Jobs for the Future

Immersive Learning & XR Technology Skills and Careers

Where the Future of Work Meets Economic Opportunity

AT A GLANCE

Extended reality (XR) technology and immersive learning are reshaping the future of learning and work. In this paper, Jobs for the Future (JFF) presents a new framework of occupations and career paths created or transformed by XR technology and immersive learning, including illustrative job titles, critical skills, and anticipated training/hiring requirements. With a focus on equipping policymakers, workforce developers, and training providers with actionable recommendations, we demonstrate that future XR careers can be responsibly planned and that training pathways can be transformed to support multiple on-ramps into quality jobs for learners and workers—especially those from systemically excluded populations.

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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

JFFLabs is JFF's innovation Lab. JFFLabs drives innovation by providing market insights, incubating solutions, and investing in companies.
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Executive Summary

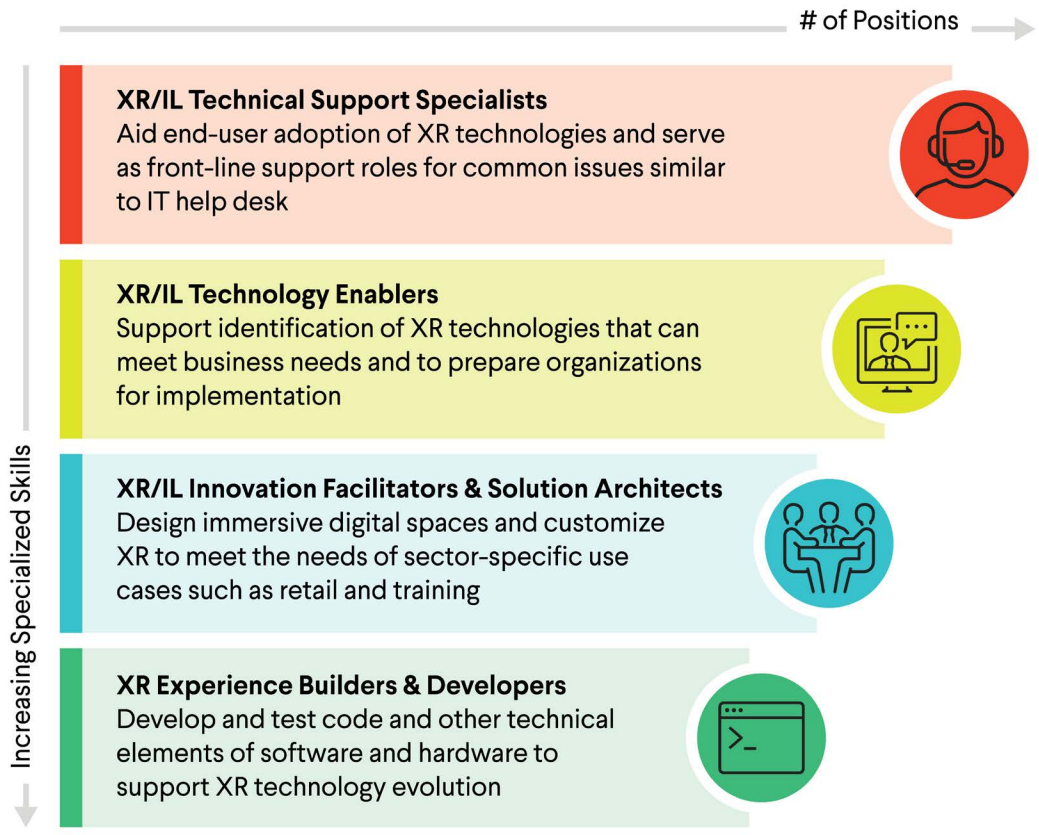
Extended reality (XR) technology and immersive learning (IL) are reshaping how people have fun, learn, and work while also creating entirely new categories of jobs and careers. Naturally, there is an immediate demand for professionals with the skills to design, code, and assemble new XR software, hardware, and platforms, but the transformation doesn't stop there. New career paths are already emerging to ensure that businesses, consumers, and society are able to take full advantage of the opportunities created by "metaverse" technologies, to find the best technology solution for key business challenges, to help individual users navigate and feel safe in immersive experiences, and to determine how best to translate real-world experiences and scenarios into XR—or dream up new worlds entirely. XR technology and immersive learning will also change how people are trained in new skills and has the potential to fundamentally evolve how we work. As technology grows and adoption continues, we will see the enablement and growth of access to a number of skills certifications, short-term training programs, and other accessible education opportunities—instead of just four-year degrees—to support economic mobility.

In this paper, Jobs for the Future (JFF) presents a new framework of occupations and career paths created or transformed by the emergence of XR technology and immersive learning, as well as illustrative job titles, critical skills, and anticipated training/hiring requirements for each. We draw connections between currently available non-XR careers and their XR/IL equivalents, presenting parallel career paths and skills for XR with a particular focus on ensuring on-ramps for populations that too often experience barriers to economic opportunity. We also highlight opportunities to disrupt typical career paths to develop more accessible on-ramps than currently established careers often allow.

Our Framework

Based on our findings, we defined four clusters of jobs that are distinctly characterized by role, function, and training pathways. These career clusters align to the process of creating, developing, and deploying immersive technology:

- **XR/IL technical support specialists** facilitate ease of use by the user and address common issues with both the hardware and software. Technical support may also help in the use of peripherals and navigating the virtual environment.
- **XR/IL technology enablers** help customers ideate and develop requirements for products and make note of any technological limitations and propose solutions or alternate approaches.
- **XR/IL innovation facilitators and solution architects** translate requirements—physical environments, scenarios, and features—into virtual spaces and help design the future of learning and work in these new worlds.
- Finally, **XR experience builders and developers** design and build the state-of-the-art devices and software needed to sustain an extended or virtual reality.



Key Findings

- Existing, familiar technical and non-technical occupations, such as help desk support technicians, software developers, and sales representatives, will readily translate into equivalent roles working with XR technology, thus offering opportunities for workers with transferable skills.

- Populations who have been historically and remain systemically underrepresented in the technology sector, especially career changers and workers without degrees, will find new opportunities in emerging XR technology careers if these pathways are intentionally developed to support high-quality, work-based learning; stackable credentials; short-term training experiences; and other workforce development best practices.

- As digital literacy expands to include XR technology and metaverse literacy, equitable access to high-speed internet; low-cost headsets, tablets, and other devices; the use of immersive learning in educational settings, in community spaces, and so on will ensure XR does not deepen but alleviates digital divides.

Recommendations

Ultimately, we call on policy stakeholders, education and training providers, and workforce developers to support three key areas that ensure workers are prepared to learn, work, and thrive with the growth of XR technology and immersive learning:

1. **Design jobs and career pathways based on skills and experience, not formal education:** This includes supporting policies that incentivize a skills-first hiring approach broadly (workforce and employer focused), developing intentional opportunities to build familiarity and access to XR/IL use, and thinking creatively about on-the-job training models to develop skill specialization needed for this growing market.

2. **Promote and incentivize a wider array of education-to-career pathways:** Expanding efforts to expose learners to careers in XR technology, building public-private partnerships to innovate relevant and blended learning models for learners, and, most importantly, supporting policies that encourage learners to engage in short-term training and credentialing for these careers.

3. **Democratize access to XR software and hardware:** Promoting broad adoption and innovation with this technology requires enacting policies that support infrastructure, such as stable electricity and high-speed internet, to enable these technologies to reach more users, supporting programs and policies to reduce overhead cost for users to access this technology, and ensuring technology accessibility meets all needs.

The Future of Careers Shaped by Extended Reality

XR technology and immersive learning are likely familiar to most people as next-generation entertainment. Virtual reality (VR) games, movies, and related hardware have grown significantly, nearing $12 billion in global market value in 2021.[1] [2] But even more excitingly, **the growth of XR technology and immersive learning is reshaping the future of learning and work**, with Gartner estimating 25% of the global population will spend at least an hour a day in the metaverse by 2026.[3] In the last year alone, more than 40,000 jobs were posted in the United States specifically requiring knowledge or expertise in XR technology and related tools.[4] Employers seeking these skills range from large corporations to small businesses and include startups, creators, and entrepreneurial groups that are developing innovative use cases with XR technology and immersive learning. Moreover, companies are increasingly building their presence and projecting further investments in the metaverse through 2024.[5] As XR technology is used more by the general public in addition to places of employment and education, the nature of how we work, learn, and live will all evolve.

With strong signals that XR technology will create demand for new jobs and career paths, educators, employers, and policymakers cannot afford to wait and must begin to prepare learners and workers for this rapidly approaching reality now. The speed and exact nature of this demand will be shaped by adoption and penetration rates of XR technology and immersive learning. This, in turn, will create increasing demand for the jobs we outline in this paper.

We recommend continuing to monitor labor market trends and future predictions. Indicators of growing adoption include:

- XR technology and immersive learning in use to teach algebra to middle school students through spatial learning, social and behavioral skills to learners on the autism spectrum through supervised virtual reality, and biochemistry and history to college students on virtual campuses built by the institutions.
- Workers using XR technology and immersive learning to explore new career paths, onboard to new jobs, and train (or upskill) to be insurance claims adjusters, HVAC technicians, retail sales associates, dialysis technicians, nurses, frontline managers, and more.
- Manufacturing workers using AR-enabled tools to digitize paper-based checklists for operations, including product assembly, diagnostics and repair, error and malfunction prevention, and communication with subject-matter experts.[6]
- Innovative use of XR technology and immersive learning to amplify the growth of a "creator economy" for individual and organizational users who build unique and creative content and monetize their efforts.
- "Try-before-you-buy" AR empowering consumers to digitally—and more vividly—imagine the experience of using goods such as cosmetics and apparel or engaging with services such as interior decoration and other shopping experiences.[7]
- Business meetings using XR technology to provide a deeper sense of presence and engagement for participants than is possible through two-dimensional videoconferencing technology.[8]

And that's just the beginning. Imagine a near future where certification and skills-building could be fully augmented through XR technology and immersive learning, becoming more accessible to workers and learners. **Behind this wide and growing universe of use cases will be a similarly wide and growing workforce imagining, building, and implementing these immersive learning experiences – both within the companies that originate them and, in the businesses, schools, and other settings where they're put into practice.** While the coding and design skills needed to build XR software or render real-world objects and places in 3D are at the heart of XR technology careers, job opportunities in this growing space will require a much broader array of skills.

What Is XR?[9]

Extended reality is an umbrella term that encompasses augmented reality (AR), virtual reality (VR), and mixed reality (MR). XR blends the virtual and physical worlds and creates immersive environments for users.

- AR technology overlays digital images on real/physical images, meaning the user experience combines both worlds.
- VR technology allows users to immerse themselves fully in the virtual worlds, providing 360° views.
- MR technology allows virtual and real objects to co-exist, going beyond AR and allowing users to manipulate virtual objects within the context of a physical space.

What is Immersive Learning?

- Immersive learning is a form of experiential training powered by XR technology to simulate real-world scenarios and allow for skill-building for all in a safe and engaging environment.[10]

Emerging Skills and Careers

Through traditional and real-time labor market research, desk research into trends in XR technology, and a series of interviews with XR technologists, education providers, and businesses deploying XR solutions, **we built a framework charting the emerging new jobs that will be needed as XR technology and immersive learning matures.** Our framework includes current and emerging skills, proposed models of training (see Table 1), and illustrative examples that demonstrate how skills-first approaches to career progression allow for these to become lifetime jobs with stability and progression.

With a focus on supporting populations who often experience barriers to economic opportunity and mobility, including women; people who are Black, Native American, or Latinx; and those who do not hold a college degree, we defined this framework to highlight emerging jobs, ranging from entry-level springboard jobs that can launch individuals into a specialized and high-quality career pathway to more specialized positions that individuals can train into or transfer into as career-changers.

TABLE 1.

XR Roles and Characteristics [11] [12]

	XR/IL Technical Support Specialists	XR/IL Technology Enablers	XR/IL Innovation Facilitators & Solution Architects	XR Experience Builders & Developers
Description	Aid end-user adoption of XR technology and serve as frontline support roles for common issues similar to IT help desk	Support identification of XR technology that can meet business needs and to prepare organizations for implementation	Design immersive digital spaces and customize XR technology to meet the needs of sector-specific use cases such as retail and training	Develop and test code and other technical elements of software and hardware to support XR technology evolution
Typical Tasks	Technology maintenance and troubleshooting Onboarding of users into technology and virtual worlds Ongoing user support Supporting positive user experience	Requirements gathering Planning, developing, and implementing business cases Advising customers and identifying potential benefits and limitations of solutions Managing customer relationships Sales prospecting	Designing and building three-dimensional representations of people, places, things, and interactions, such as digital twins and avatars” Defining user interaction Building and integrating haptic feedback into user experience	Developing software Integrating sensors or haptic devices QA testing, debugging, and related troubleshooting Managing development cycle
Potential Training Models	Prior work experience, on-the-job training, short-term credentials	Prior work experience, work-based learning, short-term credentials, some college	Prior work experience, work-based learning, short-term training, stackable credential models, college degree	Prior work experience, work-based learning, stackable credential models, college degree

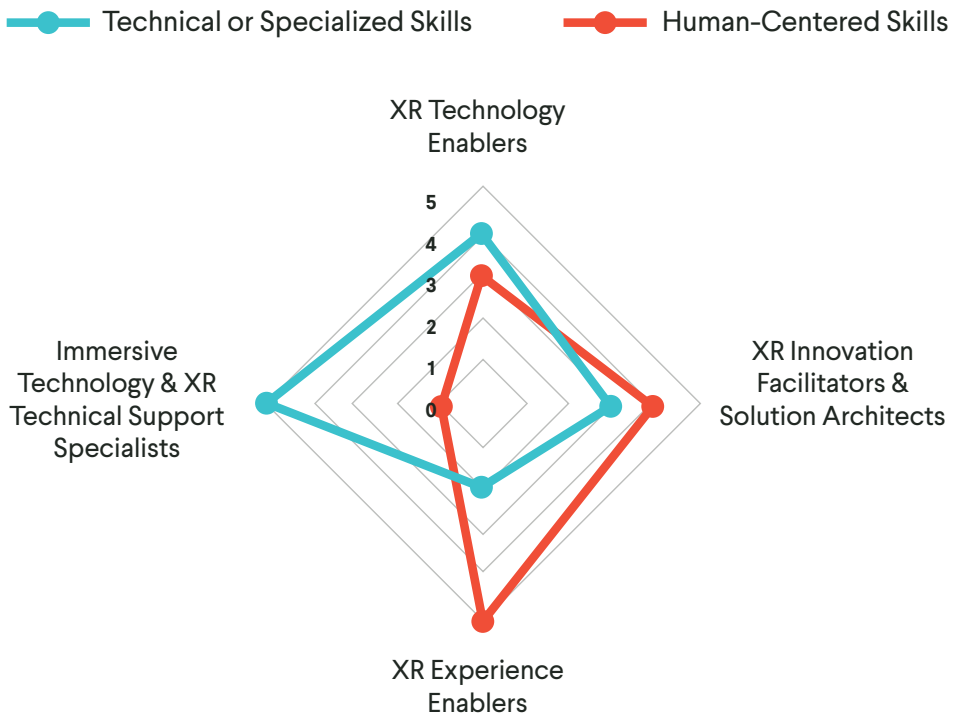
Our research points to **the potential of XR technology as a career advancement pathway for learners and workers of all backgrounds**, especially when considering current or potential requirements for technical versus human or "soft" skills. Many XR/IL-enabled jobs:

- **Do not require strong coding or technical expertise** for someone to be successful.
- Are demonstrating trends to favor low-code/no-code tools, ultimately **becoming more accessible with incremental training**, similar to data analysis,[13] where jobs began with a high level of expertise but can now be accessed with non-degree credentials thanks to automated software and visualization.[14]
- Stem from or are closely related to existing roles, which **may make it easier for workers to upskill into XR/IL jobs** after establishing experience in equivalent roles.
- **Require high-value, human-centered skills that can be gained from other experiences and do not necessarily require a college degree**, as demonstrated in Figure 1. Of the more than 40,000 job postings that mentioned XR or related technology as part of the job duties in 2022, about 40% said only a high school education or an associate degree was necessary or had no education requirements at all.[15]

This suggests that those who have been systemically excluded from or underrepresented in the technology sector because of education attainment barriers will soon be able to access, enter, and advance through emerging XR/IL career pathways more easily. Through training that progresses from fundamental to specific, a learner can begin in an entry-level role such as XR technical support specialist and then specialize for roles such as virtual-world design (solution architect), sales, or consultant on appropriate immersive solutions to meet business needs (enablers). Developing training and talent pipelines on the broad range of roles beyond near-term technical coding skills also ensures that meeting user and business needs remain central as technology advances and adoption grows.

FIGURE 1.

Technical vs. Human Skills in Emerging XR Jobs



XR/IL Technical Support Specialists

Like their IT "helpdesk" counterparts, XR/IL technical support specialists will be critical to ensuring successful use of XR technology and will be enduring supports as the technology evolves. Our research shows that some of the biggest needs with the implementation of XR technology solutions revolve around two things: ensuring users can effectively use the tools and software and supporting the actual launch of simulations based on the type of solution and user needs. Additionally, these roles represent the frontline specialists who maintain technology, ensure updates are in place, and keep users engaged with the software and hardware.

Workers holding these jobs will have a range of responsibilities, including:

- Helping users try on, adjust, and use VR headsets and controllers, often helping them feel comfortable as they adjust to the virtual experience and supporting those who feel dizziness or motion sickness[16]

- Assisting retail customers using AR applications in stores
- Setting up and troubleshooting XR software or platforms for simulation-based training or virtual twin "offices" in the metaverse[17]
- Serving as community managers who can help in the maintenance of immersive worlds by tagging virtual bugs and escalating to solution experts
- Supporting the implementation and launch of training programs and certification pathways that can occur exclusively through or can be augmented by XR technology and immersive learning
- Moderating virtual communities in spaces and classrooms
- Promoting end-user satisfaction and ongoing engagement over time by lowering the technical barriers to entry and ensuring positive user experience

As with IT help desk positions, we expect many of these jobs will require no more than a high school education to meet basic qualifications for entry.

Sample Job Titles for XR/IL Technical Support Specialists[27]

Current and future job titles may include:

- Field service technician
- XR technical support
- Simulation technician
- Technical trainer
- Simulation technologist

Career Trajectories for XR/IL Technical Support Specialists

- Of the roles identified through our research, technical support specialists require the least amount of technical knowledge and expertise, making these roles accessible to most workers and learners.
- The educational barriers are lower for these roles, making for strong entry-level opportunities with greater emphasis on human-centered and professional skills such as critical thinking, problem-solving, communication, flexibility, and light technical specialization.
- Technical support specialist roles will make up a larger share of roles than others as XR technology and immersive learning are adopted in educational settings, workforce and training scenarios, gaming technology, immersive community building, and others. Some adopters will develop support personnel in-house to ensure that those providing technical assistance to users are familiar with the organization's tailored XR technology instances. Other technical support specialist roles will be in businesses that provide outsourced support, including setup, maintenance, and management, at scale.
- Technical support specialist roles can serve as a first job and a springboard into more specialized careers in XR technology, such as sales, human-centered design, or 3D/4D design, through additional incremental training and upskilling.

Current and Future Training Pathways for XR/IL Technical Support Specialists

Current technical support occupations typically do not require a college degree and are often filled by individuals who have comfort with technology.[18] Training for XR/IL technical support specialist roles could occur via these pathways:

- **Prior work experience:** Workers can easily transition into these roles if they have prior experience in similar roles or gain the necessary professional skills through school projects, part-time customer-facing work experience, and even summer jobs that many younger workers may have held.
- **Short-term credentialing:** Given the precedent for short-term credentialing and non-degree approaches for many existing customer service roles in IT, capitalizing on this model may provide especially promising opportunities for young workers looking for positions not requiring advanced degrees. These training pathways could be adapted

for XR technology and specific use cases within an organization or sector. Similarly, numerous opportunities to upskill those with existing skills or explore certifications, like Unity's, with specialized skills for XR technology can be a means to create career transition pathways at scale.

- **On-the-job training:** Because these roles emphasize professional skills over technical knowledge, job-specific technology orientation, such as learning the specifics of the XR technology the organization uses, could be provided during the onboarding process as short-term training.
- **Ongoing training to support career mobility:** Augmenting these roles with additional work-based training, certifications, and learning modules will enable workers to have career mobility by creating opportunities for them to stack experiences and credentials into opportunities in the other three spaces we discuss in this paper.

XR/IL Technology Enablers

XR/IL technology enablers will be sales professionals, consultants, customer success team members, and field experts who help identify promising immersive solutions, match consumers and business leader needs to technology solutions, customize solutions in consultation with the platform developers, and give support to the organization during deployment of the technology.

Workers holding these jobs will have a range of responsibilities such as:

- Consult with clients to identify needs and goals and recommend XR solutions
- Identify specifications and requirements for use of XR/IL technology as a blend of physical and virtual worlds
- Collaborate with technical engineers and platform specialists to support XR technology product customization
- Research and present market intelligence about XR technology use, adoption, and success to support business processes

- Define and support onboarding into solutions for organizations once the XR tool has been selected and built to design
- Work as brand champions, helping to create opportunities for XR technology adoption and to generate excitement about this growing suite of technology solutions
- Support the integration of e-commerce functionality and related strategies in virtual worlds[19]
- Ensure that measures are put in place to protect the privacy of end-users and their data

Career Trajectories for XR/IL Technology Enablers

- Career pathways into these roles, if developed well, can help those who enter careers in XR technology through entry-level opportunities move into higher-quality jobs.
- These roles require high-value, human-centered skills such as customer service, communication, and adaptability, paired with specialized skills such as sales, metrics setting, benchmarking, and human-centered design. Educational qualifications range from a high school education to a bachelor's degree.[20] If XR technology vendors, developers, and innovators partner with education providers such as community colleges and STEM schools, learners can be exposed to XR technology and immersive learning in high school and early college to gain experience for these jobs without formal higher education.
- As strong entry-to-mid-level jobs, these roles require more specialized skills than technical support roles, such as a familiarity with technology capabilities and limitations to identify how solutions might match business and consumer needs.

Sample Job Titles for XR/IL Technology Enablers[28 29]

Current and future job titles may include:

- Program manager
- Design lead
- XR sales representative
- Learning experience designer or developer
- Product manager
- Sales associate
- Privacy manager

- To avoid creating barriers for those without a college degree, organizations will need to develop strong onboarding programs for XR/IL technology enabler roles and to focus on hiring for aptitude with professional skills, rather than making technology specialization the priority.

Current and Future Training Pathways for XR/IL Technology Enablers

Occupations that are equivalent to XR/IL technology enabler roles have a range of requirements. Many require related work experience, with some combination of education and training and possibly specialized experience in areas such as business, marketing, design, or education. To ensure that pathways into this career are not limited to those holding a college degree, we recommend these training options:

- **Work-based learning:** Using a work-based learning model to allow people without four-year degrees to move into these roles will expand accessibility, allowing individuals with some requisite skills and knowledge to earn an income while completing further training that can position them for jobs in XR marketing, user experience/design, and consulting.

- **Short-term credentialing:** Offering short-term training and credentialing alongside job-related specialization can support individuals in filling specific skill gaps. For example, consider blending XR/IL training with online certifications like "Business in the metaverse" or "Digital marketing and e-commerce professional" to enhance specialized job readiness.

- **College courses:** Accessing short-term training through community colleges, continuing education, or college-based education programs can help to provide alternatives to the technical specialization that may be required for roles such as XR product manager or design lead. This is an affordable pathway to specialized knowledge that can be combined with high-value human skills such as communication and customer service to gain entry to the XR industry.

- **Ongoing training that supports career mobility:** Providing short-term training and work-based learning for individuals in XR technology enabler roles can encourage them to become more familiar with the technology's specifications or to gain expertise in other areas such as 3D/4D visualization, user interaction/design, or virtual design. The result should be advancement to the higher-quality roles still to be discussed in this paper.

XR/IL Innovation Facilitators and Solution Architects

Conceiving of new uses for XR technology and customizing and designing XR/IL environments that meet the needs of learners, businesses, workers, and education providers will be the province of a cluster of jobs categorized as XR/IL innovation facilitators and solution architects. These thinkers and builders will help to generate new use cases of immersive environments in classrooms, help users develop new skills and training, and test new ideas.

Workers holding these jobs will come from a variety of backgrounds and have roles that leverage their particular expertise:

- Psychologists, economists, and sociologists will find opportunities to help embed meaning within virtual worlds and ensure high-impact, inclusive, and quality environments are built in virtual spaces.[21]

- Subject-matter experts from various fields, including **health services, engineering, higher education, and manufacturing**, will use their expertise to align virtual environments appropriately and meaningfully to the physical world. This expertise will ensure that virtual-world training processes, equipment, and tools sufficiently mirror the form and function of their physical counterparts and that the training is applicable to the physical world.

- Learning designers, training specialists, and education experts will apply their knowledge and expertise to help build interactions and engagement opportunities that promote learning and development.[22]

Sample Job Titles for XR/IL Innovation Facilitators and Solution Architects[30] [31]

Current and future job titles may include:

- 3D artist
- Architectural designer
- Art director
- Avatar tool designer
- Creative director
- Human-factor engineer
- Metaverse economist
- Metaversity director
- Technical artist
- Visual effects (VFX) artist
- Visual designer

- Artists, designers, architects, and art curators will apply their expertise to help develop the virtual spaces in ways that appropriately mirror the physical world or to develop new worlds entirely with human-centered design in mind. This includes elements of **fashion design, interior design, and even typography** that will inform environments how avatars, environment, and text convey meaning within virtual spaces.[23]

- Engineers and software specialists will help convert ideas into the virtual reality and will ensure software evolves and real-time upkeep and debugging of virtual spaces occur.

- Artists with expertise in **animation, motion capture, and rotoscoping** will create avatars and background characters that may mirror real-world appearances and motions while also applying the aesthetics of a given virtual world.[24]

- Developers will integrate blockchain technology to facilitate transactions, ownership, and other interactions related to digital assets.[25]

Career Trajectories for XR/IL Innovation Facilitators and Solution Architects

- As mid-to-senior-level roles that require low or no coding skills, innovation facilitators and solution architects require knowledge and skills in a specific subject matter (examples include psychology, special-effects animation, and graphic design) to help develop ideas for XR experiences into virtual reality and understand user needs as a part of that process.

- These roles require some level of professional and human-centered skills such as communication, critical thinking, and flexibility, alongside design thinking and the technical expertise to build immersive environments.

- These jobs will require understanding users' needs and designing spaces to meet them. While professional and human skills will be important for doing that well, technical and specialized expertise will ultimately determine success in the job, and most innovation facilitators and solution architects are likely to have college degrees.

- To ensure that these specialized careers remain accessible, it is important that incremental and informal training can grow to support the required specialization without a college degree.

Current and Future Training Pathways for XR/IL Innovation Facilitators and Solution Architects

Jobs in this cluster often require a college degree and are filled by individuals who have advanced training. However, other pathways could develop. Because professional licensure may not be required for a psychologist who collaborates on designing immersive experiences rather than counseling patients, incremental training in subject specialization could open innovation facilitator and solution architect roles to more workers. In addition to prior work experience and work-based learning models, we encourage a focus on:

- **Short-term training and stackable credential models:** Because of the high degree of specialized knowledge and expertise required for many of these positions, building short-term training pathways that develop competencies over time will be important for broadening accessibility. If the credentials are allowed to stack over time into a degree, individuals could progress into senior roles as each level of training is acquired. Identifying the specific specializations that are needed for success (e.g., spatial reasoning and design in virtual spaces, 3D animation) and developing incremental training and/or boot camps for acquiring such specialization could help individuals to develop resilient skills and progress through career pathways.

- **College:** Requiring a bachelor's or master's degree in a specific area of interest is the most straightforward approach to enter these careers, but only if knowledge of XR technology or immersive learning is embedded in the process.[26] However, restricting positions to degreed workers will reduce who can fill these high-quality jobs, so growing stacked credential models and approaches that allow workers to gain additional expertise over time is vital for equity and access.

XR Experience Developers and Builders

Much like their counterparts of software developers or hardware engineers, XR experience developers and builders are critical to continuing the evolution of XR technology and immersive learning. XR experience developers and builders innovate the software that allows users and other XR professionals to develop XR environments, implement them, and learn from them. They also develop hardware such as haptic feedback gloves or wristbands to track movement in immersive worlds.[32] Our research shows that while many of these roles require a high degree of coding knowledge now, we are already seeing a movement toward low-code and no-code tools that allow for the same kind of technology development with much less expertise. In an equivalent career path for software coders, we are seeing a similar trend towards low-code solutions as artificial intelligence tools complete the bulk of the coding, allowing the developer to take on other work in software design that requires a different type of expertise that still cannot be automated.[33]

Sample Job Titles for XR Experience Developers and Builders[36 37]

Current and future job titles may include:

- AR/VR software engineer
- Blockchain developer
- Unreal Engine developer
- Graphics software engineer
- NFT engineer
- Security architect
- Simulation technician
- Software engineer and developer
- UI/UX architect
- Unity developer
- UX researchers

Essentially, XR experience developers and builders design the technology that every other role we have discussed in this paper must adapt for user needs. Workers holding XR experience developer and builder jobs will:

- Build and optimize systems software for immersive devices, including the base coding, operating system stacks, and drivers

- Lead the testing of software and hardware, solutions including debugging, quality assurance, and user testing
- Design prototypes, refine, and iterate innovative software and hardware based on research insights and through experimentation
- Develop concepts, frameworks, codes, and presentation materials for product development stages
- Experiment with novel system technologies in the areas of optics, silicon, perception, and more to build integrated tools for XR technology

Career Trajectories for XR Experience Developers and Builders

- XR experience developers and builders, as senior-level roles, will require constant and ongoing education and the flexibility to remain up to date with the latest innovations and updates in software.
- These roles currently require a strong knowledge of programming languages such as C++, C#, and Unity. Professional skills specialization includes agile methodology, workflow management, and debugging. Additionally, human-centered skills such as communication, problem-solving, planning, and troubleshooting will be beneficial to individuals in these roles, although they are less central to their overall success than in previously discussed roles.[34]
- To ensure that these career pathways remain accessible to those who may not have a college degree, relying on currently established alternate entry points into technical fields may be easily replicated here (e.g., technical boot camps, industry-valued certifications and credentials, and technical apprenticeships).

Current and Future Training Pathways for XR Experience Developers and Builders

These roles typically require a bachelor's degree and certainly demand that workers have computer science or programming education and experience.[35] Nonetheless, multiple pathways into these specialized tech careers have developed, and we recommend relying on a few training approaches to be in a position to enter these roles. Training pathways with promise include the following:

- **Work-based learning:** Especially for individuals who have other roles in XR technology, work-based learning opportunities and earn and learn models can be internal career pathways to grow skills in coding languages and transition into higher-wage job opportunities.
- **Stackable credential models:** Short-term training resulting in industry-valued credentials, like Unity's, can allow workers to develop a specific skill such as a coding language or approaches to quality assurance quickly and efficiently. And if the credentials can be stacked to count toward a degree, workers will gain easier access to higher-quality jobs. Such training should be aligned with employer demands and will likely be highly specialized to a single company and its technology.

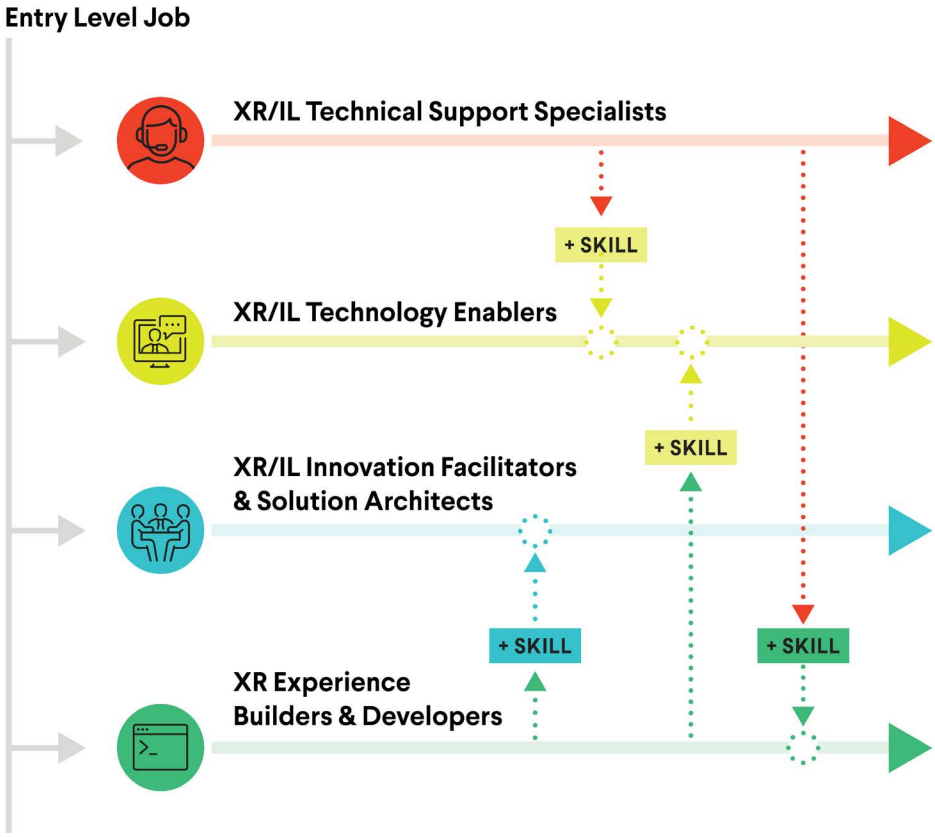
Building for the Future of XR

Imagining the future that includes mass adoption of XR technology requires an understanding of the economic impact and opportunity to introduce stable, high-wage jobs with career progression pathways and multiple entry points and reduce inequity for workers who now must overcome high barriers to similarly high-quality jobs, thus promoting wider access. In this section, we prioritize several approaches to engaging workers and learners. These on-ramps and approaches support agile and fast ways to gain and retain talent while centering skills and knowledge needed over degrees (which have been called a "proxy filter" that contributes to systemic barriers excluding populations).[38]

If education and training providers and employers focus on supporting concepts such as transferable skills, incremental learning models, work-based training, and stackable/nontraditional credentials, then the future holds a real opportunity for the growth of the XR industry to introduce accessible on-ramps to high-quality careers. Business organizations and local chambers of commerce can play an integral role in activating this process and then supporting communities of practice and working groups to drive progress. Figure 6 shows possible journeys for learners and workers who gain skills over time and enter through different avenues into potentially quality, stable careers.

FIGURE 6.

Potential Entry Points and Career Transitions in XR Technology



Promoting a Skills-First Talent Pipeline

New and future workers will benefit from XR technology being incorporated into educational programs, effectively positioning workers to enter jobs directly after program completion. Possibilities for doing this include specialized XR pathways or as pathways in other fields with specializations related to XR technology and the metaverse. Several programs aimed at XR and related technologies already exist at Morehouse College, Arizona State University, and Los Angeles City Community College, among others.[39] At a minimum, introducing the opportunity for learners to explore these careers will ensure they become comfortable with the technology as users and can promote curiosity and interest in the metaverse as a future worker. This is the route that Meta's Spark curriculum takes.

While the current landscape for hiring in the IT sector highly favors workers with a bachelor's degree, there is great potential—and we'd argue imperative—in the nascent XR market to redefine pathways to these jobs. It is promising that nearly 40% of job postings in the last year for a range of careers in XR technology did not list education requirements or explicitly require a college degree further indicating an opportunity for skills-based practices to become a norm. What's more, current job descriptions for roles such as simulation specialists, human-factors engineers, and virtual design specialists call for familiarity with specific software or tools rather than formal education or degree requirements. In fact, the focus is on individuals demonstrating skills even if gained through informal activities, class projects, relevant prior experience, or online learning.[40]

We must ensure that skills-based hiring becomes the norm for these careers. Skills-based training and hiring practices offer more flexible and adaptable training, support the identification of transitioning workers, and promote the recognition of transferable experience. Additionally, the adoption of short-term credentials and incremental training programs could support the development of a talent pipeline that supports numerous on-ramps and career progression opportunities across all educational levels and career trajectories.

Defining what skills are needed and how they are evaluated will be key to building pathways not requiring a college degree. When this is a priority for workforce developers and employers and incentivized through policy, the focus shifts to promoting equity and movement for those without a bachelor's degree, those who are changing careers, unemployed youths who are unattached to educational institutions, Black and Latinx workers, and women, all of whom are historically underrepresented within the IT sector's more specialized roles.

Recommendations: Enabling Equity Through Transformation

Leaders in the market continue to find value in the utilization and deployment of XR technology far above and beyond gaming, into business solutions, promoting worker engagement, and revolutionizing education and training. With this transformation, an eye to promoting opportunity and access for all learners and workers and ensuring the digital equity divide is not increased is incredibly important. Of the more than 40,000 jobs requiring some sort of XR-related knowledge or expertise in 2022, 20% of the positions were posted and open in the last three months of the year.[41] Market signals tell us job demand for these roles will grow. So, how do we invest to promote talent supply?

Policymakers can support practices that enable adoption and amplify the impact of XR technology and immersive learning. Educational institutions, workforce boards, and employers can identify skills needed and ensure the alignment of education and training to those needs. Local business organizations and chambers of commerce can serve as intermediaries and hubs for innovation for all stakeholders and as influencers that can help organize contributors around priority careers and pathways for their region. Collaboration between these stakeholders will be critical to ensuring that current workers in this industry are provided with advancement opportunities, that new workers have training and educational pathways that allow them to enter the industry, and that workers in other industries can reskill and apply their expertise and skills to building the metaverse.

Our recommendations are centered across three key areas:

1. Design jobs and career pathways based on skills and experience, not formal education:

Enact policies that support skills-first hiring, which would emphasize job candidates' experience-derived skills (communication, critical thinking, customer service, etc.) over trainable skills involving the tools, hardware, and software specific to XR technology. It would be particularly helpful to recognize skills developed through recreational use of XR technology, including VR gameplay, the development of consumer uses of AR filters, and engagement in metaverse spaces and communities, as signals of XR job readiness.

We also recommend developing work-based learning programs and apprenticeships to recruit talent and train those individuals reliably while offering them family-sustaining wages. Many technology companies have launched work-based learning or apprenticeship programs that can offer helpful lessons learned.

2. Promote a wider array of education-to-career pathways

Expand efforts to expose workers to the possibilities of XR-related careers, using information-sharing, mentorship, and other methods. Include the full spectrum of XR/IL job and career pathways described above.

In addition, establish policies and procure funding to support non-degree credentials, short-term training programs, and certificates for XR-specific needs to help recruit more learners and support employers hiring for all levels of roles. It can be especially effective to create comprehensive, progressive job training opportunities awarded with industry-recognized XR credentials that "stack" together over time.

We also advise developing public-private partnerships between XR technologists/vendors and education providers such as STEM academies, early college programs, and community colleges to offer industry-vetted training through blended learning models in for-credit courses.

3. Democratize access to and equity in XR technology (software and hardware)

Support infrastructure policies to ensure high-speed internet access and stable electricity are available so using XR technology is feasible and accessible to more users. Specifically, expand support for programs like the Affordable Connectivity Program to subsidize costs beyond access to high-speed internet to include supporting hardware/software costs can help broaden technology exposure.[42]

Use social programming and education programs in community-based venues such as public libraries, recreation centers, and senior centers to show the utility of XR technology, expose the public to this technology, and simultaneously leverage this technology as a mechanism to meet community needs.

Continue research and development to ensure that XR software and hardware comply with the Americans with Disabilities Act, which should make adoption easier for education providers.[43]

Conclusion

It will be critical to engage policymakers to make XR technology and training widely available. This includes activating business organizations and local chambers of commerce, as well as employers, workforce developers, education institutions, and training providers. Mobilizing stakeholders around this vision is essential to seeing success and proactively meeting this growing demand for talented workers. It's important for all entities to collaborate and support the development of career pathways focused on increasing individuals' comfort with immersive technology and tools. Aligning to business or company-specific needs, this can look like merging technical training in a field with existing short courses on XR technology such as "What Is the Metaverse?" on Coursera. From there, promoting experimentation with tools like Meta Spark Studio, and blending this with experience that supports the development of high-value human skills can help create new ways of work while unlocking new career opportunities over time.

Done well, immersive learning can unlock an opportunity for local and regional economic advancement, promote and stimulate entry into the labor force and sustained progression through it, and leverage a more flexible approach to training, hiring, and talent development that ultimately aligns with the growing business need and value for XR technology. Moreover, these technologies present innumerable opportunities for policymakers and education and workforce system leaders to leverage and deploy to provide career transition pathways and skilling opportunities to support workers as regional economies, industries, and labor markets shift, ultimately reducing the negative impact of job displacement.

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