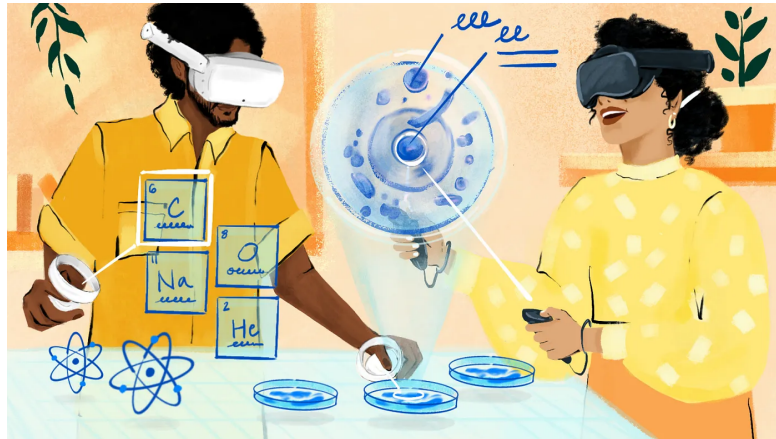


How the Metaverse Can Transform Education



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You're in the air traffic control room overlooking the runways of O'Hare International Airport in Chicago the morning after a heavy storm caused a number of flights to be rescheduled. Now the storm has passed, the pilots are itching to take off and the departure gates are chock-a-block. A pilot asks you to open Gate 1, so you do. Then another wants Gate 5 opened. Within seconds a request for Gate 3, then Gate 2, then Gate 4, then another pilot at Gate 1. As you open the gates one by one, the planes taxi and prepare for takeoff, but the taxiways are getting crowded. Just as one jumbo jet begins to zoom along the far runway, the plane you just let out of Gate 2 crosses its path and —

CRASH!

The stern-faced instructor isn't happy. But this isn't the real O'Hare airport. It's an algebra lesson in Virtual Reality and you'll soon be plotting flight paths on x and y axes and using equations to figure out potential collision points. Then it's off to south Florida to work out the probability of being hit by a hurricane by creating a simulator based on historic humidity and temperature data. Or to a rice field to mix chemicals for pesticide to keep the crops from being destroyed. And afterwards, you can join a virtual space with your teacher and other students to practice and apply what you've learned. It certainly beats the math lessons at my old school (or maths lessons as we called them, since the school was in England).

These examples are real lessons created by a company called [Prisms VR](#) that are being used in classes in 130+ school systems across 30 states in the US, as well as schools in Romania, Singapore and China. But they're just the tip of the iceberg. Metaverse technologies like virtual and augmented reality have the potential to revolutionize education and training, bringing teachers and students together in new ways, introducing interactive elements to classes that can help students retain what they learn, making experiences accessible

that would otherwise have been out of reach to many due to income or geography, and taking the risk out of otherwise dangerous or expensive training.

Digital technologies have transformed so many areas of education over the last two decades or so. I'm only in my 50s but when I went to school the most technologically advanced thing in class was a pocket calculator. Now iPads and other tablets are commonplace. Museums and galleries the world over have integrated touch screens and other interactive elements to their exhibits. Apps like Duolingo have brought language learning to smartphones. The fact these things have become normalized so quickly is a testament to the rapid way we have all seamlessly integrated new technologies into our lives.

But there are limits to two-dimensional technologies. While the shift to video-conferencing and other remote learning tools kept the wheels of education turning during the pandemic — something that would have been impossible just a few years earlier — anyone with teenage kids can attest to the fact that it was often a frustrating experience. It was hard to keep them engaged for lengthy periods interacting with thumbnail images of teachers and classmates on a flat screen. They lacked that vital sense of presence — being with their classmates and teachers, interacting in a shared space.

The metaverse is the next evolution of the internet — and it is exactly this sense of presence that sets it apart. It spans a range of technologies, including virtual reality (VR) headsets that transport you to whole new environments, immersing you in virtual spaces where you and others interact as avatars; augmented reality (AR) glasses that will one day project computer-generated images onto the world around you; and mixed reality (MR) experiences that blend both physical and virtual environments. These technologies create a more immersive, 3D experience where you feel like you are right there with another person or in another place.

Technologies that create a sense of presence and shared space offer new ways for educators to engage and interact with their students. This isn't about making teachers the servants of new technologies. Quite the opposite. It's about giving teachers more ways to do what they do best — teach. Getting the tech into the hands of teachers and trainers so they can shape how they're used will be the key to unlocking this potential.

For most of us, learning is social — we learn from and with others, and from each other's experiences. It's about interaction and discussion as much as it is about absorbing facts. That's why this unique feeling of presence and immersion these technologies create are so fundamental.

While the technology is new, and the research base is still emerging, the early evidence is really promising. Academic studies have found that VR can positively improve a variety of learning outcomes — such as comprehension, knowledge retention, student engagement, attention span and motivation. I think that's something we all intuitively understand. It is so much easier to remember doing something than being told something. According to a 2021 [study](#) by PwC, 40% of VR learners are more confident in applying what they've been taught and 150% more engaged during classes. Similarly, a

recent [survey](#) by [XR Association \(XRA\)](#), and the [International Society for Technology in Education \(ISTE\)](#) found 77% of educators believe these technologies ignite curiosity and improve engagement in class.

That's what makes the possibilities for learning in the metaverse so exciting. Instead of telling students what the dinosaurs were like, they can walk among them. Entire science laboratories can be built and filled with kit that most schools would never be able to afford. Students from disadvantaged towns can go on field trips to the world's best museums. This isn't science fiction or wishful thinking — it is happening right now.

One example that came up at a [roundtable event](#) I chaired with educators, academics and others in London last month is a school that has built a digital version of the Globe Theater — the circular Elizabethan theater where Shakespeare's plays were performed — and is putting on their end of term show on its famous stage, completely virtually. Young people won't be in the same physical space as their classmates, and they won't be traveling to London, but they will still be able to collaborate and learn how Shakespeare's plays were created for this unique space.

The combination of immersive technologies with powerful advances in Artificial Intelligence (AI) creates opportunities for education experiences that are much more tailored to the needs of individual students. Too often, education systems are built to be one size fits all. Using AI, a teacher with little coding experience could design a virtual environment to deliver a specific lesson. It will become possible to quickly and easily personalize curriculum materials to the learning needs of individual students. And because AI can process and translate multiple languages simultaneously, it can be a powerful tool for language learning in particular, especially when combined with immersive technologies. A language student could, for example, sit in a virtual Paris café, converse with the waiter and receive real time feedback on their pronunciation.

The four main ways the metaverse is transforming education and training

Re-imagining school lessons

In his book [Experience on Demand](#), Jeremy Bailenson, a leading researcher in the field of VR, coined the acronym DICE, suggesting that the kind of experiences that should be designed for VR are those that would be Dangerous, Impossible, Counterproductive or Expensive in real life. By allowing students to drive a train, monitor a disease outbreak, or even crash jumbo jets on virtual runways, immersive algebra lessons can show how to apply theoretical skills in real life.

There's great potential here for the teaching of languages. Every linguist knows it's easier to remember how to order a cup of coffee in another country when you've actually done it, rather than reading words and phrases in books or endlessly reciting them in a classroom. In VR, we can immerse language students in a city abroad. A recent [study](#) comparing the use of VR and videos in teaching English as a foreign language found that the VR group outperformed the video watchers on both listening comprehension and retention. Meanwhile, AR apps that are already available on the smartphones many of us carry in our pockets are bringing museum exhibits to life, or making the pages of an anatomy textbook pop out in front of us.

These technologies can free teachers from the constraints of the classroom and make lessons so much more vivid and interactive for their students. They can teach marine biology on the ocean floor, or deliver their philosophy lecture in an amphitheater in ancient Rome. A pioneering Danish company, Labster, has built virtual science labs that allow students to use the equivalent of millions of dollars' worth of equipment that no school could ever afford. And they can use it to conduct experiments that would be far too dangerous in real life. After all, in VR you can blow things up or spill acid everywhere without consequences.

Bringing teachers and students together in shared virtual spaces

In the metaverse, we will be able to bring different classes, students, and teachers together regardless of geography in a way that feels much more real than a Zoom meeting. At Morehouse College in Atlanta, Georgia, biomolecular chemist Dr Muhsinah Morris teaches her students in a virtual lab — a digital twin of the real chemistry lab at the physical university. In the virtual lab, students can conduct experiments just as they would if they were there in person.

Morehouse is one of 10 'metaversity' digital twin campuses in the United States — with a further 16 on the way — created through a partnership between Meta and VictoryXR to create replicas of existing campuses constructed in fully spatial 3D. In these virtual campuses, students can move about, socialize, learn and compete in activities, and take part in classes they can access remotely. These campuses are accessible to students who can't attend in person — they might have caring responsibilities, or not be able to afford the travel — and they're reporting impressive results. Morehouse found that students who learned in VR had an average final test score of 85, versus 78 in person and 81 for traditional online methods. They also reported an uplift in student attendance and engagement.

And this isn't just happening in Higher Education or in North America. Countries like Japan and South Korea are pioneering the use of immersive technologies in education. At Japan's N and S high schools, the largest online high schools in the country, more than 6,000 students learn in VR using Meta Quest 2 headsets. Their teachers report that this enhances the learning experience and enables students to nurture social skills even when they are physically far away.

Enhancing vocational training and removing risk

How do you train a vet to dissect animals without the need for actual animals? At Georgian College in Canada they use a VR program, also developed by VictoryXR, and in a separate program Veterinary Technician students learn about bovine and canine anatomy using an open source application that was developed by Virginia Tech University. These virtual settings give the students real hands-on experience without the need for live animals — or dead ones.

The metaverse can make vocational training like this much more accessible and affordable. In the metaverse, we can simulate the situations people will experience in the workplace — particularly those where it might be challenging or potentially dangerous to get real world experience. Plumbers can train on virtual pipes; firefighters can escape virtual buildings; nurses can train on virtual patients. Elsewhere at Georgian College, paramedics practice resuscitation on virtual patients, future architects use it to stand inside the spaces they design, and Maritime Ship Navigation students go on the virtual bridge of an oil tanker to navigate in and out of simulated ports around the globe. The College specifically embraced VR for a form of training that would otherwise be extremely expensive and dangerous in the real world.

Again, the early evidence suggests that immersive technologies can be extremely effective for teaching procedural tasks requiring a high degree of visualization and experiential understanding. A [study](#) comparing the outcomes of medical students learning how to respond to an emergency fire in a theatre found that 70% of the students who trained in VR were able to perform the correct procedure in the correct order — 50% higher than the control group who were exposed to a presentation and reading material instead. In Australia, St John Ambulance has worked with developer Start Beyond to use VR to transport first aid students into realistic situations where they can apply their skills with confidence, with 9 out of 10 students feeling prepared upon completion.

It's easy to see how the benefits of learning in VR could be particularly concentrated in science, technology and math (STEM) subjects, which are a key part of government economic growth agendas the world over.

New opportunities for lifelong learning

One of the most common misunderstandings around the metaverse, often made by people who don't use these technologies at the moment, is that it is all just about playing video games. But that's missing the point entirely. While gaming has been a big part of the evolution of these technologies thus far, the people using them right now consider it to be just one part of the experience. It's clear that many Meta Quest users already see education as one of the main motivations for owning their device, alongside health and wellbeing, work, socializing and more.

A host of apps already bring learning into people's homes. While those created by Jurassic Park Studios or National Geographic are fun to use, they also introduce people to new subjects and fire up enthusiasm to learn more. Apps like the Anne Frank House or Travelling While Black help people experience history, or even the present day, from someone else's point of view. Through [The March 360](#) experience, they could even feel what it is like to march with more than a quarter of a million people and witness Dr Martin Luther King deliver his famous *I Have a Dream* speech.

In the UK, a company called Bodyswaps is building full courses in these soft skills — things like interview training, public speaking, and building trust in the workplace. These skills have traditionally been hard to teach because they are fundamentally visual and three dimensional — if I attend a job interview the way I sit, use my hands, and make eye contact can be just as important as the words I say. More than 100 higher education institutions have already signed up to Bodyswaps and will be teaching soft skills in the metaverse this year — but there is certain to be crossover demand for people to use these types of app at home too.

The metaverse can help level the playing field

Perhaps most excitingly, the metaverse could help solve one of the most stubborn problems in education — equity. Children from poorer backgrounds falling behind, and staying behind, their wealthier peers is a complex problem that I was confronted with repeatedly in my time in Government in the UK. I introduced a number of policy changes to try and address this — like introducing universal free school meals for children in the first three year groups and creating a “Pupil Premium” to give extra funding to schools based on the number of children they had from poorer households. After leaving government, I chaired the [Commission on Inequality in Education](#) for the Social Market Foundation think tank, which found that the performance gap between the richest and the poorest in the UK has remained persistently large between the mid-1980s and the mid-2000s, with no significant improvement in that time. As our report said:

how much money a child's parents earn, which region they live in and their ethnicity are all very significant factors in how successful they are at school. Where someone comes from can still matter much more in determining where they end up in life than their talents or efforts.

This educational divide is by no means unique to the UK, as demonstrated by the OECD's Programme for International Student Assessment, which reports a pattern of poorer pupils lagging behind their wealthier peers around the world.

While much more research is needed to understand how the benefits of education in the metaverse will support all pupils, it's not hard to imagine the benefits of being freed from the limitations of time and geography. Metaverse technologies create the possibility of approaching geographic educational disparities in new ways. Colleges in disadvantaged areas will be able to collaborate and get support from those hundreds of miles away. An outstanding teacher could teach in an underserved school 100 miles away. A school system that has a shortage of teachers in a particular subject — a real problem in some parts of the United States — could recruit them to teach classes from anywhere in the country — and actually feel present.

It also opens up opportunities for ambitious students to learn from people they don't have access to locally. A college student in Madrid could attend a seminar led by a Professor in Seoul. Students in the most remote corner of Alaska could tour NASA, the Louvre in Paris, or the Grand Egyptian Museum in Cairo. A personal tutor could run a session with a student in a completely different city without either having to leave their house.

Research has already shown that VR may be a compelling intervention for students challenged within the current education system. As far back as 2001, it has been considered a promising way of supporting the social learning of children who have autism spectrum disorder, with more recent studies finding that VR "improved emotion recognition, social attribution, and executive function", and led to "a positive change in participant skills related to... interactions, use of eye contact, and initiation of interactions". A

combination of 3D interactions based on modern therapy techniques, emotional control and relaxation software, and simulation of various social situations, can improve the behavioral, communication and social skills of children. Teachers at Dublin's Coláiste Pobail Setanta School — for children on the autism spectrum — use a VR platform developed by Floreo to help their students learn social, behavioral, communication and life skills by navigating simulated situations like going to a supermarket or visiting a safari park full of animals.

In many parts of the world, young people too rarely see people like them reflected in the things they are learning about. Australia's Indigital uses VR to help children connect with and learn from indigenous elders about cultural knowledge, history and language — all while learning digital skills like AR, animation, audio recording and coding. Georgian College has built a virtual house specifically for indigenous students to learn, with objects labelled in both Anishinaabemowin and English words. Every Thursday, students meet with their teacher in avatar form, occasionally joined by an elder from the Indigenous community for conversations and storytelling.

And while some people might assume that VR could put more, not less, distance between a learner and their subject, in fact in some important scenarios the opposite may be true. When the University of Maryland Global Campus surveyed students who had met with tutors and classmates in VR they found that, for some, being an avatar reduced their fear of speaking to faculty members and interacting with peers. Students with agoraphobia and PTSD both reported experiencing difficulty with in-person interaction, but were comfortable in the virtual classroom.

This phenomenon is backed up by research. Dr. Yukie Saito at Japan's Chuo University studied the effects of VR on foreign language learning using Immerse and found that while participants in her studies felt hesitant speaking foreign languages in person, using an avatar lowers a psychological barrier and encourages them to express themselves without feeling self-conscious. The hope is that, when it comes to applying what they've learned in the real world, these students will bring the same confidence they felt in avatar form.

What happens next?

At the heart of all of this are educators. More technology isn't an end goal in itself. Technology in the classroom is exciting because it can help teachers, not replace them. The point of these technologies is that they can bring people together in new ways, creating new opportunities for teachers to connect with and inspire students. As with all innovation, our starting point should be supporting brilliant educators to deliver the most impactful and accessible programs of learning.

While this work has important societal benefits, the education market also presents commercial value for companies like Meta, as well as those companies and developers building education products for our devices. The EdTech market is thriving and estimated to grow a further 16% by 2026. From the calculator to the Acorn computer, the electronic whiteboard to the iPad, immersive technologies are likely to take their place in a long line of technological innovations that have found their way into schools and universities.

There are exciting things happening right now in the education space, but we are still a long way from realizing the full potential of these technologies. Meta's own headsets are not fully available in many markets, and there's a lot of homework we and others have to do to make sure that the products we produce are classroom-ready. In the short term, the application of metaverse technologies in education is likely to be easier in higher education and workforce training, where users are adults and providers are better resourced and able to adapt quickly. While some schools are doing trailblazing work, this sector is likely to take longer to develop as we learn more about the best way to use these technologies with different age ranges.

To make the metaverse a reality, Meta can't and won't be doing this work alone. Like today's internet, the metaverse will be a constellation of technologies, platforms, and products. When it comes to education and training, the apps and experiences that will find success will be built by others, and delivered by education professionals.

The Brookings Institution, which has produced valuable work on how to assess quality in education technology, highlights the importance of developers and technology companies communicating with the scientists who study how people actually learn.

That's why Meta is supporting a detailed, global research program that is looking at how to maximize the benefits of these technologies while minimizing the risks. For example, in Europe, academic institutions, think-tanks and other experts in the UK, Italy, Spain, France, and Germany, will examine and pilot how immersive technologies can contribute to the future of education, improve existing learning experiences, boost youth employability, and contribute to professional and executive training. This research will be published for the whole sector to learn from.

But the tech companies themselves can only do so much. Once the technologies exist, it is ultimately governments and other institutions that will have to make sure they are utilized properly across public education systems. What we really need is for policymakers, academic institutions and educators to recognize the opportunities these technologies present and run with them. It is for governments to develop ways to utilize new technologies in the public sector, and to provide the investment to make it possible at scale. And it is forward-thinking education administrators who deploy these technologies creatively in their schools and colleges who are going to provide the best practice case studies for others to adopt.

Above all, it is skilled teachers who know best how to inspire their students. That makes widespread teacher training an essential component of any government strategy — none of it will work without teachers who understand how to get the best out of these products. Getting this kit into their hands is the necessary starting point.

Governments can also start laying the groundwork through curriculum development, digital literacy schemes, and by supporting and convening educators to help steer this technology in ways that can have the biggest impact. Crucially, it will be up to governments to help to ensure that all schools have access to these technologies, so that educational inequalities

don't get further entrenched simply because better resourced schools can get hold of hardware others can't.

Some governments are already getting a head start. In India, where the Government has made digital skills a core part of its “techade” strategy, Digital Citizenship and AR-VR Skills have been introduced to the curriculum for children in grades 6–8 across 25,000 schools. More than 300,000 teachers and a million students in India have also been introduced to training in cyber safety, cyber security, digital citizenship, and immersive technologies.

A US company, Lighthaus, has developed a curriculum-aligned science app called Nano through a grant from the US National Institutes of Health, and is already reporting statistically significant gains in students' interest in and enjoyment of science. The US Department of Education also ran the EdSim Challenge, a competition to identify and reward “immersive simulations that transfer academic, technical, and employability skills”. In Poland, the Ministry for Education is supporting a schools project by VRHeroes, which teaches students about the Warsaw Uprising. So far, 25,000 Polish students have learned about this important historical event through being immersed in it and 2,000 teachers have learned how VR can be used as an educational tool. Building on that project, Meta is now working with VR Heroes and the Research and Academic Computer Network (NASK), under the Prime Minister's Chancellery, to create a training program for hundreds of teachers from across Poland, so they can learn how to use immersive technologies to teach students. It's early days, but these first steps are laying the groundwork for Polish students to be among the first to learn subjects like math, history and geography in VR.

Of course, some of the predictions people make of how future technologies will impact society are fanciful or overly-optimistic. Indeed, much of what we at Meta believe will make the metaverse so revolutionary doesn't exist yet. But that's not the case when it comes to education and training.

These technologies are already being used to teach and learn.

The potential they have to transform education more broadly relies not so much on technological advances but on scale and access. The more developers build these programs, and the more governments, companies, schools, colleges and other institutions utilize them and invest in them, the more impact they will have. And as the technologies mature and develop, so will their ability to translate ideas across cultures, break down socio-economic barriers, and create more and better ways for teachers to bring subjects to life for their students.



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