



VIRTUAL REALITY: OPPORTUNITIES FOR LEARNING?

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In 2016, Virtual Reality (VR) surged forward. The concept that we could watch a video with deeper engagement, immersion, 360 perspectives, and even complete virtual environments became a working experiment. From the surge of interest in Pokémon Go to the Facebook investment in Oculus to the most recent arrival in my LAB of a set of Snapchat Spectacles, the world of VR lit up in 2016.

So, can we use any or all of this to enhance learning? That became a widespread question from the field and The MASIE Center decided to invest in its exploration. We set up a VRLearn Project at our LAB to acquire, test, experiment with, and assess the changing world of Virtual Reality as it might impact Learning in the Workplace. We brought Bobby Carlton on for several months to be our front-line tester and we exposed hundreds of learning colleagues to this emerging technology in our LAB in Saratoga and at Learning 2016 in Orlando.

This report, "VRLearn: Virtual Reality & Learning", is an outcome of this project. It contains perspectives, curated content, and some experiences that were captured by our team in the last six months.

What does Elliott Masie think about VR Learning? Here are my quick thoughts on January 4, 2017:

- Virtual Reality and Augmented Reality are here and growing.
- Currently, the largest consumers of VR/AR are in the gaming world. But, that may just be the early adopters.
- Goggles that are worn, while they are "Oh Myyy" awesome, will not be the final destination of VR/AR. We will want to engage and respond, without wearing a large device over our eyes. Pokémon Go was a good early predictor of how non-goggled experiences will soar.

- Learning can be amazing with VR/AR...but we will need three elements to make it grow and be sustainable:
 - o Authoring Systems: We will need authoring systems that will allow learning professionals, or even users themselves, to create and adapt VR/AR Learning.
 - o Marketplace of VR/AR Learning Content: Organizations will jump at licensing great AR/VR content that can be acquired off the shelf with the ability to add minor adaption and personalization.
 - o Assessment Focus: VR/AR can play a unique role in the practice and assessment side of learning. Think of the role that a flight simulator plays with a new or experienced pilot. It may not be where they learn how to fly, but it is key to assessing and measuring their in-flight performance.
- Finally, we need ongoing research and experimentation in what works or does not work with VR/AR.

Let us not overstate, hype, or exaggerate the current state of VR for Learning. If we do, we will never get to the future of VR Learning. Experimentation, collaboration, and breaking our own assumptions and behaviors will set the groundwork for the future of Virtual Reality and Learning - whatever it is called.

We are placing "VRLearn: Virtual Reality & Learning" in Open Source and encourage you to share it with your colleagues. And, we would love to hear your continuing questions and observations. Send them to vrlearn@masie.com.

Yours in learning,





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VRLearn brings participants into a 360° immersive world where they can explore, learn, and have interactive experiences with the goal of gaining new knowledge in a personalized setting. VRLearn is rich with data and gives the learner the ability to fully direct experiences, choose from multiple pathways, and have a physical and emotional engagement that includes empathy and risk. Really, it's extreme storytelling and these experiences can come in the form of virtual reality (VR), which is a fully immersive virtual world, or as augmented reality (AR), which is VR interacting with one's real-world surroundings.

Immersive technology is exciting, in part, because of how fast it changes and how quickly it is being adapted and used in all aspects of workforce training. Many companies are using VRLearn as a way to recruit new talent, train employees, and promote team building and employee engagement.



Multiple Pathways Create Multiple Approaches to Learning

The learner is able to:

- Take the test/course multiple times and explore multiple solutions.
- Explore different options/solutions with the freedom to fail without risk.
- Explore new ways to be successful without the worry of using resources.

Empathy and Risk Drive Engagement

The learner is able to:

- Feel like they are taking an actual risk and make decisions accordingly.
- Experience a situation from the perspective of another person (e.g. someone of the opposite sex, someone with a disability, or someone with a different nationality). This is called the "In Your Shoes" experience.
- Understand workplace or location-specific cultural etiquette.
- Behave differently than they normally would and experience the effects of those behaviors on themselves and others - without consequences.

Physical and Emotional Engagement

The learner is able to:

- Experience full physical motion in the real world to navigate a scenario in a VR world.
- Bring up body temperature and feel tense, causing muscles to tighten up and flex.
- Feel emotions like fear, excitement, and curiosity.



WHAT ARE THE EXPERIENCES OF VRLEARN?

360° Immersive Views of the Workplace or the Learning Environment Provide Opportunities for Contextual Learning

The learner is able to:

- Move around and explore the immersive experience.
- Try things out in a safe, simulated environment without risk.
- Manipulate, shrink, and enlarge objects in all directions.
- Move freely in the experience and look through panels and walls.
- Create an object and have it run based on the actual laws of physics.

Learner Directs to Create a Personalized Learning Experience

The learner is able to:

- Control, direct, and customize the course
- Change the perspective at any time
- Start over and retry an experience
- Change the speed of the course
- Remove or add elements to the experience

Storytelling on Steroids

The learner is able to:

- Experience scenarios, new techniques and procedures, or prepare for a difficult task without having to worry about failure.
- Experience a story in a much more dynamic way with ZERO constraints.
- Think unconventionally to explore more options and alternate solutions.
- React to many elements of a story and, in return, supply more data.
- Experience the same or altered VR scenarios over and over.

Practice and Fail Forward Often

The learner is able to:

- Attempt tasks multiple times.
- Fail without risk, which encourages them to explore new solutions and be creative in their pursuit.
- Observe a problem, form a hypothesis, test that hypothesis, and continue to try again and again until success is achieved.
- Practice and fail-forward, allowing them to be creative in their problem solving. This encourages the learner to keep trying.
- Seek an alternative approach, one that might prove to be faster or more productive than a previously successful attempt.

Social Collaboration Option

The learner is able to:

- Collaborate with another learner or a team - locally or globally - or with artificial intelligence (AI). The collaboration could be examined from every angle and the learner could move freely from team to team in VR.
- Complete on-the-fly training when needed.
- Open up doors to faster and more productive problem solving.

Data Rich Environment

The learner is able to:

- Compare success and failure rates from different experiences.
- Determine which routes they took were more or less productive.
- See a comparison of how they physically reacted in each story or path.
- Contribute data to be used for future training with teams, individuals, or on a company-wide level.



By combining all of the above, the learner can achieve an "All In" Effect

The learner is able to:

- Be fully engaged. All of their senses are being pushed to make choices and reactions based on what they see, hear, and feel.
- Explore multiple paths and have a physical and emotional engagement, which leads to empathy and a feeling of risk, or motivation to complete a task or avoid failure.
- Have more of a natural reaction. With the ability to "alter" the storytelling, the learner will react differently in each situation.

ARE THERE EXAMPLES OF HOW IT COULD BE USED IN WORKPLACE AND OTHER LEARNING ENVIRONMENTS?

Human Resources and Employee Development (Across Industries)

- **Recruitment**

VR allows students to visualize themselves at a company, see the work culture, and get an idea of what a day at the office is like. Innovative companies around the globe have turned to VR to show off their workspaces and let candidates try out their skills. Companies like General Mills, Jet, Deutsche Bahn, and Commonwealth Bank of Australia have turned to VR as a recruitment tool by setting up VR stations at college job fairs.

- **Onboarding**

The immersive VR experience could be used as a way to speed up employees' familiarity with their new work environment and culture before they ever set foot inside the office.

- **Employee Job Training**

Many industries have turned to VR as a method of employee job training. In a study carried out by the National Training Laboratory, retention rates for lecture style learning were at 5% and reading rates were at 10%, while the method of VRLearn had a retention rate of 75%. This is why industries have moved to VR, which allows learners to make critical errors and experience the results in a safe environment. VR also dramatically reduces the cost of training and produces a lot of data regarding learners' accuracy, mistakes made, and completion percentage.

- **Continued Learning of New Processes and Procedures**

VR and AR have been great tools for continued learning in the workforce. VR/AR is being used as a way to train employees on new processes and work methods, as well as for continued learning. It allows learners to make mistakes during training without putting themselves at risk, using up materials, or putting expensive equipment at risk.

- **Team Building/Development**

VR experiences have proven to offer great employee development and team building. They can showcase how an individual works independently or in a team environment as well as how well an individual or team can give or receive instructions. They encourage coaching and communication skills, and allow learners to fail forward and explore various pathways to success.

In Addition, Some Specific Industries Currently Use Immersive Training

Military Training

One major user of immersive training is the U.S. military. Soldiers are able to participate in new recruit training, equipment training (e.g. driving tanks and using guns) and other standard training. This takes the danger out of the training situation to ensure the soldiers' safety, but the soldiers still feel as if they are in actual combat.





Medical Training

Many medical facilities are seeing the benefits of training in VR. This technology allows students to experience everything from a surgical procedure to the study of anatomy. For example, the work being done at Royal London and St. Bartholomew's hospital is changing how other hospitals train future surgeons. This training means fewer textbooks and more thorough experiences. The students all wear VR headsets and each of them will have an over-the-shoulder surgeon's view of an actual surgery vs. what medical trainers call "Operating Theater", where surgeons in training must peer over each other's shoulders with only the students in the front row having the best view.

- VR training eliminates Operating Theater and gives EACH trainee the perfect view.
- Thousands of surgeons can be trained simultaneously.
- In 2014, a surgeon streamed a training session through Google Glass that reached 14,000 surgeons worldwide.
- In 2016, a surgeon live streamed a cancer surgery in VR to remove a colon tumor. The surgery was streamed worldwide and captured every part of the surgery.

Warehouse Training

Online shopping has skyrocketed in recent years with sales increasing both domestically and internationally, often with one-day shipping expectations. With this increasing demand, many companies like Amazon, Jet, and other online stores are hiring large numbers of warehouse workers and forklift operators. Many of these companies have turned to VR as the way to train a large number of warehouse employees quickly. OSHA (U.S. Occupational Safety and Health Administration) recognizes VR training and certification as a viable option to meet training demands and many companies and retailers are now using VR to speed up the process of training a forklift operator.

Air and Space

- Through VR, pilots are able to learn how to operate a fighter jet, participate in formation training, and engage other fighter jets. VR allows the pilot to experience every part of piloting a jet other than the g-forces they will experience during flight.
- NASA uses VR as a way to train astronauts to perform complicated tasks (repairs and experiments) in zero gravity.



Sports

Organizations like the NFL, NBA, and MLB are using a form of VR as a way to train and work with athletes. They also use it as a tool to train employees and assist with workplace issues like conflicts and discrimination. VR is also being used as a recruitment tool to entice high school athletes to apply for or consider a college sports program. The VR experience gives the student a very detailed, inside look at the college training facilities along with the coaching staff.



For a Consolidated list of Companies Using VR mentioned in this report, see Appendix A

WHAT IS THE STATE OF VRLEARN IN 2017?

Billions of dollars are slated to be invested into VRLearn's future development, both for commercial and non-commercial use. Many companies are seeing the potential impact of VR/AR for elements like recruitment, employee engagement, and employee development. Companies are being creative yet practical with their use of VR/AR. Developers can create a very specific VR/AR experience that is specific to certain tasks or procedures using almost any type of VR hardware. We are also starting to see companies using commercial VR experiences that can be found in any VR store (e.g. Viveport, Steam, Microsoft App store, Apple Store, and Google Play) and using them as training tools, team building tools, or employee development tools.

IS THERE A FUTURE WITH VRLEARN?

We know that VR has found its way into sporting events, entertainment, marketing, and the real estate market. As for VRLearn, the idea is indeed being used in many K-12 classroom environments. Schools report that up to 20% of their curricula involve using VR, while VRLearn in the workforce is finding a slightly bigger audience with about 30% of the workforce using VR to train employees. Fields like medicine, sports, and the military have adopted VRLearn as a way to train individuals using VR scenarios. We are also finding VRLearn being used in the medical field to treat phobias, assess brain damage, and to treat PTSD and even autism. VRLearn shows a lot of potential, but what we don't yet know is just how much further VRLearn will go into areas of training. The question we need to ask is will VRLearn become part of the learning norm? Technology is fast moving, always changing and evolving, but will companies move just as fast? The corporate environment is always looking for ways to expedite training in a way that is quick, thorough, and that provides positive results. It's reported that almost 88% of companies with \$1 million to \$1 billion of revenue see huge potential in VR for training, employee development, and customer and brand engagement.

- PERSPECTIVES -

Traditionally, the classroom has been a safe environment in which to learn. Learners sit for a lecture, aided by a textbook and perhaps some slides and movies. It's a model that works and, in some cases, it's still the best model. But traditional learning doesn't transport you, evoke emotions, or give you control in the way that VR learning does. VRLearn allows you to practice dangerous tasks and participate in risky scenarios - without the risk. Learners can continually practice, learn, and fail-forward. VRLearn gives the learner the ability to direct their course by controlling the pace and perspective.

We feel that VR and AR are incredible engagement tools. As they become more accessible for individuals, they start to become part of the learning norm. With VRLearn, the learner has a fully immersive 360° experience that allows them to control the learning environment, change the perspective, and be able to direct the immersive experience. The learner is out of the chair and away from the textbook, directing their own experience with the freedom to explore solutions, control the environment, fail without fear, and come up with innovative and creative ways to resolve tasks. Is VR/AR a perfect learning tool? Not yet, but we are making advances in VR technology that will bring us closer to completely realistic, immersive experiences. Eventually we will move away from the clunky headgear and have something more portable that will allow the learner to move around in VR freely without tethers.

We firmly believe that VR is not about the headgear. It's about the experience that the learner has and how it engages them, draws them in, and stimulates their senses. It does this by immersing the learner, giving them the ability to design, alter, and manipulate their experience, as well as have physical and emotional reactions by stimulating emotions (e.g. fear, anxiety, happiness, and excitement). The combination of all of this can spark curiosity, innovation, and success in a learning environment.

WHAT ARE THE TYPES OF IMMERSIVE EXPERIENCES AND HOW ARE THEY DELIVERED?

Immersive experiences can come in a variety of forms. Some will fully immerse you with sight and sound, creating a full digital environment that will fully stimulate your brain and body. While other experiences will create a digital layer on top of your real-world environment. Immersive technology can be delivered through a headset, mobile device or a personal computer.

For more details, see Appendix B - Glossary.



See Appendix C for a list of some of the more popular companies offering VR/AR Solutions.

WHAT ARE EXAMPLES OF VR HEADSETS AND HARDWARE?

The VR/AR market is a rapidly changing one with new companies offering headgear, haptic suits, accessories, and experiences at an incredible rate. It is estimated that the VR/AR industry will generate \$150 billion dollars of revenue by 2020. Here is a list of the more popular companies currently offering VR/AR hardware (or that will have something in the very near future).

In 1987, former Atari employee Jaron Lanier, founder of the Visual Programming Lab, coined the phrase "virtual reality" and was one of the first companies to sell VR gear such as the Dataglove and VR goggles.

1987

1952

The idea of an immersive experience began in 1952 when Morton Heilig created the first Head Mounted Display (HMD). It was a simulator for 1 - 4 people that would provide the illusion of reality using a 3-D motion picture with smell, stereo sound, vibrations of the seat, and wind in the hair to create the illusion.

2012

In 2012 Palmer Luckey created a wearable HMD, which he called Oculus Rift, which was much more comfortable than earlier models and had a much more robust software that allowed the user to be immersed in the game.

WHAT IS THE HISTORY OF VIRTUAL REALITY?

Appendix A - Consolidated list of VRLearn Examples

- General Mills, Deutsche Bahn, and Jet use VR as a recruitment tool by going to college campuses and showing potential applicants what it's like to work for them.
- Bosch trains 8,000 - 10,000 service technicians on direct-injection and braking technology using the Oculus Rift headset to take three-dimensional tours of the inner workings of a car engine to enhance technicians' understanding. The mobile tour consists of a classroom experience, which is supplemented by wearing the Oculus Rift DK1 to watch the automotive parts in action. The sessions consist of a 10-minute virtual lesson followed by a 15-minute discussion centering on the participants' thoughts, including how to implement the ideas into their work environments.
- Jiff, Inc uses Pokémon Go as an engagement tool for its wellness program with an 83% success rate in participation.
- Volkswagen is using VR and AR for service training on new cars and repairs.
- L'Oréal uses VR to train new stylists on products and work culture, but also as a tool for continued education on new products and trending makeup and hair styles.
- ThyssenKrupp uses AR headsets with all of its elevator technicians for repair work. Since moving to this technology, elevator repair times have been cut from 1-2 hours to just 20 minutes.
- Lowes created the HoloRoom so customers can create a virtual mock-up of their homes and then work with designers for renovations.
- YouVisit works with colleges to create VR tours.
- Boeing trains engineers and pilots with VR.

Appendix B - Glossary

Virtual Reality - (VR) is a multimedia or computer-simulated reality that creates a full 360° immersive experience for the user. Users can experience VR with only 360° video but they have a more immersive experience if they use audio and video together (vs. just video). In order for VR to be truly immersive, the audio cues need to match the visuals so the brain fully processes the VR experience. This immersive environment can be similar to real-world experiences and locations, or to fantasy-based locations, by using 360° photo, 360° video, or a VR simulation to immerse the user.

Augmented Reality - (AR) combines VR with the user's view of the real world to provide a composite view. A computer or mobile device superimposes VR images over the user's real-world environment. Examples of this can be seen with the game Pokémon Go, where 3-D VR characters are "captured" in the real world. Another example is your mobile device showing a route to a destination using arrows and street turns.

Mixed Reality - Mixed Reality is when digital and physical worlds interact with each other in real time. This experience is mostly seen when a video game player's physical form is actually part of the game play. This is made possible by using a green screen, a real-time camera, and foreground and background images from the game play. The user uses a controller to emulate hands in order to lift up objects, throw them, etc.

Merged Reality - Not to be confused with Mixed Reality, Merged Reality is different in the sense that users have the ability to use their actual hands in the experience. For example, users can turn doorknobs and push buttons and other objects using their hands instead of a controller. Users can also bring any real-world object into the AR environment, and that real-world object has a "physical" presence in AR. For example, you could use your own car keys to carve your initials into an AR/VR tree.

Augmented VR - This is a technology that the creators of Oculus Rift are working on. They predict it will be something we could be using in 5 years. Augmented VR would recreate an entire digital environment based on one's current real-world surroundings. Augmented VR needs 100% accurate eye tracking and a larger depth of field to be convincing to the user. The concept for Augmented VR was recently shown at the 2016 Oculus Connect conference.

How is The Immersive Experience Delivered?

Tethered Headset VR - The user can participate in a VR experience by using a computer with a tethered VR headset (also known as a Head Mounted Display - HMD) like Facebook's Oculus Rift, PlayStation VR, or the HTC Vive. The user has the ability to move freely and interact in the VR environment while using a handheld controller to emulate VR hands. But, the user has a limited area in which to move about because they are tethered to a computer.

Non-Tethered Headset VR/AR - These devices are headsets and computers built into one system, so users are free of any cables limiting their movement. These devices use AR to deliver a 360° immersive experience. Much like with Oculus Rift and Vive, the user would be able to move around in the AR environment as well as interact and manipulate objects. A great example of this headset is Microsoft's HoloLens, which delivers an AR experience to the user through just a headset.

Mobile Device Inserted into a Headgear - To experience VR, the user inserts their mobile device into a Google Cardboard, Samsung Gear 360°, or any other type of mobile device headgear, along with headphones if they choose. This form of VR doesn't require the user to be tethered to a computer and most VR experiences can be 360° photos, videos, and interactive scenarios.

Mobile VR - The user can access VR without any type of headgear simply by using a mobile device and headphones (optional). They can still have many of the same experiences that they would through Google Cardboard or any other type of mobile device headgear. Although they don't get the full immersion that they would with headgear, they would still be able to experience VR. Currently, this version of the VR experience seems to be the most popular because it only requires a mobile device. Apps like Pokémon Go and Snapchat's animated selfie lens only require a mobile device and have a huge number of users.

Desktop VR - Using just a desktop computer, the user can access 360° photos and videos, as well as other VR and AR experiences, by using the trackpad or computer mouse to move their field of view and become immersed in the VR scenario.

New VR - Non-mobile and non-headset platforms like Leap Motion use depth sensors to create a VR image of one's hands on a desktop computer; they emulate hand gestures in real time. This technology could be used for anything from teaching assembly in a manufacturing plant to learning a step-by-step process to medical training.

Appendix C - VR/AR Solutions

- Oculus Rift - www.oculus.com
- HTC Vive - www.htcvive.com
- Playstation VR - www.playstation.com
- Samsung VR Gear - www.samsung.com
- Google Daydream - <https://vr.google.com/daydream/>
- Leap Motion - www.leapmotion.com
- Magic Leap - www.magicleap.com
- Most mobile devices

