



# The Effectiveness of Virtual Reality Soft Skills Training in the Enterprise

A Study

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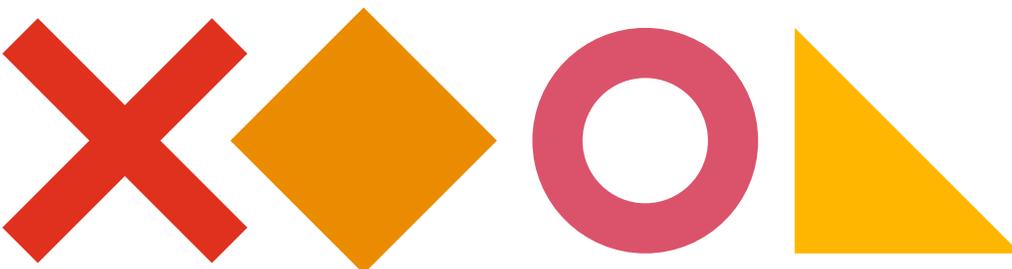
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SECTION 1

# Introduction



# Why study VR for soft skills training?

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Digital upskilling is part of our digital journey at PwC to enable our digital mindset and improve the way we work. We continuously evaluate new learning technologies and methods to determine how we can train employees faster, smarter and more cost-effectively.

PwC's Emerging Technology Group has explored the business value of virtual reality (VR) for several years. In the training world, VR has some compelling use cases. Until recently, VR work in the enterprise has focused on job skills simulation training: flight simulators, safety procedures, equipment operation and maintenance, etc. Industries using VR for safety, repair and maintenance simulation training are seeing improvements in process efficiency, but we wondered whether virtual reality would be as effective for training leadership, soft skills or other human-to-human interactions? Does it have advantages over traditional classroom or e-learning methods?

# About the study

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Between February and October 2019, PwC's Emerging Technology Group, US Learning and Development Innovation team, supported by Oculus for Business and Talespin, collaborated to plan, design, build, deploy and evaluate the results of a soft skills training module. The VR pilot studied the impact of using VR to train new managers on inclusive leadership, a specific soft skills course that is part of PwC's focus on training our leaders about diversity and inclusion.

Selected employees from a group of new managers in 12 US locations took the same training in one of the three learning modalities: classroom, e-learn, or v-learn. Learners were allowed to take the course in only one of the three modalities. The team surveyed and provided learners a pre-assessment prior to and a post-assessment immediately after the course. Users also completed another assessment 30 days later to determine retention and provide any additional learnings they may have discovered.

Between November 2019 and February 2020, the team analyzed the data, including evaluating the cost associated with deploying each of the three courses, to compare the value of each of the three modalities. We also investigated what would be necessary to effectively deploy VR training at enterprise scale, with a strong focus on cost-effectiveness and return on investment (ROI).



## Summary of findings

V-learn, using virtual reality to train employees on various skills, was more effective than classroom and e-learn training modalities at teaching soft-skills concepts. The v-learners were up to **275% more confident** to act on what they learned after training—a 40% improvement over classroom and 35% improvement over e-learn. V-learners were up to **four times more focused** than e-learners. They completed training on average **four times faster** than classroom training and 1.5 times faster than e-learn. V-learners were **3.75 times more emotionally connected** to the content than classroom learners and 2.3 times more connected than e-learners. On top of those benefits, v-learn was estimated to be more cost-effective than classroom or e-learning modalities when delivered at scale.

**V-learning will likely be an accelerator that helps drive a new age of enterprise training and education by delivering a cost-effective, immersive, and efficient experience to train employees on soft skills.**

We found that VR is ready to deploy at enterprise scale. The team was able to provision, deploy and manage a large fleet of VR headsets (head-mounted displays, or HMDs) with a very small team. We determined that while VR training would not replace classroom or e-learn modalities anytime soon, it should be considered as part of a blended learning curriculum when training specific types of skills. When you combine classroom, e-learn and v-learn together, you provide your employees with an industry leading approach.

V-learning will likely be an accelerator that helps drive a new age of enterprise training and education by delivering a cost-effective, immersive, and efficient experience to train employees on soft skills.

# 275%

more confident to act on what they learned after training

# 4x

faster than classroom training on average

# 4x

more focused than e-learners

# 3.75x

more emotionally connected to the content than classroom learners



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## SECTION 2

# Study Concept Development



# Study inspiration and design

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In September 2018 at an Emerging Technology conference in Boston, the team experienced a VR demonstration that used a virtual human avatar to train a human resource professional on how to legally and empathically terminate a worker's job. [The "Barry Demo,"](#) created by Talespin Reality Labs, provided an immersive, engaging and emotional experience in which a trainee, using his or her own voice, would interact with a virtual human.

In the Talespin VR demonstration, learners play the role of a manager required to fire Barry, a fellow employee. The demo includes the dialog, heavy emotions and stress normally found in this type of situation. Even in a digitally created room with a computer-generated character, users feel emotional and physical responses while communicating to Barry that he is fired.

When interacting with Barry, the user must choose from a number of effective and ineffective conversations, with different termination pitfalls, in addition to Barry's verbal and physical reactions. The resulting experience feels genuine, and the training is not only about what is said, but also how the user responds to Barry's reactions.

This VR training experience felt like a game changer, but we needed quantifiable data. The PwC Emerging Technology team knew the technology, but didn't have the knowledge or experience to understand the psychology and science behind it. They reached out to PwC's Learning and Development group and were introduced to a team of learning scientists who were looking at VR as a potential training tool. They understood the science behind what learners were feeling, but didn't understand the complexities of the technology. It was a perfect match.

Both teams worked together for more than 10 months to socialize the use case, secure the additional funding necessary, and then design, build, deploy and analyze the results of the study. PwC collaborated with Talespin to use their software platform. They also provided guidance and support on how to build an effective soft-skills training course in VR. Oculus for Business provided hardware support, as PwC was one of only a few companies that had access to early versions of their hardware and software management platform. Collaboratively, we worked as a single team to build a solution that would likely improve a user's VR learning experience.

**We needed the study to answer two specific questions:**

**1**

**Is VR soft-skills training more effective than traditional training methods?**

**2**

**Is VR soft-skills training more cost-effective to deploy than traditional training methods?**

For PwC, this would mean comparing VR training, what we called "v-learn," to our two most common training methods: classroom and e-learn.



# Our initial hypothesis

**Our hypothesis was that training using VR is more effective in achieving learning outcomes than traditional training methods (classroom or non-VR digital experiences).**

**To determine if soft-skills training in VR is more effective, the outcomes would focus on the following:**



## **Employee satisfaction**

We assumed users would enjoy v-learn more than traditional learning methods. We wanted our learners to feel like their time was spent doing something valuable and enjoyable. If learners felt that the training was effective, it could help build employee satisfaction and lead to better employee retention.



## **Learner flexibility**

We assumed v-learn would help provide a more flexible remote learning experience to our employees than traditional classroom methods. Our people are our greatest asset, and having them travel to attend live training can be impractical and costly. It would be important to enable employees to have the flexibility to take the training away from the workspace, as that is easier to fit in with their schedules and saves time and energy.



## Comfortable learning environment

We assumed v-learn would provide a more comfortable and less stressful environment to practice new skills than traditional methods. Practicing skills in VR offers the ability to try different paths to achieve better results. Learning something new involves being awkward, making mistakes, course-correcting and trying again. By giving people the opportunity to repeat a task in a natural way, practice builds confidence, which improves quality and helps to reduce mistakes.



## Improved attention

We assumed v-learn would result in fewer instances of being distracted while learning (i.e., less multitasking than traditional methods), and distractions result in lower comprehension and retention.



## Higher information retention

“Emotion has a substantial influence on the cognitive processes in humans, including perception, attention, learning, memory, reasoning and problem solving.”<sup>[1]</sup> We assumed v-learn would possibly evoke deeper emotional connections than traditional methods, which significantly improves retention of the information learned. Higher retention also means learners may require training less often.



## Confidence building

We assumed v-learn would help build more confidence in the execution of learning outcomes than traditional learning methods. Confidence builds employee satisfaction, leads to better employee retention, improves quality and reduces mistakes.





## The course topic

**The next task was selecting a curriculum to compare the three modalities. We focused on one of PwC’s top-priority topics: Inclusive Leadership and Belonging at PwC.**

In 2018, PwC mandated that every manager and above take classroom training on inclusive leadership. This training, designed and built by PwC, focused on how familiarity, comfort and trust (FCT) influence hiring, staffing and performance reviews. During the training, learners are asked to understand personal and team member behavior that could potentially be caused by unconscious bias. The goal of the training is for learners to commit to using only objective criteria in decision-making.

Some participants evaluated the training as “phenomenal” and reported feeling encouraged by PwC’s commitment to diversity, equity and inclusion. Others felt the training was awkward and worried that their comments shared during discussion might be misconstrued, which may have created reluctance to participate during the course. Even though the classroom training was mandatory, there are always a significant number of employees who are unable to attend due to client conflicts, so this training was also available as an e-learn course.

We selected this preexisting training curriculum for the comparison study because it was applicable to a wide audience, and we felt it would be significant if we could make a bigger impact on this issue through a more effective training method. The US PwC’s Office of Diversity and Inclusion was also consulted. This enabled us to create an e-learn and v-learn variant of the curriculum that would be designed to meet the same learning objectives as the classroom course.

## Classroom

For the study, the classroom version was identical to the late-2018 class, in which groups of up to 60 PwC staff members gathered at their local office for a two-hour session facilitated by a PwC partner and two directors (or senior managers). Facilitators were given preparation documents to confirm training standardization across 40 office locations. The facilitators led the groups through a series of videos, reflection activities and discussion topics.

Thirty minutes of the class was dedicated to encouraging commitment to inclusive leadership behaviors and exploring how potential unconscious bias might develop and contribute to non-inclusive leadership behaviors. One hour of the class was dedicated to identifying inclusive and non-inclusive behaviors in specific PwC situations. The facilitator would play a video demonstrating non-inclusive leadership behaviors in team discussions around hiring decisions, project staffing and project performance credit. After playing the video, facilitators asked learners to identify undesirable behaviors and highlight which inclusive behaviors should have been employed instead. The goal was to help learners self-identify where they could better employ inclusive leadership behaviors.



## E-learn

The online module allowed learners to take the training at any time by using their laptops. The training was 45 minutes and guided learners through the same activities, videos and reflections found in the classroom version. Learners participated by watching, selecting the next button and answering multiple choice questions. The largest challenge with the e-learn training was the inability to control learner attention. They could easily be distracted and focus elsewhere during the “watch” portions of the training.





**We hypothesized that placing the learner directly in the scenarios covered in the curriculum and giving them the ability to act as they might in real life would be more rewarding for them.**

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## V-learn

We needed to design and develop the new v-learn course. We leveraged the existing classroom and e-learn content, but needed to employ it in a significantly more interactive simulation. The classroom and e-learn course experiences were linear: A video was shown, the learners asked some questions, then the next scenario was presented. A VR experience is achieved by placing a VR head-mounted display (HMD) over the eyes of a learner, replacing the view of their physical surroundings with a digitally generated display, which leaves the learner feeling he or she is in a new environment.

The course design could have used a virtual classroom, where learners could passively watch and listen to the classroom presentation. However, we determined this linear approach would not leverage any advantages of the VR modality. We hypothesized that placing the learner directly in the scenarios covered in the curriculum and giving them the ability to act as they might in real life would be more rewarding for them. The same three scenarios would be presented (who to hire, who to staff and who got the performance differentiator) in the three scenarios, but instead of watching a video, the v-learner would be one of the team members participating in the discussion.

In each of the scenarios, learners would be presented with situations and questions where they needed to act and make a choice. Not all of the choices provided were correct, so a learner could make mistakes. This wasn't necessary in the classroom or e-learn training, but it was critical for the v-learn. The team would need to create a branched narrative for each of the possibilities because if the learner chose incorrectly, the interaction on the screen would have to react to the learner's choice. At the end of a scenario, the learner would be provided feedback on the decisions he or she made and would be given the opportunity to try again.



## Designing the v-learn course

**Unlike the classroom and e-learn courses, which were built from existing content, the v-learn course took almost three months to design.**

We understood how to create a branched narrative, but we contracted with Talespin to help guide us through the design process and the VR development.

At the same time, we needed to understand how users would react to the overall VR experience, so we explored different approaches to help enable a positive learner experience. This impacted the design of the course, so close contact was maintained between the project workstreams.

In the final v-learn course, learners find themselves in a virtual office (modeled after actual PwC offices). They are speaking to a group of animated virtual characters that are representative of PwC colleagues sitting at the conference table or are attending via a conference call. Learners play themselves as they carry out professional conversations with characters to determine whom to hire, whom to staff, and which ones to credit for success.

In each of the three scenarios, the learner speaks directly to virtual characters, reading dialogue aloud from a list of options. The head-mounted display microphone collects the spoken choice, and a voice-to-text service matches spoken words to the option.



The program then records the learner’s choice. Virtual human characters then react to what the learner says, and the conversation progresses with more options. Each option allows learners to observe and practice the inclusive leadership behaviors identified as key learning points of the curriculum.

During the course of the conversations, learners may state that another character is showing bias for a particular candidate, ask questions to collect information or share their own candidate recommendations. They must read their chosen dialog aloud, versus saying “A,” “B,” “C” or “D.” Having the learner say, “I think Marie should be given the performance differentiator.” gave the simulation a more realistic and conversational experience. It also, subconsciously, reinforced the desired behavior.

Each module was five-to-seven minutes long, depending on the learner’s choices and speed. After each conversation, learners could review their dialogue choices. Weak and neutral options selected by the user are highlighted, and wording reflective of more inclusive behaviors is presented, along with explanations as to why the recommended dialogue is more inclusive. Learners are allowed to repeat and practice each scenario as many times as desired.



# Measurement

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In late 2018, the firm had already trained more than 13,000 leaders on inclusive leadership. The v-learn training was scheduled to begin in August 2019, so we needed to find enough leaders to participate in the study.

Each year at PwC, more than 700 senior associates are promoted to manager. We determined that if we combined those associates with new senior experienced hires and leaders who missed both the classroom and e-learn course, the total potential study participants could be greater than 1,600. We identified our test group and divided them into three groups. Each group was asked to take one of the following training sessions: classroom, e-learn or v-learn.

## **Learners were given identical assessments and surveys before and after completing their course. Assessments included:**

- A pre-assessment, which evaluated the ability to make inclusive leadership decisions before taking any course.
- A post-assessment, which evaluated the ability to make inclusive leadership decisions after taking their assigned course.
- A retention assessment, which evaluated the ability to make inclusive leadership decisions 30 days after taking their assigned course.

We also conducted experience surveys and performed face-to-face and phone interviews to capture the learner experience.

The team engaged groups of test users to gauge the effectiveness of the learning and the sentiment about the user experience (UX). Iterative improvements were made throughout the summer based on UX testers' feedback.

## SECTION 3

# Technology and Operations Considerations



# Technology and operations considerations

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It is one thing to create virtual reality software simulations, but it's a completely different challenge to scale the deployment of head-mounted displays (HMDs) in the enterprise. Other than content development and/or licensing of content, HMDs and their operations require the greatest investment when building VR capabilities for the enterprise.

Our initial estimate of the number of PwC staff who would be eligible to participate in the study was greater than 1,600, and training would take place in 12 PwC office locations throughout the US.

## **We needed to purchase HMDs, but we would also need to:**

- Manage the HMDs
- Manage how software was loaded on the HMDs
- Confirm the HMDs were secured both physically and logically
- Determine where in the various offices the experience would take place
- Confirm that the data collected was secure and met PwC's guidelines for employee privacy.

To address the location requirements and other contributing variables, it was necessary to get answers to several questions: Which HMDs should we purchase? How many should we order? How will they be managed? How will we secure them physically and logically? And how will we protect data collected from each user?



# Which type of HMD should be purchased?

**There are two categories of VR HMDs: tethered and wireless.**

## **Tethered HMDs**

Tethered HMDs require the HMD to be connected to a high-performance computer via cable(s). This is the traditional way HMDs are deployed for VR as it provides better performance. These setups could also require lighthouses (tracking sensors that help the computer determine where the user is positioned inside a simulation) and spaces as large as 10m x 10m to support 6 Degrees of Freedom (6DoF) experiences.

However, this category requires specialized IT support, large spaces not often found in organizations, and greater investments. It is not uncommon for tethered HMDs ecosystems to cost approximately \$5,000 each (including the VR HMD, positional tracking, controllers and a high-performance computer with the appropriate high-performance video cards).

## **Wireless HMDs**

Wireless HMDs are self-contained. Everything necessary — computing power, positional tracking, network connectivity and controllers — is wireless. Since these units are wireless, they are easily transported from environment to environment; there is no need for VR users to be concerned with tripping over wires while in the experience; and they do not require any

special IT support services. However, immersive hyper-realistic experiences are limited due to lower graphics and CPU performance on these HMDs, and in-headset duration is limited to a few hours, as they are powered by rechargeable batteries. Wireless HMDs require less investment than tethered HMDs, with prices ranging from \$199 to \$1,499.

We had extensive experience deploying tethered solutions, but due to how much technical support they required, we selected wireless HMDs to support the VR study.

## The Oculus Quest

For this study, PwC selected the Oculus Quest, a wireless 6DoF HMD that provided a majority of the features we needed. It was wireless, tracking was handled by the headset itself and there was no need to set up external tracking sensors (lighthouses). It also had a built-in microphone so we could use voice control within the training application in lieu of the controllers (if we chose to do so), it was comfortable to wear once adjusted properly and battery life was adequate to meet our needs.

Other HMDs had similar features, but Oculus also had the Oculus for Business solution, which let our team manage our fleet of HMDs remotely. This software helped enable our team to turn on and off specific features, manage access, monitor the health of the device and control which applications were loaded on the Oculus Quests.



# Headset deployment model

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To execute the study, we needed to understand how many HMDs would be needed. We already knew that the training would take place in 12 different PwC office locations, plus we were asked to keep the training window down to six weeks. We knew that office space was limited, and we had a limited budget to purchase HMDs. We considered the following deployment models:

## 1:1 model

1:1 means one headset to one user, so every user would receive his or her own headset. The 1:1 model was rejected almost immediately as it would be cost-prohibitive.

## 1:Many

1:Many is when one headset is shared with many users. The 1:Many model made more sense, as we could place a limited number of HMDs in each location and enable trainees to check them out just prior to attending the training.

Selecting the 1:Many model required the team to create a way to schedule HMDs to align with user scheduling to confirm there was an HMD for a specific user at a specific time.

# How many HMDs should be purchased?

To determine how many HMDs to purchase, we had to capture the following variables:

ID	VARIABLE	VALUE
A	The number of training cities (PwC office locations)	12
B	The number of cubes/rooms/offices per office location that we could lock down for the study	4
C	Total number of eligible trainees	1,600
D	Total number of eligible trainees by location	Varies
E	The total duration of the course (from the time the trainee arrived until the time he or she returned with the headset)	1 Hour (rounded)
F	How many spare HMDs would be held as backup in case there was a hardware and/or software failure (mostly likely due to an HMD not being charged)	20%
G	How many days will the training be made available? The requirements to train 10,000 employees in 30 days are significantly different from needing to train 10,000 employees over 12 months.	20
H	How many hours per day will the training locations be available?	4-8 (varies by day of the week)

In addition, it was important to understand that PwC partners and staff normally work at client sites and are only in the office on Monday or Friday. However, some teams work from a PwC office five days a week. Finally, participation in the v-learn course was voluntary, so we assumed we would not get all eligible trainees to attend.

The simple calculation should have been one headset per training area, times the number of locations per city, times the number of spares. Or, if using the table above, from the ID column:  $B * A * (1+F)$ . Using the variables above (12 x 4 x 120%), 57.6 HMDs would be needed. However, after evaluating the situation, we erred on the positive side and determined we should ship an average of six HMDs to each location. This provided the total number of HMDs (72) that would need to be purchased.

It is critical to remember the three “hows”: How many locations, how many users and how fast do you need to train users are the key variables in determining how many HMDs you need to purchase.

We have deployed a 1:Many model, and as of February 2020, we are supporting 250 HMDs across 25 locations. We could host a one-hour training simulation for up to 2,000 PwC partners and staff a day, and train the 55,000 partners and staff in the US firm in less than five weeks. For PwC, the key variable is the number of locations. We expect to increase the inventory over time as more content is onboarded.



**It is critical to remember the three “hows”: How many locations, how many users and how fast do you need to train users are the key variables in determining how many HMDs you need to purchase.**



# Data and HMD security

## Data security

HMDs can generate a lot of data. If the HMDs are not secured and managed, data can potentially be tied to a specific user. For example, data might be simple, such as user ID, time of session or even the location where the headset was used. Data collected can also be quite extensive, such as gaze heatmaps (what was the user looking at, for how long, and what was the user doing before and after that gaze). It could also include the time to respond to specific stimuli (questions, interactions, voice biometrics) or even the user's emotive state (happy, anxious, fearful, etc.).

When considering data security on a headset, it is important to understand that there are normally two types of data security that need to be addressed: the security of the underlying operating system that is running on the hardware, and the security of the data collected by an application running on top of that operating system (i.e., data collected from inside the application). For the study, the Oculus Quest HMDs were running a more secure enterprise build of their consumer version of the headset, and their management software (Oculus for Business) helped enable the team to manage the headset features in a secure way.

If the HMDs have access to the corporate network and enterprise data shares, it will be important to also have logical security. It could be as simple as a PIN code or enabling an authorized user's mobile device in close proximity to the headset. It could also be as robust as LDAP-based user ID and password. Future HMDs may also have built-in biometric sensors (retina scan or fingerprint) to validate users, as entering in user IDs and passwords can be cumbersome in virtual reality.

For the study, any trainee could put on a headset and have access to it. However, only the v-learn course was loaded on the Oculus Quest, and users were limited in what they could do. We placed the Oculus Quests in “kiosk mode,” which means when a user put on the HMD, the v-learn course would launch automatically. Controllers are required to exit the kiosk mode, but since participants used voice interaction, controllers were not provided when a participant checked out the HMD.

Each study participant was provided with a unique PIN to access the v-learn course when logging into the experience. No user identifiable information was passed to Talespin. The only thing Talespin knew was that a specific PIN accessed the course at a certain time from a specific HMD. This was a low-cost yet secure way to help support high data security. It's important that data collected be encrypted, secure and managed appropriately. For the study, we worked closely with Talespin to confirm the data collected was encrypted end to end. Data was also stored encrypted, and even if that data were decrypted, no user identifiable information was passed outside of PwC's firewall. At the end of the training period, Talespin securely sent PwC the user data, which we then decrypted and associated individual users with their unique PINs prior to analyzing the data.

## **HMD security**

Our initial purchase was for 100 HMDs. 76 were earmarked for the study, and the balance was for other uses. These HMDs needed to be received, provisioned, configured, placed into inventory, and stored in multiple PwC office locations throughout the US. HMDs should be stored like any other electronic equipment (low humidity, constant temperature, etc.). Like any other asset of value you also should be concerned about the HMDs physical security.

For the purposes of this study, it was necessary to create several different mechanisms to manage the physical inventory and stay organized — spreadsheets, feedback forms, shipment logs, asset tags, scheduling software, etc. The hand controllers were paired to specific headsets and it was important to not mix them up as there is no easy way to quickly identify which controller belonged to which HMD. Each HMD kit consisted of the headset, two hand controllers, power supply, USB-C cable, headphones, and a headphone cable. The hand controllers were paired to specific headsets and it was important to not mix them up as there is no easy way to quickly identify which controller belonged to which HMD. Each Oculus Quest has a unique three letter designator stored within the serial number which also aligned to the Oculus For Business device manager software which we used to manage the HMDs. We created asset tags that aligned to these unique IDs and tagged each of the HMD kits. It was not the most gratifying part of this study, but it was critical to the success of the overall effort. One part-time team member was able to manage 800 individual assets both physically and electronically without losing or misplacing a single asset.





## HMD connectivity

**When discussing VR at enterprise scale, we are making the assumption that the enterprise HMDs are wireless. Tethered HMDs require additional computer and technology support, cost more money to purchase, and are more difficult to manage. Future HMDs may have cellular connectivity (LTE or 5G), but today WiFi is the most common way to get HMDs on the network. Bandwidth requirements are determined by where the VR application (content) is “running”: local, network and network+.**

### **Local**

Local does not require a network to run. Specific content is loaded on the wireless headset or, in the case of a tethered headset, it runs on the connected computer. It is common to preload 360VR content this way due to the size of the experience. Network bandwidth requirements are easily managed, as the content is downloaded to the headset (wired or wirelessly) before it is accessed. created asset tags that aligned to these unique IDs and tagged each of the HMD kits. It was not the most gratifying part of this study, but it was critical to the success of the overall effort. One part-time team member was able to manage 800 individual assets both physically and electronically without losing or misplacing a single asset.

## Network

Network requires an active network to support the application running on the headset. This might simply be a user login or API to support voice interactions, or more complicated use cases to support Q&A, branched narrative or in-headset support. Network bandwidth requirements need to be addressed at 100+ HMDs all on the same subnet.

Each headset requires approximately 52kbps to maintain real-time interactivity. A large corporate network can easily manage this, unless you are supporting an event where the entire inventory of HMDs are being used at the same time and in the same physical location (like a conference or large meeting). For example, if you are supporting 100 HMDs for a conference and they will be used simultaneously, expect to require a minimum of 52Mbps connectivity.

## Network+

Network+ is a variation of the network above, but, in addition, the content is loaded in real time from the cloud. A simple example might be WebVR content: Very little content is loaded on the headset, and most of the heavy lifting is provided by the cloud. Network+ is very dependent on network capacity. As an example, an interactive 360VR video streaming at an uncompressed 720P requires upwards of 50Mbps for each headset. There are many vendors that can compress this in real time, so depending on the implementation, performance may vary.

We implemented a network approach for the study, as the content was stored locally but required network access for voice interaction and for the collection of course data. It was necessary to work with network security to prevent the blocking of specific API calls — a task that took more than three months to implement. This was not necessary for the study, but we wanted to enable our network infrastructure to support this modality globally.



# HMD management (logical)

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The most critical aspect of deploying VR at scale in a shared 1:Many model is how you will manage the inventory of HMDs. Maintaining software patches; monitoring power; making sure HMDs are secure; loading, unloading and distributing content; and making sure users do not install unauthorized applications or go to unapproved websites is a labor-intensive activity — especially if the HMDs are in multiple locations and/or countries. Just like mobile phones in the enterprise, VR HMDs need some kind of mobile device management (MDM) to manage the experience.

If you have only five or 10 HMDs, management can be manual, but if you have hundreds or thousands of HMDs, you will need to purchase and install this technology in your enterprise. Traditional MDM providers are starting to introduce this capability for virtual reality HMDs, and there are some standalone solutions provided by third parties. Even the headset manufacturers are providing different levels of management. Every organization is different, so research and due diligence are necessary to see which solution best fits your enterprise. Last year, there were no solutions available, but today there are many.

One item of note: The installation of security certificates on some of the HMDs is not yet possible. If you are using a certificate-based security approach for your enterprise and mobile phones, you may have to address MDM capabilities outside your standard platform.

A woman with curly hair is wearing a white VR headset and a white button-down shirt. She is looking down at her hands, which are held in front of her. The background is a bright, modern office with desks, chairs, and large windows. The title 'Sanitation considerations' is overlaid on an orange rectangular background on the left side of the image.

# Sanitation considerations

In the 1:Many distribution model, it's important to make sure HMDs are cleaned prior to sharing the headset with the next user. Gupta, Wantland and Klein (1996) suggest that much of the peripheral equipment used in VR are potential fomites (“a harmless object that is able to harbor pathogenic organisms and may serve as an agent for the transmission of infections”)[\[2\]](#). The study discusses how airborne pathogens and skin flora may thrive in environments similar to those of HMDs and hand controller devices. HMDs are enclosed, and after being immersed in a simulation for a while, they can become warm and cause the user to sweat, which can be absorbed by the padding that sits between a user's face and the HMD. It's easy to see how germs can be transferred to another user. Before sharing our HMDs, we sanitized them before each use.

The team used two different approaches to sanitization. We followed Oculus's approach to sanitization[\[3\]](#) as it was simple and low cost. We also used a device that was designed specifically to sanitize HMDs by bathing it in UVC light. UVC light is used to sanitize medical equipment and should not be confused with UV light. UV Light operates in a slightly higher band and does not destroy harmful viruses and other contaminants. Radiation in the UVC range of 250-280nm destroys bacteria, viruses and other microbes. UVC light penetrates the cells of microorganisms and disrupts the structure of the DNA molecules rendering them inactive and no longer harmful. The process was quick (one minute) and left no chemical smell. Using both sanitization processes supported our 1: Many distribution model. Each HMD was sanitized after each use prior to letting another user check it out.

# Software platform

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We employed Talespin's CoPilot and Runway software platforms to host the VR portion of the study. Talespin also provided the development and design resources necessary to support our effort to create the v-learn course.

## CoPilot

CoPilot uses artificial intelligence and virtual humans to simulate realistic conversations in virtual reality, enabling learners to develop and practice critical soft skills in a safe and controlled environment.

## Runway

Runway is where performance data is accessed and analyzed. It is supported by a native cloud infrastructure, robust administrative functions (including tracking, skills mapping, assessment, analytics and distribution), and a scalable and secure solution that is designed from the ground up to support native v-learning.



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SECTION 4

# Findings



# Findings

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The findings below are based on the results of this specific pilot, which was designed for PwC employees, and results will vary with other programs or populations. Most companies should see a positive impact, but how much would be dependent on the factors discussed in each section.

## Findings at a glance:

- **Employees trained using VR completed training faster**
- **Employees trained using VR were more confident**
- **Employees trained using VR had a stronger emotional connection to the content**
- **Employees trained using VR were more focused**
- **VR can be more cost-effective at scale**

# Employees trained using VR completed training faster

We were able to train employees up to four times faster in VR than in the classroom and 1.5 times faster than e-learn. We were surprised when our digital natives initially struggled with the VR headsets, but, once they were comfortable, most found them easy to use. Even when we accounted for the additional time needed to onboard new users in VR headsets for the first time (on average 10 extra minutes), we found it is still three times faster than classroom and 1.15x faster than e-learn.



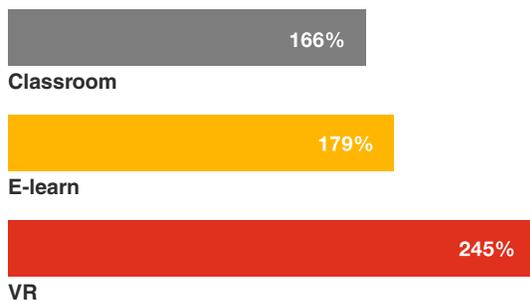
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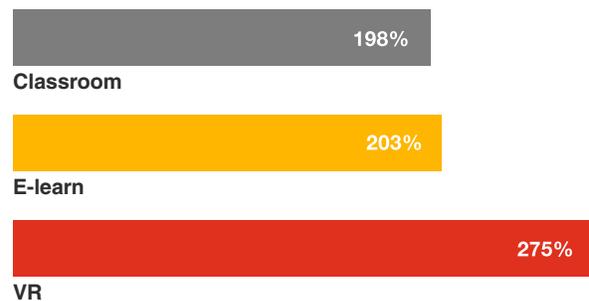
# Employees trained using VR were **more confident**

Users trained with VR were up to 275% more confident to act on what they learned after training—a 40% improvement over classroom and 35% improvement over e-learn. They were almost two and a half times more confident in discussing diversity and inclusion issues after taking the training in virtual reality and nearly three times more confident in acting on diversity and inclusion issues after the VR training. That's significant because, when it comes to soft skills, confidence is a key driver of success. Believing in themselves and having confidence helps learners connect better with others, while also feeling more satisfied with the time spent training.

## Improvement in confidence **discussing issues** of diversity and inclusion after the training:



## Improvement in confidence **acting on issues** of diversity and inclusion after the training:

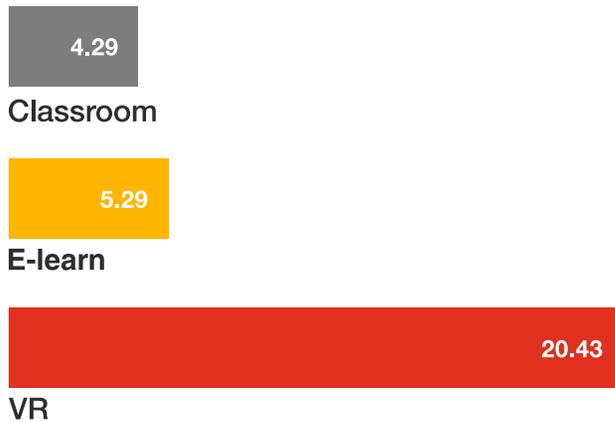


Users trained with VR were up to 275% more confident to act on what they learned after training—a 40% improvement over classroom and 35% improvement over e-learn.

# Employees trained using VR had a stronger **emotional connection** to the content

V-learners felt 3.75 times more emotionally connected to the content than classroom learners and 2.3 times more connected than e-learners. People connect, understand and remember things more deeply when their emotions are involved. Consider the emotional impact of viewing a photo of a wildfire, compared with reading a fact-filled analysis of climate change and the wildfire crisis, and it's easier to understand how strong emotional connections could lead to more positive outcomes.

## Average emotional connection felt to learning content



V-learners felt 3.75 times more emotionally connected to the content than classroom learners and 2.3 times more connected than e-learners.

# Employees trained using VR were **more focused**

When you think about how VR works, it's easy to understand why users would be less distracted with this technology: The simulations and immersive experience command their vision and attention. In our study, VR-trained learners were up to 4 times more focused during training than their e-learning peers and 1.5 times more focused than their classroom peers. When learners are immersed in a VR experience, they tend to get more out of the training and will likely have better outcomes

	Classroom	E-learn	VR
How many times were you <b>multitasking or distracted</b> during this experience?	0.78	1.93	0.48
How many minutes do you estimate it took to get <b>back on task</b> ?	1	2.63	0.48

VR-trained learners were up to 4 times more focused during training than their e-learning peers and 1.5 times more focused than their classroom peers.



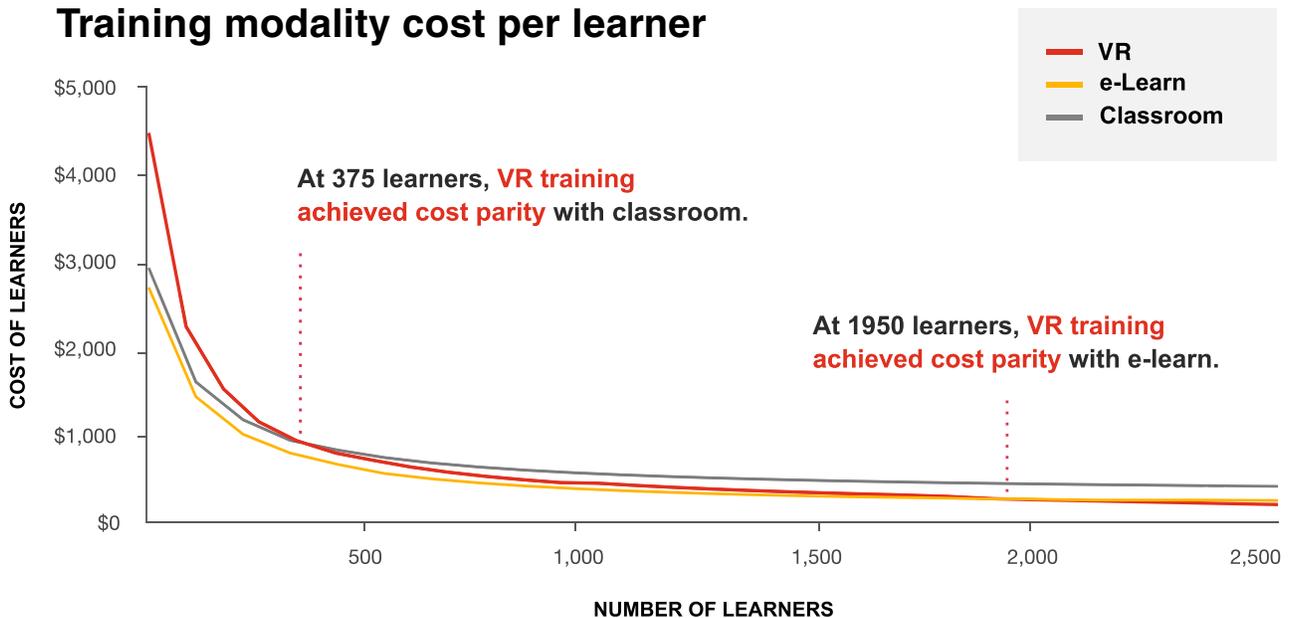
# VR can be **more cost-effective** at scale

When PwC decided to study the efficacy of VR training, we also chose to compare the cost of developing each of the learning modalities. The most effective way to do that was to design and build a course that could be replicated on each of the three training modalities. We found that, while VR requires more upfront investment to build and deploy than classroom or e-learn training, when delivered to enough learners, VR training can be more cost-effective at scale.

When we evaluated the price differences between building a VR course versus a classroom or e-learning course, we discovered that the VR custom course cost 47% more than the classroom course and 48% more than the e-learning course. This makes sense when you account for the cost of creating the content, but also the cost of developing the VR experience. That may require 3D artists and software developers, which you don't need when creating traditional classroom or e-learning content.

However, when you consider the return on investment (ROI), a new picture emerges. VR training takes less time than classroom and e-learning courses. So, if you take into account the cost of the employees' time, VR becomes a better investment at some point. And that factor just considers the time saved. The graph below shows PwC's total cost savings and where we broke even on training our learner population.

## Training modality cost per learner



Even if you include onboarding times, we estimated we would be able to achieve parity in costs vs. classroom costs at only 375 learners. Based on these variables, we also calculated at 3,000 learners, VR costs fall to 52% less than classroom; at 6,000 learners, 58% less and at 10,000 learners; it's 64% less. In every company, an employee's time has value, so the more time workers save, the faster you can achieve positive ROI.

Comparing VR training ROI to e-learn requires more learners than the classroom, as e-learn does not require a facilitator/trainer to lead each class. We estimated we would be able to achieve parity in costs for v-learn vs. e-learn costs at 1,950 learners. Based on these variables, we also calculated at 3,000 learners, VR costs fall to 8% less; at 6,000 learners, 20% less and at 10,000 learners; it's 26% less. Just like with classroom training, the faster an employee can return to work, the faster you can achieve a positive ROI.

# 52%

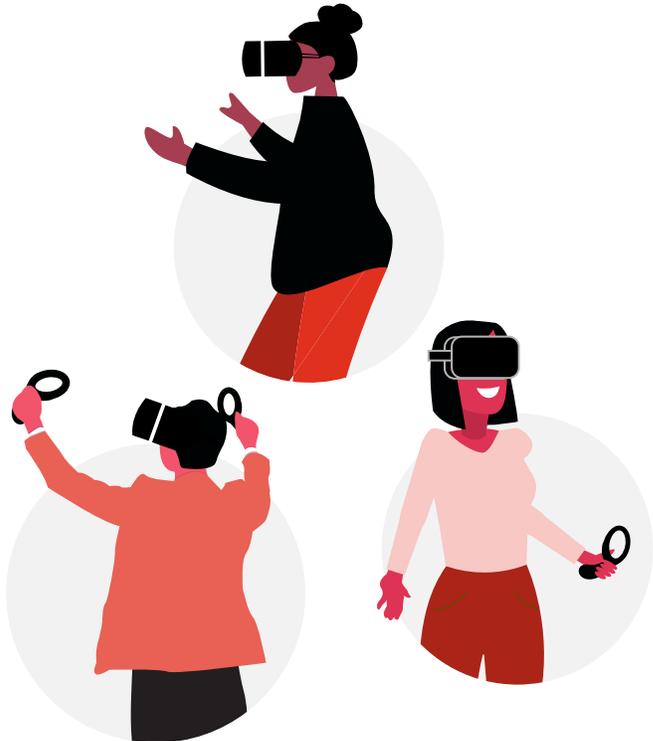
more cost-effective than classroom training at 3,000 learners

# 58%

more cost-effective than classroom training at 6,000 learners

# 64%

more cost-effective than classroom training at 10,000 learners





# Validating our original assumptions

**Our initial hypothesis was, “Training using VR is more effective in achieving learning outcomes than traditional training methods (classroom or non-VR digital experiences).” We felt ROI would come from several areas. The study validated a majority of our assumptions:**



## Employee satisfaction

We assumed users would enjoy v-learning more than traditional learning methods. We wanted our learners to feel like their time was spent doing something valuable and enjoyable. If learners felt that the training was effective, it could build employee satisfaction and lead to better employee retention. Post-survey results indicated that 78% of all VR participants preferred v-learning to more traditional modalities. In fact, 91% of the participants who took the classroom or e-learn course and then were given the option to take the v-learn course preferred the v-learn over both the classroom and e-learn course.

**Post-survey results indicated that 78% of all VR participants preferred v-learning to more traditional modalities.**



## Learner flexibility

PwC was not able to test this assumption for the following reasons:

- It was cost-prohibitive to purchase an HMD for each learner, enabling them to take the device home and take the v-learning training based on their availability. We decided early in the planning phase that we would deploy a 1:Many model (sharing HMDs) which would require them to take the v-learn training in a PwC office.
- Early user onboarding testing sessions also uncovered that learners had preconceived notions of how to use virtual reality and demonstrated an inability to successfully put on and use VR gear following written or audio-visual instruction. This required the team to rethink the learning experience, and, after three UX iterations, the team came up with a highly effective process with onsite personnel providing instruction and support.
- Each of the HMDs were managed: what software was loaded, WiFi configuration, guardian settings, etc. If learners took the HMD home, the learner would require administrative rights to the headset to enter in their WiFi credentials. Although the process to configure network settings was not difficult, the team felt it could cause the learner to spend more time dealing with the technology than taking the training course.
- The study plan stated that we wanted to train the learners in four to five weeks. If learners could check out the HMDs, the team could have had a difficult time retrieving them, which would have delayed the next learner from starting.
- In the end, the team decided it would be easier to have learners trained in a PwC office.



## Comfortable learning environment

The overall simulation required learners to practice behaviors they were taught. The experience also enabled learners to retry (practice) a module to see if they could improve their outcome, as there were several different paths to success (and failure). Consequently, 24% of the learners chose to do an optional retry of one or more of the learning modules. Survey results indicated that 97% of v-learners felt time spent on practice was appropriate. We saw immersive practice, with dynamic feedback and optional retries, improved learner confidence. VR learners were 40% more confident than classroom learners and 35% more confident than e-learners in employing the skills they learned during training.



## Higher information retention

We quickly discovered retention scores were inconclusive, as the delta between pre- and post-assessments in each modality was not significant. Indeed, the assessment team underestimated the previous knowledge experience our test population had on the diversity and inclusion topic. In hindsight, we should have selected a topic that was not already in our curriculum or selected a different test group that had not already been immersed in similar training.

We did test several associates and senior associates (1-2 levels below manager) who had not been exposed to diversity and inclusion behaviors in leadership functions, and the results demonstrated significant retention scores and learning in a v-learn course. However, these were not approved study participants, therefore their data was not part of our assessment or these results.

Despite our inability to demonstrate learning via assessment, 75% of those surveyed reported experiencing a wake-up call moment about the inclusivity of their behaviors. This indicates that learning did take place, even though our assessments were unable to demonstrate it.



## Improved attention

As identified in our key findings, VR-trained learners were up to four times less distracted during training than their e-learning peers and 1.5 times less distracted than their classroom peers. This was self-reported, and the team did not use any passive technology to observe this attribute. Based on experience and months of observation, the team actually felt the self-reported statistic was lower than what we observed. However, the statistic was significant and should result in higher learner comprehension and retention.



## Confidence building

VR-learners demonstrated significantly higher confidence compared to e-learn and classroom learners. They were almost 50% more confident than their classroom peers when discussing the topics learned during training. That's significant because, when it comes to soft skills, confidence is a key driver of success. Believing in themselves and having confidence can help learners connect better with others. Confidence builds employee satisfaction, which can lead to better employee retention, and help improve work quality and reduce mistakes.





**75%** of learners said the training helped them identify moments from their past when they were not as inclusive as they had previously believed.

## Other observations

Because it was a realistic simulation where they played themselves, v-learners reported making decisions based on what they would have done in real life. Seventy-five percent of learners said the training helped them identify moments from their past when they were not as inclusive as they had previously believed. Data showed a measurable sentiment trend, with users reporting feeling inspired and confident after completing their final module of feedback in the VR headset.

Classroom learning provided an emotional, authentic and interpersonal environment for learning. The success of classroom learning depends heavily on the skills of the instructor and the contributions of class members, so learners can take the same course and have a completely different experience because of the varying dynamics between the instructor and fellow classroom learners. Good classroom instruction is often expensive because of the cost of knowledgeable instructors.

e-Learning offers convenience, scalability and flexibility for the learner. If the e-learning is cloud-based and the learner can take the course from anywhere, at any time, on a computer they already have, then it is possible to quickly roll out training at scale. However, e-learners often multi-task and are highly distracted. They may feel less emotional connection with the content, which is believed to lead to lower retention of the material. In our study, they reported less satisfaction with the opportunities to practice skills in the online setting.

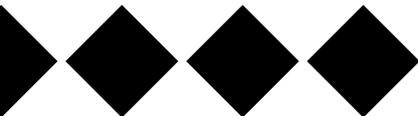


Photo courtesy of Talespin

VR-based learning can yield higher confidence and improved ability to apply the learning on the job because of the ability to practice in an immersive, low-stress environment. It is more effective than e-learning because of the immersive nature of the practice experience. "It feels like you are really there," VR users often say. "It demanded my attention and my involvement, I couldn't just sit back and listen, I actually had to do the task."

VR practice is likely more effective than classroom practice because often there are not enough subject matter specialists to observe and provide feedback on each person's performance in a classroom setting. This means that during classroom practice, the learner may not be applying the skills taught and, in fact, the practice could possibly reinforce incorrect behavior because of the lack of feedback.

To address this, VR simulation is designed by asking the subject matter specialist to help create a scenario that offers the learner the opportunity to make choices that apply the skills being taught, along with options that depict the most frequent mistakes. In VR, we include dynamic feedback so that when a learner makes a choice in simulation, the strong behavior choices are called out, and the mistakes are met with corrective feedback, reasoning and an opportunity to retry.



**SECTION 5**

# Comparing Costs to Determine ROI



# Comparing costs to determine ROI

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We are often asked: “How much does VR really cost?” All three modalities (classroom, e-learn, and v-learn) each require a course to be planned, designed, developed and deployed. As part of this pilot, we sought to compare the costs and ROI of deploying the same learning content in the three learning modalities. We explore our findings in this section.

# Comparing the costs of key tasks

The table below highlights some of the key tasks and comparison cost ranking between the three modalities as they relate to common tasks. The more \$\$ symbols there are, the more that task costs to execute.

TASK	CLASSROOM	E-LEARN	V-LEARN	NOTES
Course design	\$	\$	\$\$	VR requires more options to be considered; "happy" and exception paths must each be flushed out to help provide a dynamic experience.
Research	\$	\$	\$	Equivalent
Script	\$	\$	\$\$	VR requires additional scripting to account for the exception paths.
Talent acquisition	\$\$	\$\$	\$	Assumption that videos will be created requires more actors to be used.
Creative/video	\$\$	\$\$	\$\$\$	VR requires additional creative assets to be created (3D art).

TASK	CLASSROOM	E-LEARN	V-LEARN	NOTES
Development	\$\$	\$\$	\$\$\$\$\$	VR requires the solution to be coded, whereas e-learn is normally built upon a learning platform.
Editing/assembly	\$	\$\$	\$\$\$	VR requires additional assembly work to account for the exception paths.
Testing	\$	\$\$	\$\$\$	e-Learn and v-learn require additional testing to identify software anomalies
Legal review	\$	\$	\$	Equivalent
Logistics setup	\$	\$	\$\$	VR requires additional equipment (such as the HMD, headphones, etc.) to be managed that is not part of a standard employee equipment package.
Support	\$	\$	\$\$	Equivalent
Facilitation	\$\$\$\$	-	\$	Classroom training requires facilitation that is not scalable. The more people you train, the more facilitators you need.
Total cost comparison	17	16	25	VR courses in general will be more expensive to build than classroom or e-learn courses.

This table aligns closely with the actual costs tracked to execute the inclusive leadership course in each of the three modalities. Classroom and e-learn were very close (within 2%) in overall costs to develop, and the v-learn course cost 47% more than the classroom course to build. But this is only the creation of the course. Overall cost ratios change when you begin accounting for the deployment, execution and value of the course.

We monitored more than 25 variables and had more than 28 different calculations to determine the overall return on investment. Since this was not a long-term study and it was focusing on soft skills training, it was difficult to determine actual value savings for things like higher confidence levels, fewer distractions and greater emotional connection, etc. We could infer value, but we could not define it.

**This left the team with only a few variables that had an impact of the overall ROI:**

- The total cost to build a course for a specific modality.
- The cost to facilitate, manage and operate a course for each specific modality.
- The number of people that are trained.
- The fully loaded cost per hour of each employee trained including revenue loss (at PwC, we use the term RSR).
- The average time it takes for an employee to be trained for each specific modality. If a modality takes less time to train someone, that employee can go back to work sooner, and less revenue is lost.



# Cost drivers



## The time spent learning

The highest cost driver is the duration employees spend on a specific training. In our study, VR took one-fourth the time of classroom training and two-thirds the time of an e-learn. As an example, if an employee's fully loaded rate is \$100/hour, for our study, employee cost for classroom learners was \$200, \$75 for e-learners and \$50 for employees that were trained with VR. At 20,000 employees, the costs to train within each modality become easy to differentiate: In this example, it would be \$4M for classroom training, \$1.5M for e-learn, and \$1M for v-learn.

The more employees you train in VR, the more time you save, therefore the less money you spend on time to train your employees.



## Course facilitation as a cost driver

The second largest cost driver is facilitation. For classroom training, this is not a scalable proposition. Each class requires a facilitator, while e-learning does not require any facilitation, and (in our study) the v-learn modality had a part-time facilitator in each location. As an example, the cost to facilitate training 13,000 leaders in a classroom at PwC is eight times more expensive than the cost to facilitate a v-learn course for the same number of people. e-Learn has no facilitation costs associated with it.



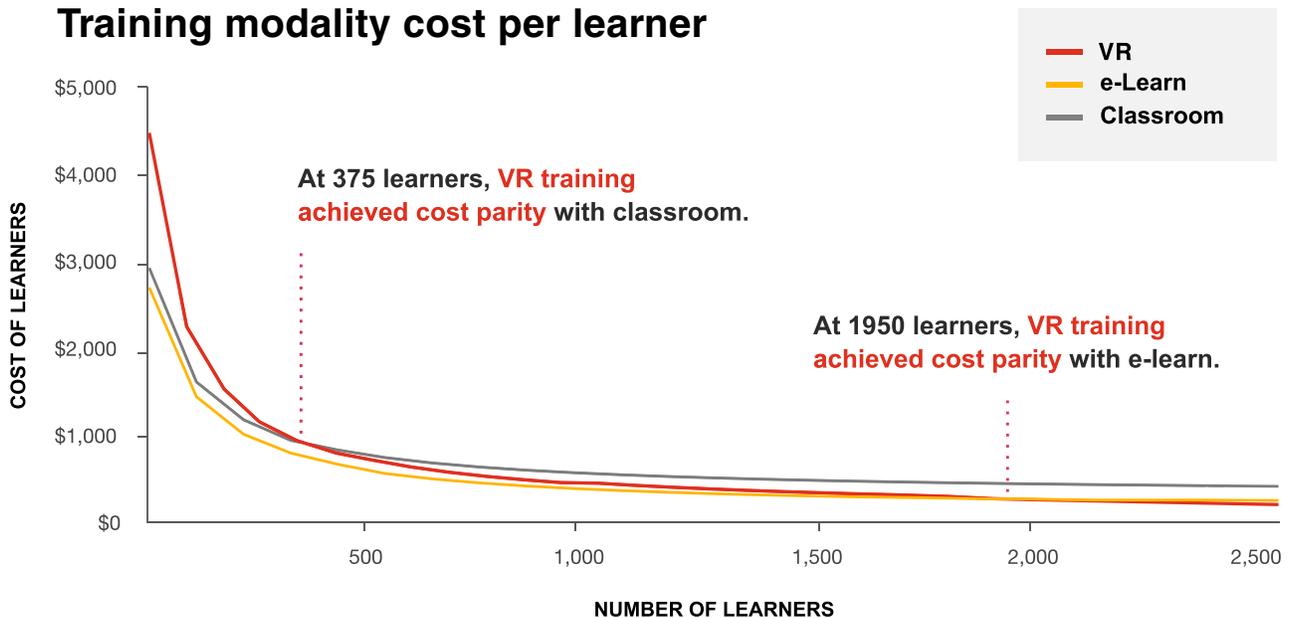
## Hardware and software considerations

e-Learn and v-learn require additional hardware and software that must be included in the overall cost. However, for our calculations, we amortized the hardware over a period of 12 months, as we assumed the hardware could be used for other courses or purposes.

# Cost per learner

For the purposes of this study, we created a value curve to see which modality was the most cost-effective. The curve changes as you add more employees to be trained.

### Training modality cost per learner



The summary of the curve is simple: There comes a time when v-learn becomes more cost-effective than classroom and e-learn modalities. The fewer employees you train, the more expensive the cost per learner. The more you train, the less it costs per learner. However, it is not a linear curve. As an example, if you train 100 employees, you have to recover the entire cost to create and deploy the course across those 100 employees.

It is important to understand the numbers used in these models were for a custom built course. ROI will be different for every company. If the fully loaded cost per employee is \$35, the number of learners you require to reach ROI is significantly higher. If you can create a two-hour training with less investment, then your overall costs are lower, and if you purchase an off-the-shelf course, then the cost per learner will drop across all three modalities.

**Overall, there were a few variables that really moved the needle one way or the other.**

- Cost of facilitation
- The number of locations needed to conduct training
- The number of employees needing training
- The fully loaded cost of each employee to be trained
- How quickly the employees needed to be trained

## Classroom value table

Below is a table looking at an example of average cost per learner for classroom training. As you can see, the more you train, the lower the cost per learner.

Employee rate**	\$100 per hour
Facilitator rate*	\$400 per hour
Facilitator time	2 hours
Learning time	2 hours

TOTAL LEARNERS	100	500	1,000	3,000
Classroom course creation	\$250,000	\$250,000	\$250,000	\$250,000
Cost of facilitation*	\$4,000	\$32,000	\$40,000	\$120,000
# of classes	4	32	40	120
Lost value (employee time)**	\$20,000	\$100,000	\$200,000	\$600,000
Total cost of training	\$274,000	\$382,000	\$490,000	\$970,000
<b>Average cost per learner</b>	<b>\$2,740</b>	<b>\$764</b>	<b>\$490</b>	<b>\$323</b>

\*Cost per hour per facilitator is illustrative at \$400/hour as we used senior leaders to provide the training. The classroom course was 120 minutes and it was necessary to add an additional 30 minutes for the facilitators to prep. Classroom size was 25 people and required 1 facilitator.

\*\* For this example, we are using an illustrative cost of \$100/hour to cover trainee time.

Initially, we were surprised at the cost per learner and thought that the cost of facilitation was the key cost driver. However, even if we lowered the cost of facilitation to \$0, the cost per employee only lowers to \$2,700, \$700, \$450, and \$283 respectfully. This identified the key cost driver for classroom training is the duration of the class (2 hours). Unless you reduced course duration, the cost totals would not change significantly.

## V-learn value table

Looking at the v-learn training course, we needed to account for different types of costs including the VR headset (which we amortized), onboarding time to the VR Headset, and the facilitation needed to help users get fitted and trained on how to use the VR headset. Just like classroom training, we did not account for any additional infrastructure costs.

Employee rate	\$100 per hour
Facilitator rate*	\$75 per hour
Learning time	0.5 hours
Onboarding time**	0.25 hours

# OF LEARNERS	100	500	1,000	3,000
V-learn course creation***	\$367,500	\$367,500	\$367,500	\$367,500
Cost of onboarding	\$2,500	\$12,500	\$25,000	\$75,000
Lost value (employee time)	\$5,000	\$25,000	\$50,000	\$150,000
Facilitation cost	\$3,750	\$3,750	\$3,750	\$3,750
Equipment (amortized)	\$169	\$843	\$1,687	\$5,060
Total cost of training	\$378,919	\$409,593	\$447,93	\$601,310
<b>Average cost per learner</b>	<b>\$3,789</b>	<b>\$819</b>	<b>\$448</b>	<b>\$200</b>

\*The cost per hour of the facilitator as they did not require the subject matter expertise of an instructor and was there to help users onboard to the VR experience.

\*\*The total average time to take the course was approximately 29 minutes, for this calculation we rounded this number up to 30 minutes.

\*\*\*The time it took for the learner to check out the headset, be trained on the equipment, find the location for the training, and return the equipment averaged 12 minutes. For the purposes of these calculations, for this calculation, we rounded this time to 15 minutes.

\*\*\*The cost to produce a VR training course was estimated to be 47% greater than the classroom course.

Facilitation cost was the same for each grouping of learners because we added more HMDs to complete the training in approximately 6-7 days. If you reduced the number of HMDs, you would increase the number of days needed to train, increasing the cost of facilitation. In this model, we used 2, 10, 20, and 60 HMDs respectfully. If you remove facilitation, which we would expect to happen once users became more familiar with using HMDs, (this would also reduce onboarding time to \$0), the impact is \$3727, \$787, \$419, \$174 respectfully.

## E-learn value table

Looking at the costs of the e-learn, the curve begins close to the classroom costs per learner, but it takes much longer to cross the cost-per-learner curve with the v-learn modality. It is no longer necessary to account for facilitation, but there was still the need to account for the cost of the computer and the learning management system license fees. In this example, we did not account for any additional infrastructure costs.

Employee rate	\$100 per hour
Training time	0.75 hours

TRAINEES	100	500	1,000	3,000
E-learn course creation	\$250,000	\$250,000	\$250,000	\$250,000
Lost value (employee time)	\$7,500	\$37,500	\$75,000	\$225,000
Amortization / licenses*	\$2,125	\$10,625	\$21,250	\$63,750
<b>Total cost</b>	<b>\$259,625</b>	<b>\$298,125</b>	<b>\$346,250</b>	<b>\$538,750</b>
<b>Average cost per learner</b>	<b>\$2,596</b>	<b>\$596</b>	<b>\$346</b>	<b>\$180</b>

\*The cost of the equipment and licensing fees for the laptop/computer, LMS, and software necessary to manage the course deployment.

Using the notional data in this example to illustrate cost differentiation, even at 3,000 learners, e-learn was more cost effective than v-learn. However, once you remove the cost of onboarding users and the cost of facilitation, v-learn catches up and actually becomes more cost effective to deploy at 3,000 learners (in this model)—\$180 per learner vs. \$174 per learner (or about 4% less expensive). If you extrapolate that to enterprise scale (10,000 learners as example), the e-learn drops to \$121 per learner and v-learn to \$53 per learner.

## SECTION 6

# Considerations & Insights for Deploying VR Training



# Considerations and insights

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Using and deploying virtual reality at enterprise scale uncovered many lessons that we would not have learned by doing a proof of concept in the lab. This pilot required the team to develop new skills and processes that simplified the deployment. Below are some insights we learned. We explore each of these insights in this section.

- 1 Onboard new VR learners effectively**
- 2 Create compelling learning content for VR**
- 3 Collaborate cross-functionally**
- 4 Reinforce learning through debriefing**
- 5 Create templates to support scaling**
- 6 Include VR as a part of a blended learning curriculum**
- 7 Invest in the learning modality suited to the learning objective**
- 8 VR is ready to scale in the enterprise**



# 1. Onboard new VR learners effectively

**Introducing a VR experience to an employee who has never had a VR experience can be challenging based on several factors: culture, experience with other modes of technology, topics to be trained and their role within the organization.**

The following are recommendations that should apply to most first-time users. We have discovered that it is only necessary the first or second time a user engages with VR. Once they have had an experience, it's very easy. The important point to remember is to make sure the experience is positive. You really only get one chance; if a user has a poor experience, the chances of them being receptive to a second VR experience are extremely low. When addressing new user onboarding in VR, there are three things you should consider:



## **Pre-communication**

Sending a “what to expect” communication will help learners feel less self-conscious and more excited about the experience. Share enough information to address any of a user’s perceived fears, questions or concerns. Make sure you share in detail how they will be trained to use the VR headset, what to know about the experience, safety, hygiene, etc., before they arrive for the training.



## Arrival and fitting

For first-time learners we encourage someone to show them how to fit the HMD and make sure it is adjusted appropriately. Do not assume users know how to put on a headset, how to adjust it or how to be safe while using it. This single change to our VR onboarding process for new learners increased our user satisfaction by more than 100%. For first-time learners, we normally let them use a small office to reduce the self-conscious feeling they experience the first time they put on a headset. This helps put them at ease.



## The VR experience

The first thing a learner should see is a simple graphic that shows them how to adjust their headset, how to improve clarity and how to adjust focus. Please notice the learner didn't put on the headset and immediately go to a "desktop" of apps and settings. For first-time learners, help them begin by making their experience comfortable and clear. Ideally, a learner will then progress to the actual simulation. This "kiosk" way of engaging users helps make it simple, so they do not need to understand how to navigate to the different apps, settings, etc. They put it on, make sure everything is clear and the simulation starts.

Many employees get bored and distracted while being instructed on core VR skills, so we suggest having most of the introduction done inside the experience (i.e., after they put the headset on). It is not uncommon for users to possibly feel self-conscious and discouraged if they are not receiving validation that they are engaging with VR equipment and technology as intended, so if possible, let them know they are doing great. Once a simulation starts for the first time, learners need a minute or so just to look around and absorb what they are seeing.

Since learners may feel disoriented or dizzy from repeated side-to-side head movements to explore, keep the initial screens simple so they can focus on one thing. Our simulations used voice (not controllers) so the first thing users do is learn to talk with the virtual avatars. If you are using hand controllers, it will be important to help learners understand how to use them properly. No matter which user interface you use, keep distractions to a minimum in the first sequence (unless you really want to provide some eye candy wow). Give them some time to experience it – try not to rush them. Give users a way to jump into the simulation right away if they do not need extra time to get oriented.



## **2. Create compelling learning content for VR**

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**VR offers a real opportunity to improve your employees' vital workplace performance through experiential learning.**

**If you want to create leadership skills that can impact confidence, make emotional connections, reduce distraction, and truly make VR a differentiating part of your recruiting, training and retention strategy, then you should create content that is compelling and aligns to the modality. Do not just create one path for your learners to follow. Create realistic scenarios that learners can relate to. Create settings that mimic your environment. Introduce them to virtual avatars whose behavior is modeled after common personas.**

**VR holds a leading opportunity to help improve your organization's workplace skills by providing scalable hands-on practice and feedback in a realistic and accessible on-the-job setting.**



### 3. Collaborate cross-functionally

**VR development is not owned by one group. To get a VR program prioritized, funded, supported and deployed, you need to coordinate and collaborate across several groups:**

- HR
- IT support
- IT operations
- Security
- Infrastructure
- L&D
- Designers
- 3D artists
- Learning scientists
- Data analytics
- Developers
- Topical subject matter specialists

The business needs to be supportive of having the training offered to a large number of people through this medium. Training functions and HR needs to be involved to help track, organize, schedule and support training in VR. IT needs to provide support from a technical and deployment perspective. You will need equipment procurement, asset tracking, user management, access to WiFi and integration with learning management systems.



## 4. Reinforce learning through debriefing

**Single learner training is often more effective in VR. However, if that learner can then share that experience and discuss what they learned immediately afterward, the learning is exponential.**

We refer to this as “team level reinforcement,” and its adoption helps drive the behaviors you are looking to promote. Doing it via a debriefing session was the leading approach we have employed. It is a combination of v-learn and classroom training.

Yes, v-learning is the most expensive approach, but it can also provide the highest value. Book times for individuals to take the v-learn course. Then schedule debrief sessions in work teams with the team lead as the facilitator. The team debrief sessions help learners further personalize the training to their team and make action plans that help allow them to hold one another accountable.



## **5. Create templates to support scaling**

Since deploying our initial v-learn course, we've established tools and templates for easier script writing and content collaboration, which help new authors focus on creating experiences and utilizing VRs strengths. Templates were the key reason we have been able to reduce the time it takes to build VR course content.

## **6. Include VR as a part of a blended learning curriculum**

VR is not an appropriate platform to host every type of training, and we do not believe that it will completely replace other modalities. What we do think is that VR is a new modality that should be considered when training specific types of skills. This multimodal approach is the future. VR is ideal for practicing what you learn in a safe environment, in a dynamic way, while e-learn is great for learning how to use software, or quickly jump in for a learning burst. Classroom training is great when it is necessary to collaborate and discuss a topic.

When you combine each, you are providing your employees with the leading approach. This new modality will likely help transform a new age of training and education.

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Photo courtesy of Talespin

**When users need to practice a soft or hard skills task, VR provides a safe training environment.**

Trainees are not judged for failing a task or saying something awkward. They can experience new techniques without putting anyone or anything in harm's way. A VR simulation never tires, and a virtual avatar can be asked the same question, or perform the same task, 1,000 times without losing patience.

The more thought that goes into a course design, the more the learners benefit. However, it does come at a cost. It is necessary to deploy VR in the correct scenarios. VR is not ideal at simulating training for a software application or very linear content. These are preferred for e-learn or classroom modalities. We recommend VR be used for the practice portions of training. It can also be effective to provide environmental (360) context to information. Skills performed in specialized environments with specialized actions are better practiced in VR than in other modalities. The key for VR is having enough learners to help justify the cost.

## 8. VR is ready to scale in the enterprise

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In the past, VR was just too expensive, too complicated and too challenging to deploy outside of a small group. Today, enterprise headset ecosystems are under \$1,000, and these HMDs can be managed like any other enterprise mobile device. Large (and small) studios are developing compelling content, vendors are creating software packages to enable non-VR developers to create their own content in a cost-effective way, and big learning management system players are enabling VR content to be more easily integrated into their platforms.

The value VR can provide is unmistakable when you apply it the correct way. This VR pilot gave us 10 months of learning experience with VR design and deployment. Since the pilot was completed in November 2019, we've created and deployed v-learning on sales conversations, difficult conversations and cyber training to over 4,000 PwC partners and staff. We moved from a 10-month process to a three-month process, and we are tracking for six weeks for soft skills training and two to three weeks for hard-skills training modules.



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SECTION 7

# Conclusions





# Conclusions

**Is VR soft skills training more effective than traditional training methods, and is VR soft skills training more cost-effective to deploy than traditional training methods? The answer to both questions is “yes.”**

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A combined team from PwC’s Learning and Development Innovation team, PwC’s Emerging Technology Group, Oculus for Business, and Talespin worked together to launch a 10-month pilot to understand if VR can be used to train enterprise employee soft skills.

This pilot answered specific questions: Is VR soft skills training more effective than traditional training methods, and is VR soft skills training more cost-effective to deploy than traditional training methods?

The answer to both questions is “yes.”

V-learn, the ability to use virtual reality to train skills, is more effective at training soft skills concepts than classroom and e-learn training modalities. Learners are more confident, less distracted, have a stronger emotional connection, and when deployed to enough learners, v-learn for soft skills training can be more cost-effective than classroom or e-learning modalities.

Many lessons were learned and captured. The key driver to achieve a positive ROI would be to make sure you have enough learners to train, as VR course content requires greater investment to develop than classroom or e-learn content. The difference in value will eventually balance out, and you can achieve a higher ROI because VR training takes less time than classroom or e-learn training. The more learners that train in VR, the easier it is to make up the difference in development and deployment costs.

VR can be ready to deploy at enterprise scale. Since we've completed the pilot, we have deployed additional courses and have reduced our time to three months and are tracking to reduce it to six weeks. The cost to deploy is also dropping, as we have become more efficient at managing the equipment and have significantly improved the learners experience with VR.



VR training is not the answer to everything and will not replace classroom or e-learn training modalities anytime soon. It is not an appropriate platform to host every type of training, and so we do not believe that it will completely replace other modalities. VR is a new modality that should be considered when training specific types of skills. Companies should consider a multimodal approach in the future, as VR can be ideal for practicing what you learn in a safe and dynamic way. When you combine classroom, e-learn, and v-learn together, you are helping provide your employees with an industry leading approach. This new modality will likely help transform this new age of training and education in the enterprise.

**Companies should consider a multimodal approach in the future, as VR can be ideal for practicing what you learn in a safe and dynamic way.**

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SECTION 8

# Acknowledgements



# Acknowledgements

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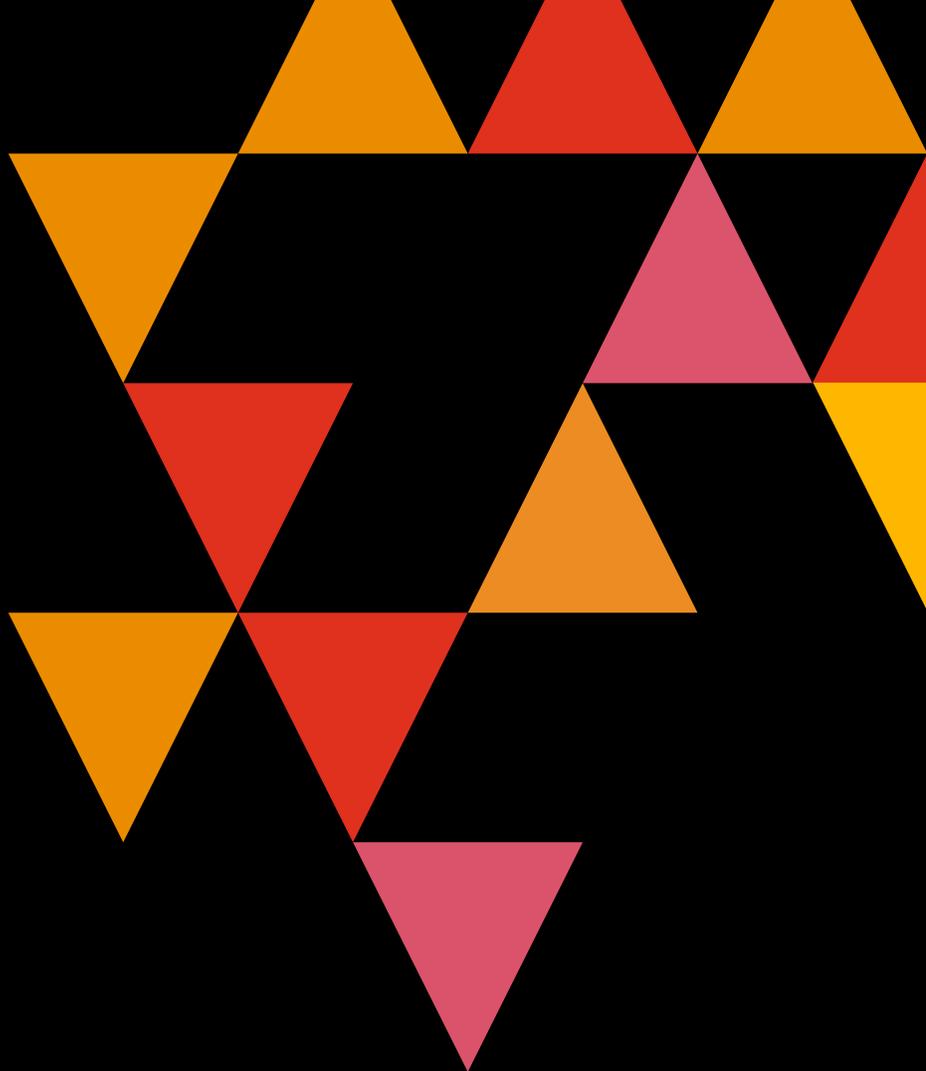
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- 1** Chai M. Tyng, Hafeez U. Amin, Mohamad N. M. Saad, and Aamir S. Malik. (2017). The Influences of Emotion on Learning and Memory. *Frontiers in Psychology* 2017: 1.
  - 2** Gupta, S.C., Wantland, C.A. and Klein, S.A. (1996). Cyberpathology: Medical Concerns of VR Applications. *Journal of Medicine and Virtual Reality* 1996: 1 (2) 8-11.
  - 3** <https://business.oculus.com/support/665720147270975/>