create realistic scenarios that highlight and educate on various forms of bias and teach how to address them. For example, a VR simulation can present a scenario where a worker witnesses a coworker making a discriminatory comment and must decide how to respond appropriately.

2. Disability Inclusion

- **Increased empathy:** MR simulations can allow workers to experience and understand the challenges faced by people with disabilities. For example, an MR simulation can create a virtual environment that simulates the challenges faced by people with visual impairments, [helping workers develop empathy](#) and learn how to make accommodations to support them.

95%

of participants in J.P. Morgan's VR training pilot in DEI **felt empathy** toward their avatar, and the program had a net promoter score of 68.

98%

of respondents from Domain Group who participated in VR blended DEI training from Equal Reality and mwah—Making Work Absolutely Human—reported a **better understanding of their role in DEI**.

Durable Skills: Critical, Yet Hard to Train

PRAXIS LABS

Praxis Labs

- Immersive learning with a research-backed curriculum for workplace DEI training
- A six- or 12-month experience that helps learners build empathy, identify barriers to equity, and take informed action in the workplace

ER Equal Reality

Equal Reality

- Empathy-focused VR training for learners to experience discrimination or inappropriate behavior and to identify bias
- Opportunities to practice making decisions in real time, hold challenging conversations, and experience situations from multiple perspectives
- According to Equal Reality, 96% of their users say they feel prepared to act in the workplace

Intersection of Artificial Intelligence (AI) and Extended Reality (XR)

AI helps create content more quickly and with a higher quality.

Scripts and dialogue, visual environments, avatars, and the like can all be created more swiftly with the help of AI. This, in turn, expands the potential for low-code/no-code XR technology solutions. Some XR vendors [have launched initiatives](#) to bring generative AI technology to immersive learning. At Talespin, for example, full integration of generative AI has made it possible to create a VR training module in less than 30 minutes. Talespin has also released an AI-powered, web-accessible, no-code creator platform, [CoPilot Designer 3.0](#), to reduce the complexity of creating custom XR content and enable creators to design with greater efficiency and higher quality.

AI helps analyze data to offer customized, adaptable solutions.

[Stemuli](#), for example, uses AI to connect students to meaningful career development experiences and maintains a portfolio of students' achievements, certifications, and development milestones to help them in their job hunt. [Alelo](#), which has its origins in military training, is making headway in Human Resources and Education as a way to offer personalized learning that is engaging and customized. XR technology is being used in many ways for personalized learning by Alelo; however, when AI is added, AI expands XR's capabilities. AI-led avatars, for instance, create more authentic scenarios for users, and XR also uses AI to continuously improve training as data is collected. [Here, Alelo shares more](#) about how AI can enhance VR training, making it more authentic and responsive, and we see the power of AI and XR combining to revolutionize training.

From strictly the ‘making a world’ aspect, AI takes on a lot of the work. Making all of these models and environments takes a lot of time and money, so AI is a magic bullet.

— Mirrorscape CEO Grant Anderson

A NEW AGE OF CAREER READINESS

Recommendations

05

Recommendations

Policymakers, the XR industry, philanthropists, employers, and educators all have a role in ensuring that all learners and workers benefit from XR. Consider these activities:

INVESTING

- **Funding research and ROI studies:** Direct funding and additional resources are needed for more research and studies across a variety of industries, particularly in the workplace as opposed to academic settings. Studies should focus on demonstrating the ROI of using XR technology on the job and on more deeply understanding the experiences of workers and learners.
- **Providing investment incentives for education and workforce providers:** This is needed in two distinct areas of focus:
 - Fund community colleges and career and technical education centers, especially in rural communities, to build new workforce development programs that use XR technology and to introduce XR technology into existing programs to improve training.
 - Targeted federal investments, paired with rigorous evaluation, will generate strong impact data and case studies that will give policymakers the information required to decide whether to scale XR initiatives.
- **Erasing the dividing line between education and the workforce:** XR's efficacy in teaching skills is proven, but employers need to see how XR makes workers better at their jobs. JFF's Big Blur initiative and the various "earn and learn" models could be effective ways to close the gap and help XR scale.

Use XR yourself!

Attend demos and visit schools and workplaces to see the technology firsthand and try it out. Then you can become an informed advocate, able to persuade others to take the next step.

Recommendations

Consider these activities:

CENTERING DEIA

- **Both DEI and accessibility goals (or DEIA) can be served by XR technology:** There are several ways to help this happen:
 - **Device procurement:** Be creative in looking for ways to make XR technology accessible at low cost, whether through donations, grants, or other resources.
 - **Instruction and support:** XR technology is accessible only to those who have been well trained; besides relying on device manufacturers, seek out organizations that support others in implementing new technology.
 - **Support distribution in multiple settings:** Learners and workers are found everywhere—including [inside our nation's prisons](#).
 - **Make devices for everyone:** People with low vision, people hearing loss, and people with other disabilities deserve technology designed for them.
 - **Expand access to broadband internet:** Many XR solutions are dependent on broadband, and this is especially true when the goal is to connect remote workers to training opportunities.
- **Develop the metaverse with an eye toward DEIA:** Virtual worlds should be as diverse and inclusive as we want the real world to be:
 - When building virtual worlds, avatars and environments should be culturally representative. This can propel XR's ability to make all users feel seen and heard.
 - Develop technology training programs that prioritize Black learners and workers, as well as other populations who are currently underrepresented in tech, so there is more representation among developers, coders, and other people working in tech.



About Jobs for the Future

Jobs for the Future (JFF) drives transformation of the U.S. education and workforce systems to achieve equitable economic advancement for all. www.jff.org

About JFFLabs

JFFLabs identifies, incubates, and invests in bleeding-edge solutions that shape the future of learning and work for JFF and the field.

About JFF's Language Choices

JFF is committed to using language that promotes equity and human dignity, rooted in the strengths of the people and communities we serve. We develop our content with the awareness that language can perpetuate privilege but also can educate, empower, and drive positive change to create a more equitable society. We routinely reevaluate our efforts as usage evolves.



Building a Future
That Works
For Everyone

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