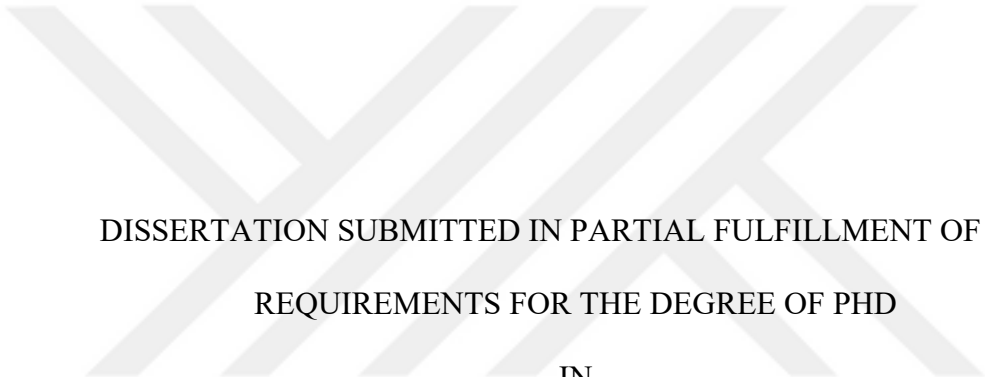


INTEGRATING VIRTUAL REALITY INTO
VISUAL COMMUNICATION DESIGN EDUCATION

BY

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DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF PHD
IN

DEPARTMENT OF GRAPHIC DESIGN

YEDITEPE UNIVERSITY

JUNE, 2022

PLAGIRISIM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

Visual communication design has evolved throughout the ages, the digital revolution not only brought more responsibilities to designers but also brought new mediums for communication. Extended Reality (XR) technologies provided new possibilities for many disciplines, however, visual communication design education did not get the best of Extended Reality although they include a high potential for design and creativity, there are a few studies related to using Extended Reality for visual communication design education and there are no educational games in 3D or for Virtual Reality, therefore, this practice-based research used a creation tool to design and develop the world's first educational game for visual communication design education to raise the awareness of the importance of Extended Reality for both the education and profession of visual communication design. The study used mixed methods to collect data from 8 design academics, 5 design practitioners, 2 Virtual Reality developers, and 40 visual communication design students, the results of the educational Virtual Reality game were positive, and the majority of the interviewees asserted that Extended Reality technologies have high potentials for the education and the profession of visual communication design.

Keywords: Extended Reality, Virtual Reality, Visual Communication Design, Graphic Design.

ÖZET

Görsel iletişim tasarımı çağlar boyunca gelişti, dijital devrim sadece tasarımcılara daha fazla sorumluluk getirmekle kalmadı, aynı zamanda iletişim için yeni ortamlar da getirdi. Genişletilmiş Gerçeklik'den (Extended Reality, XR) teknolojileri birçok öğrenci için yeni olanaklar sağlamıştır. Ancak görsel iletişim tasarımı eğitimi, tasarım ve yaratıcılık için yüksek bir potansiyel içermesine rağmen Genişletilmiş Gerçeklik'den en iyi şekilde yararlanamamıştır. Genişletilmiş Gerçeklik'in görsel iletişim tasarımı eğitimi için kullanılması ile ilgili birkaç çalışma vardır ve Üç Boyutlu (3D) veya Sanal Gerçeklik (Virtual Reality, VR) için eğitici oyun yoktur. Bu nedenle, bu uygulamaya dayalı araştırma, Genişletilmiş Gerçeklik'in hem eğitim hem de meslek için önemi konusunda farkındalığı artırmak için dünyanın ilk görsel iletişim tasarımı eğitim oyununu tasarlamak ve geliştirmek için bir oluşturma aracı kullandı. Çalışma, 8 tasarım akademisyeni, 5 tasarım uygulayıcısı, 2 Sanal Gerçeklik geliştiricisi ve 40 görsel iletişim tasarımı öğrencisinden veri toplamak için karma yöntemler kullandı. Eğitici Sanal Gerçeklik oyununun sonuçları olumluydu ve görüşülen kişilerin çoğu Genişletilmiş Gerçeklik'in yüksek potansiyele sahip olduğunu özellikle görsel iletişim tasarımı mesleği için çok önemli olduğunu söylemek mümkündür.

Anahtar Kelimeler: Sanal Gerçeklik, Genişletilmiş Gerçeklik'i, Görsel iletişim Tasarımı, Grafik Tasarım.

DEDICATION

I dedicate this work to my dear parents, thank you for supporting me unconditionally throughout my life. Special gratitude to my family and dear friends who supported me throughout this journey.

To my beloved daughter, you are the energy of my soul.



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1. INTRODUCTION

1.1. Overview

Like many other professions under the big umbrella of creative industries, graphic design has been changing and evolving throughout the ages, the digital revolution changed the roles and responsibilities of the graphic designers, consequently, the name of the profession itself frequently changed, and many educational institutions renamed the discipline to “Visual Communication Design” or maintained the name yet updating their curricula to include new media, according to Meggs and Purvis (2016): “today, the graphic design field is much more extensive than in the past, encompassing areas such as motion graphics, design for the built environment, digital type design, design for portable devices, and interactive media” (p. 115). As our society now moving towards the fourth industrial revolution or Industry 4.0 as well as Education 4.0 where we work with technology in coordination to create new potentials (Hussin, 2018), visual communication design educators must adapt and update their knowledge and skills accordingly.

Frequent developments and challenges in visual communication design require educators to think differently, especially after the challenging circumstances of the COVID-19 pandemic. Additionally, we are rapidly improving the digital world, virtual education, artificial intelligence, and moving towards the Imagination Age; which is an upcoming period that will theoretically take place right after the Digital Age, as imagination and ingenuity would become the dominant financial makers, furthermore, virtual worlds (King, 2012) as well as virtual reality (Magee, 1993), will develop and become major tools for communications, therefore, learning about such innovations would be essential for the next generations.

Current students are digital natives, they are growing up attached to technology and digital media innovations (Couch & Towne, 2018), and they thrive on new creative, and inspiring ways of education, therefore, many emerging technologies could be integrated as creative platforms for both education and profession of visual communication design, examples of such innovation are Extended Reality (XR) experiences; (XR) is a term used to include technologies like Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) (Grabowski, 2021; Mealy, 2018; Unity, n.d.).

In a profession where passion, inspiration, imagination, and creativity have always been driving forces and vital aspects, it is essential for design educators to use creative, and different approaches, which could be done by implementing the immersive power of these emerging innovations in design classrooms to build productive, creative, and inspiring environments.

1.2. Research Aims and Objectives

The study aims to raise the awareness of the importance of using Extended Reality technologies for both the education and profession of visual communication design, to achieve this aim, this study integrated virtual reality into visual communication design education using creation tools and implementing educational strategies, theories, and practices, and creating a VR educational game. The outcomes of this study's project will be evaluated using both qualitative and quantitative methods. The importance of extended reality technologies for the profession of visual communication design will be explained using a comprehensive analysis in the literature review chapter and supported by the results of qualitative and quantitative data.

1.3. Research Questions

Research questions narrow the statement of purpose and could be considered as guidelines for readers, some general questions will be used to explain proposed ideas to readers (Creswell & Creswell, 2014), such as:

- Why should we consider XR technologies for the profession and education of visual communication design?
- What are the students', educators', design practitioners', and VR developers' perspectives on using educational games and extended reality in visual communication design education?
- What is the effectiveness of "The Designer" educational VR game for visual communication design education?
- How can we integrate XR in visual communication design education and prepare students for the future?

1.4. Significance of the Study

Educational video games have always been considered supplemental learning tools that support the traditional ways of education, they could also be used through emerging technologies like Extended Reality. Currently, there are few design-related educational games, but there are none for virtual reality (VR), and there are few studies related to using Extended Reality for visual communication design education.

As mentioned earlier, one of the aims of this study is to raise the awareness of the importance of XR technologies for the future of both the education and profession of visual communication design, and hopefully, to encourage future researchers, designers, and developers to create more educational games and XR materials for visual communication design education.

2. LITERATURE REVIEW

2.1. Technology in Education

2.1.1. COVID-19 pandemic and technology integration.

COVID-19 Pandemic made huge changes to the way we learn, educate, and think, it forced education to move into the digital world using the internet. The demand for Massive Online Open Courses (MOOCs) grew larger than ever before for their easy access and beneficial features (Impey, 2020). Education moved into online learning; using live webinars and conferencing software online, virtual learning; live or self-paced education using software and the internet, E-learning; using digital tools in the classroom or online, distance learning; online learning from all over the world, and blended learning; online and classroom learning (ConexEd, (n.d.)). Everything was forced to shift into virtual platforms, lockdown and social distancing created huge demand for communication tools like Zoom, Microsoft Teams, and Slack (GLG, 2020), nevertheless, this pandemic taught us that it is a delusion to think that online education is the best way to go as public education will always be superior (UNESCO, 2020).

Lockdown brought new and unsuspected challenges and difficulties to educators, it affected the sense of motivation for both educators and students, to help boost their motivation and engagement; educators found themselves forced to use various educational tools and technologies and start looking for strategies and practices (Cucco, Gavosto, & Romano, 2021), new challenges for education would appear after COVID-19 crisis, therefore, creative and motivational ways of education will be needed, which could be done with the aid of digital technologies, these challenges and changes would also arise on design education;

Diana Murek, director of education in Istituto Marangoni Mumbai, stated that “Design is experiential learning, so there is only so much that can be done online. But when we are back in school, the teaching will be different, in that we will have a lot more digital support, for example using tablets for the illustration classes” (Shah, 2020).

2.1.2. The digital revolution in education.

In this digital era, integrating technology to support education is very essential since today’s students are digital natives, these technologies and disruptive innovations are integral to their lives and their mindsets, they help them to get the big picture of complex ideas. Students today rely on their mobile devices and tablets and use internet search engines like Google and other sources like Wikipedia and YouTube in their daily lives to get their answers (Couch & Towne, 2018; Flavin, 2017).

Although many other tools like XR could propose a new challenge for educators, they should consider these tools as new opportunities for education and educate themselves more about them, considering the belief that students could find themselves so familiar with them, therefore, providing classrooms with the latest emerging technologies would help students to get ready for the future and keep up with the pace of this fast-changing world.

Providing classrooms with new technologies would increase the sense of satisfaction, and motivation for both students and educators, (Chen, 2010; Siegel & Claydon, 2016). An improved students’ and educators’ experiences lead to a positive sense of pride, belonging, and loyalty to the university as a brand, and in turn, this would build its reputation and increase the university’s *brand equity*;

which is the value of the brand generated from increased recognition and customer loyalty (Wheeler, 2017).

2.1.3. Getting the most out of technology.

While the term *technology integration* has many definitions, it could be said that it is the use of various technological tools when needed to facilitate both teaching and learning (Summak, Samancioğlu, & Bağlibel, 2010), levels of integration could be *rare, basic, fairly regular, or daily* (Hertz, 2011).

Although integrating technology in education could be considered an opportunity, the essential thing about a technology-enhanced learning environment is not only about the technology itself, therefore *Technological Pedagogical Content Knowledge* (TPACK) framework (Figure 1) suggests that educators should have a combination of knowledge: *technological* (about technology and how it is used), *pedagogical* (teaching and learning methods and practices), and *content* knowledge (the subject matter), and repurpose these technologies creatively to fit disciplinary and pedagogical learning goals to achieve a very successful educational outcome (Mishra, 2018).

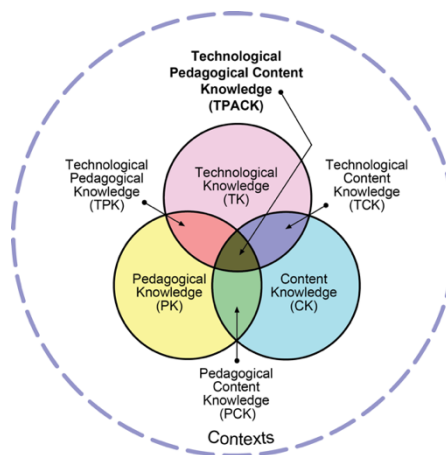


Figure 1. TPACK Framework. Reproduced by permission of the publisher, Retrieved from <http://tpack.org>. Copyright 2012 by tpack.org

2.2. Extended Reality (XR)

As previously described in the TPACK framework, educators need to have the *technological knowledge* to understand the tools which are going to be used, in this study's project, only VR is going to be used from XR technologies.

Extended Reality (XR) is a term used to include technologies like Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) (Grabowski, 2021). MR takes place between virtual and real environments, to measure these environments, Milgram's Reality-Virtuality continuum is used (Figure 2) (Barfield & Blit, 2018).

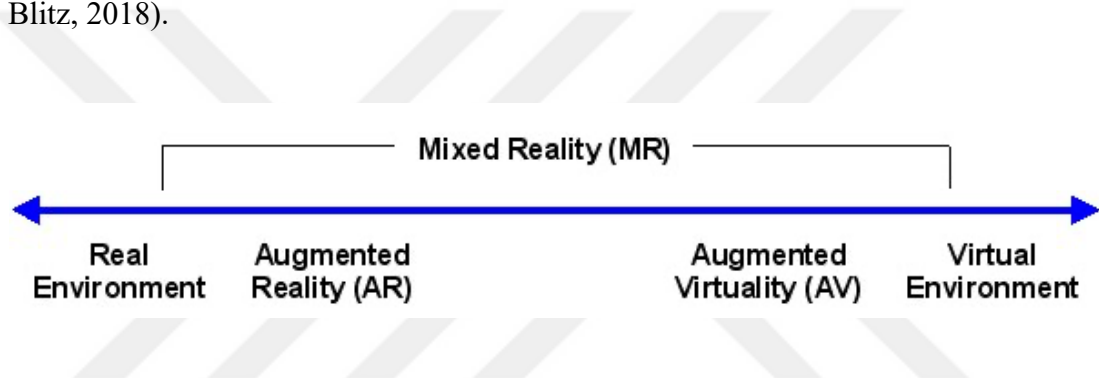


Figure 2. Milgram's Reality-Virtuality continuum. From Wikipedia. Retrieved from https://upload.wikimedia.org/wikipedia/en/d/dc/Virtuality_Continuum_2.jpg. In the public domain.

2.2.1. Virtual Reality (VR).

In many futuristic science fiction stories and movies like *The Matrix* in 1999 and *Ready Player One* in 2018, dystopian communities tend to connect to virtual worlds to distract themselves and create new possibilities, with the invention of VR, some of these fictional stories became almost possible.

Virtual reality finally came into existence thanks to early inventions such as Morton Heilig's *Sensorama* system created in the 1950s for an immersive film experience, provided with a fixed display, stereoscopic visualization, wide field of view (FOV), vibration, smell, wind, as well as seat movement. In 1968, Ivan

Sutherland created the first Head-Mounted Display (HMD) that included computer-generated images, named *Sword of Damocles* (Jerald, 2016).

A term coined by Jaron Lanier in the 1990s (Barfield & Blitz, 2018), *Virtual Reality (VR)* is a simulation of a 3D environment generated by a computer that brings a strong immersive experience to the viewer (Linowes, 2020), to simulate our natural stimuli, generally, three from our senses (visual, haptic, and aural) that our perceptual system has, are introduced with synthetic stimuli (Sherman & Craig, 2003).

During the last decade, Oculus Rift brought a huge spread in VR headsets to the larger public, followed by other products like HTC Vive, Samsung Gear, and PlayStation VR (PSVR). (Bruno, Guitton, & Moreau, 2018), most the VR devices nowadays are equipped with a head-mounted display with two lenses and a wide field of view (FOV) that displays a computer-generated *stereoscopic* scenery; a technique similar to *stereo photography* in which the same image for each eye is placed with a slight offset to create a sense of depth and *parallax* effect (Figure 3) (Linowes, 2020). Early Stereoscopes such as *View-Master* used stereo photographs to create a sense of depth (Figure 4).

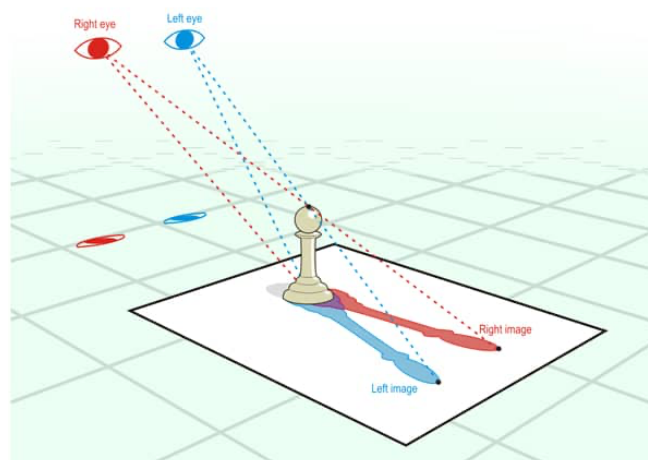


Figure 3. Stereoscopic media creates a sense of depth similar to the human eye, Retrieved from <https://immersionvr.co.uk/blog/monoscopic-vs-stereoscopic-360-vr/>



Figure 4. View-Master stereo viewer, Adapted from Wikimedia Commons. Retrieved from https://commons.wikimedia.org/wiki/File:View_Master_-_Model_G_Red.jpg. In the public domain

Most VR devices include motion sensors or Inertial Measurement Unit (IMU) to find rotation rates and spatial acceleration to track the head movements (Linowes, 2020), these sensors allow users having *6-degrees-of-freedom (6DoF)* to the users which adds an immersive experience to VR environment as it allows users to move in both axis, jump or go higher, kneel, and look around them, but some of these devices have *3-degrees-of-freedom (3DoF)* which has rotational tracking only (Figure 5) (Mealy, 2018).

Users could also interact with virtual objects using controllers that detect motion and track hand movements, they could also hear sounds since most of these devices on the mass market are equipped with audio devices (Mealy, 2018).

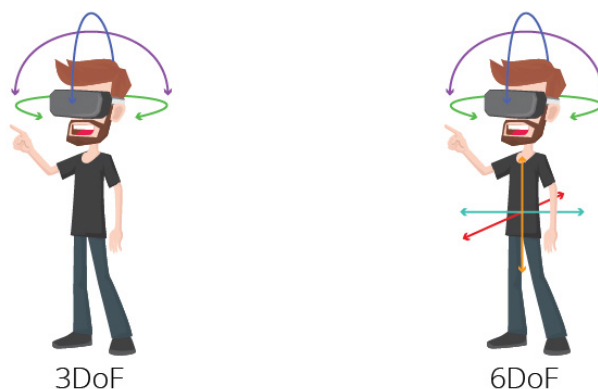


Figure 5. 3DoF and 6DoF, Adapted from Veative. Retrieved from <https://www.veative.com/blog/degrees-of-freedom-3dof-vs-6dof/>

2.2.1.1. Elements of VR experience.

According to Sherman & Craig (2003), there are four key elements of the VR experience:

- **Virtual world:** the space in which the VR experience takes place, with a set of objects to interact with.
- **Immersion:** the feeling of being in an environment, whether it was *Physical*; the synthetic stimulus of the user's senses caused by the technology brings the feeling of being in the virtual world physically or *Mental*; suspension of disbelief, being totally engaged, having a sense of presence. Also known as *presence* (Linowes, 2020).
- **Sensory feedback:** ability to track user's position, movement, and held objects.
- **Interactivity:** being dynamic and responsive to the user's actions.

2.2.1.2. Types of VR head-mounted displays (HMDs).

There are three types of VR head-mounted displays; Mobile, Desktop, and Standalone:

- **Mobile:** a device with two lenses, with a place for a mobile device that shows stereoscopic views (Linowes, 2020), such as *Google Cardboard* (Figure 6) and *Merge VR*.
- **Desktop:** the headset is tethered through wires or a wireless connection to a computer or a game console (Linowes, 2020). Such as *PlayStation VR* (Figure 7) and *Valve Index* for PC.
- **Standalone:** headset doesn't require a PC, console, or a mobile device, all the required components are built-in (Cherdo, 2018),

Such as *VIVE Focus Plus 2* (Figure 8), *VIVE Focus 3*, and *Oculus Quest 2* which has an option to connect to PC wirelessly or through cables.



Figure 6. Google Cardboard, Adapted from Wikimedia Commons. Retrieved from <https://commons.wikimedia.org/wiki/File:Google-Cardboard.jpg>. In the public domain.



Figure 7. PlayStation VR, Adapted from Wikimedia Commons. Retrieved from <https://commons.wikimedia.org/wiki/File:Sony-PlayStation-4-PSVR-Headset-Mk1-FR.jpg>. In the public domain.



Figure 8. VIVE Focus Plus 2 with motion controllers, Adapted from VIVE Enterprise. Retrieved from <https://enterprise.vive.com/mea-en/product/focus-plus>.

2.2.1.3. *VR gadgets.*

VR is becoming more affordable and widespread every day, which is a good thing for education, there are also more expensive high-end products and gadgets with additional features for people seeking the best immersive experience.

Many of these supplements and gadgets are available nowadays, some of them, such as Oculus Quest (Figure 9), are provided with body tracking, eye tracking, as well as hand and finger tracking technologies to navigate and interact with virtual objects (Marr, 2021), though using motion controllers has the upper hand as they provide physical buttons and good hand movements (Alger, 2015), furthermore, to simulate the senses of motion, force, or touch, some haptic technologies use vibrations or simulated feedback in motion controllers, foot cuffs, and gloves such as *CyberTouch* as well as *Haptx Gloves* (Figure 10) (Barfield & Blitz, 2018), also suits, and vests (Mealy, 2018).

There is a gadget that let users feel cold, heat, and pain, it could be integrated into joysticks, gloves, haptic suits, or other devices (Pettit, 2017), furthermore, there are VR treadmills that allow users to run, jump, crouch in their place (Figure 11) to enhance the immersive experience of VR (Linowes, 2020), and interactive chairs provided with haptic vibration and a motorized base such as *Roto VR chairs*.

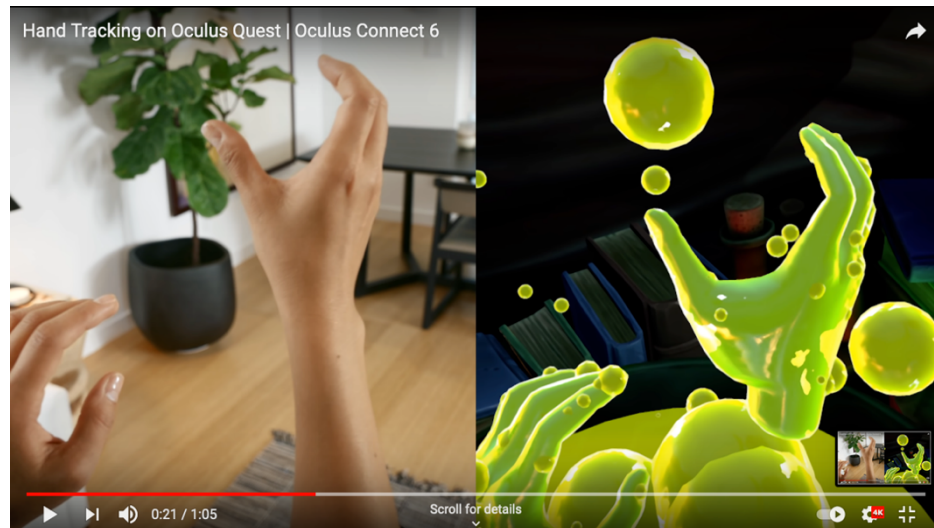


Figure 9. Hand tracking on Oculus Quest, Screenshot by author. Retrieved from <https://www.youtube.com/watch?v=2VkO-Kc3vks>



Figure 10. HaptX Gloves DK2, Adapted from Haptx. Retrieved from <https://haptx.com/dk2-release/>



Figure 11. Omni One treadmill, users can run, walk in 360 degrees, jump and crouch, Adapted from Virtx. Retrieved from <https://invest.virtuix.com>

2.2.1.4. The power and various uses of VR.

As mentioned earlier, one of the questions of the study is: *why should we consider these technologies for the profession and education of visual communication design?* to answer this question, we should know the current usages of these technologies and know their potential.

According to *Statista*; a statistics and database company, the global market size for VR is expected to increase by more than 12 billion USD by 2024 (Alsop, 2021), so there is no doubt that the reason behind investing in VR by many big companies is that they saw a huge potential in this technology, such as Sony, Google, HTC, and Samsung.

Additionally, Facebook spent billions of dollars to buy Oculus Rift (Scoble & Israel, 2017), both Oculus and Facebook CEOs predicted that in the future, the number of VR users could reach a billion or even more, Zuckerberg, Facebook's CEO also predicted that VR will be the next big platform following PC, internet, and smartphones (Raz, 2015), Additionally, Facebook considered their VR headset as a disruptive innovation, a new social platform, and saw a tremendous potential for it in gaming, communications, entertainment, media, education, and other areas (Facebook, 2014), nowadays, VR is being used in many different ways:

- **Gaming and entertainment:** there are plenty of applications and video games available in online stores such as *Rift Store* for *Oculus*, *VIVEPORT* for *VIVE*, *PlayStation Store* for *PSVR*, and *Steam* that supports various VR devices, people could also use VR

to watch content from videos, movies, animation, photos, 360 videos, and interactive experiences on *VeeR*, and *Oculus TV*.

- **Virtual communications:** people can create virtual rooms or spaces, personalize their virtual figures or avatars to engage in different communicational purposes such as education, collaboration, chatting and social engagement, and meetings using apps and websites such as *Engage VR*, *VRChat*, *Horizon Workrooms*, and Mozilla's *Hubs*, or by applying a selfie to a 3D avatar as in *Spatial*.
- **Simulation and training:** many software and applications are being used to simulate real-life situations, *VirtualShip* is software being used in maritime, *X Plane 11* is a software used for flight simulation, *SimX* and *FundamentalVR* are software used for medical simulation.
- **Healthcare and safety:** in addition to medical training and simulation, famous VR games like *Beat Saber* could be used in fitness and exercise and cardiovascular workout, VR Institute of Health and Exercise collects data for such games and assign their rating based on *METs*; a measure of exertion in kinesiology research, the institute compares the games *METs* results with activities such as walking, tennis, and biking, so *Beat Saber* was rated as a tennis equivalent (VR Health Institute, 2018).

VR is used in many areas of healthcare from self-care, treatments, and surgical procedures, or help patient to relax during their treatments, it could also be used in VR clinics during

COVID-19 to monitor or treat remotely (Marr, 2021), or used as a way of therapy and distraction from COVID-19 (Bullock, n.d.), during the pandemic, VR was used to improve compliance with social distancing by using it in virtual festivals and live music concerts planned by *Wave*; a VR social platform (Skandalis, 2020), and has been shown as a good substitute for travel during the lockdown (Sarkady, Neuburger, & Egger, 2021), additionally, a hospital in Los Angeles used VR to let more than 300 doctors learn skills to treat coronavirus patients (Kelly, 2020).

- **Education:** previous studies have shown various positive educational outcomes for many disciplines, as it supports the teacher's role in education, adds a motivational and enjoyable atmosphere, provides constructive learning, supports experiential learning, makes abstract concepts understandable, interact with cases that usually hard to deal with as a result of time, distance, and safety factors, it also provides positive learning outcomes for students with physical or learning disabilities (Youngblut, 1998).

VR could support theoretical education, in a study of astronomy education, the 3D visualization in VR assisted students in conceptual understanding of ideas that were hard to express in the traditional materials (Chen, Yang, Shen, & Jeng, 2007), another study in communication demonstrated how using VR in environmental education would facilitate learning about complex issues whether it was environmental or social (Markowitz, Laha, Perone, Pea, & Bailenson, 2018). VR could be used in academic

libraries by students to get search methods, virtual tours, or information literacy (Kirsch, 2019), it could also be used in subjects such as history, for instance, a study infused VR into *World Civilization I* course using *Oculus Rift* with educational content and apps from *Rift Store* to visit historical places and museums (M. Smith, 2020), it has been found in another study that VR increased students' interest and motivation towards history or other classes they considered as least favorite, it also changed teacher's roles in the classroom (Brownridge, 2020), another study discussed the possibility of using digitized versions of laser-scanned artifacts to be viewed in VR to teach history (Neamtu, Comes, Mateescu, Ghinea, & Daniel, 2012).

As mentioned before, VR could also be used in simulation and training which could be applied to practical, a study used VR practical course for engineering education by simulating interdisciplinary industrial projects through practical tasks in a form of projects had created a strong sense of motivation for students, it also let them experiment and learn from their mistakes (Häfner, Häfner, & Ovtcharova, 2013). Using virtual worlds to mimic real-life working environments would develop students' practical skills, help them adapt to the simulated stressful and surprising scenarios, and repeat an activity until they have learned it (Terrier, n.d.).

VR is being used in educational websites such as *CoSpaces* and *Nearpod* which provides engaging and interactive educational

materials, CoSpaces also provide applications for 3D creation that allows students to conduct simulations, or create their interactive stories, they also supported remote education during COVID-19.

Nearpod has a huge amount of VR lessons that allow educators to take their students on virtual field trips, additionally, Google Arts & Culture platform could be in virtual field trips using Google Cardboard. ClassVR platform has its standalone headsets as well as a VR system for managing multiple VR devices simultaneously from anywhere, it allows the teachers to see what students are seeing, place media, describe, place a point of interest (POI) during students' experience, and track students' head movement on the teacher's display, they also provide a big amount of educational VR content, and Sketchbox is a VR training and assessment platform.

With Education 4.0 approaching, VR will become an essential tool for learning, educators will personalize their virtual avatars to communicate with students and virtual labs will help in creating virtual training environments as an alternative to inaccessible labs (Jeschke & Heinze, 2014). According to Fortune business insights (2019), the global VR in the education market is projected to reach USD 13,098.2 million by 2026.

2.2.1.5. 360-degree media and virtual worlds.

VR experiences could be a *360-degree media*; captured from real-world experiences such as in 360-degree panoramas and 360-degree videos, or created in 3D space such as in virtual worlds.

360-degree-panoramas or (spherical panoramas), are created using several photos taken by multiple lenses or cameras, and edited or stitched together in software or automatically joined into a single image using either *Cubic projection*, or *Equirectangular projection* with an aspect ratio of 2:1 (Figure 12) (Grinev, n.d.), and later wrapped or projected into 3D models around the viewer; cubic is projected on a cube, and equirectangular is projected on a sphere (Mealy, 2018). Both 360-degree-panoramas and 360-degree-videos have *3-degrees-of-freedom (3DoF)* so the viewer's point of view will not change when moving or kneeling.

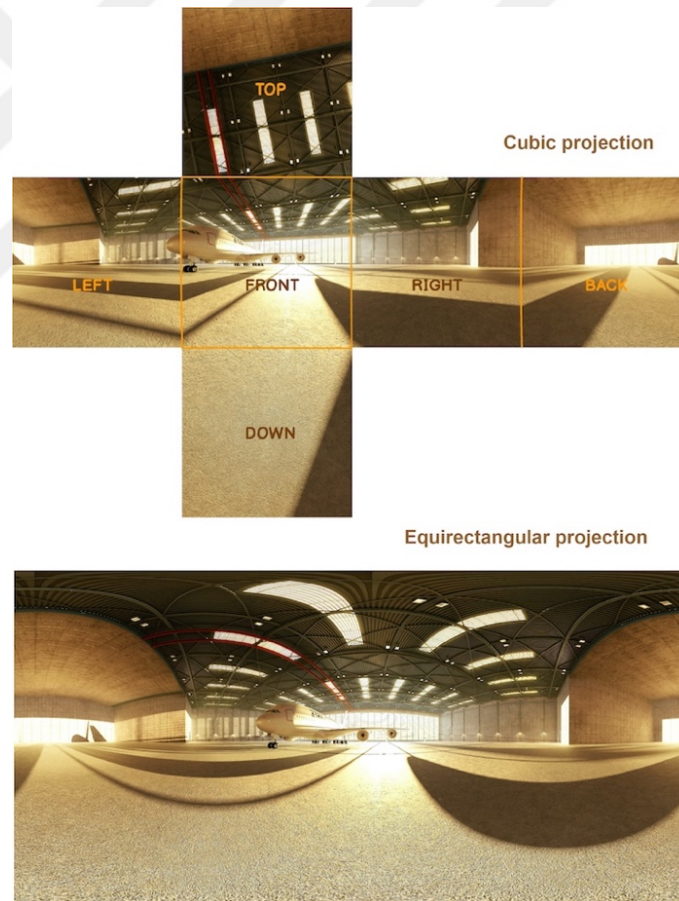


Figure 12. Equirectangular and Cubic projections, Adapted from Onix-systems.

Retrieved from <https://onix-systems.com/blog/how-to-use-360-equirectangular-panoramas-for-greater-realism-in-games>

Media in VR could also be *360-degree-videos* (spherical videos) which is a videos format captured by 360 cameras, and edited to be viewed on either VR devices or *Magic Window*; a video player in web browsers that allows users to view 360-degree-videos without the need of VR by touching or clicking and dragging to look around, or by moving and rotating their mobiles or tablets (BBC, n.d), 360-degree-videos captured by single-camera are *monoscopic*; looks flat and 2D and could be viewed from browsers, mobiles, and tablets, they do not require a VR headset, while *stereoscopic* 360-degree-videos are harder to capture and produce (Immersion VR, n.d.).

360-media does not need computer power, they are easier and less expensive to produce than virtual worlds (Linowes, 2020), but they are less immersive than virtual worlds as most of this media nowadays looks so pixelated and blurry as a result of being compressed and optimized to be streamed online, the resolution of VR media should be higher than 4K to be acceptable (Visbit Inc., 2016) as these media are wrapped into cubes or spheres to fill the whole field of view.

Virtual worlds are computer-generated environments, created by integrating a wide range of skills such as user experience design (Linowes, 2020), furthermore, Linowes (2020).pointed out that:

“VR is multimedia, requiring audio, animation, and 3D design. VR is software engineering, requiring programming, debugging, and platform operations. VR is architecture and modeling, requiring 3D models, level design, and space construction. VR is theater and storytelling, requiring

lighting, blocking, and character development. And the list goes on.” (p. 26).

Virtual worlds could be created online through web VR tools such as *A-Frame* and *WebVR* using internet browsers and programming languages, but the full interactive VR experiences are developed using software development kits provided by the VR device manufacturer (SDKs) as well as game engines such as *Unity*, *Unreal Engine*, *CryEngine* (Altexsoft, 2018), and *Godot* (Oculus VR, n.d.). The required assets and 3D models could be created from scratch in 3D programs, or purchased from websites to be used in VR projects (Linowes, 2020).

To create stereoscopic experiences, game engines render the scene twice, one for each eye (Linowes, 2020; Zhang & Green, 2017), this explains why PC and console VR headsets are more powerful than standalone and mobile headsets as rendering requires powerful devices (Heaney, 2020).

This study will use *Dreams* to create VR educational game; which is a creation system made exclusively for Sony PlayStation, it enables users to create VR experiences without having programming knowledge, further information will be discussed in chapter 3.

2.2.1.6. Considerations for creating virtual worlds.

As mentioned earlier, there are several methods for creating virtual worlds, after choosing the suitable method for the project, several considerations and principles should be considered for creating VR experiences:

1. **Comfort:** In real life, our eyes are naturally converge and diverge when we focus on something in real-world according to its distance, this movement is known as *vergence*, the lenses in our eyes also focus on the objects, but VR tricks the brain by creating sense of depth as it separate vergence and focus which could confuse the connection between eyes and brain and sometimes cause some side effects (Zhang S. , 2015), several studies displayed that virtual reality could cause fatigue, motion sickness, cybersickness, and other symptoms due to display factors such as quality of stereoscopic rendering, latency (feedback in virtual world is slower than user's action), improper field of vision, and quality of screens (Bruno, Guitton, & Moreau, 2018), Jeremy Bailenson, director of Stanford university's *Virtual Human Interaction Lab* believes that our brain believes that VR is real when it is done well (LaMotte, 2017), therefore, not only the quality of the VR devices matters, the quality of the platforms also matters.

It is also important to consider the duration of VR sessions, although people experience VR differently as some of them could use them for hours, Oculus and HTC recommend taking 10 to 15 minutes as a break every 30 minutes (Fagan, 2018), and Sony recommends taking a break for 15 minutes every hour as the length of breaks vary from person to person (Shuman, 2016). Setting up the head-tracking, and the settings HMD as well as other feedback devices would maintain the user's sense of

immersion (Faller, 2019), as a result, the user will use VR for a long time without interference.

VR could also cause a loss of spatial awareness especially while standing, most VR makers advise users to set up their playing area and check their surroundings before using their VR (Fagan, 2018), for instance, Oculus is provided with a passthrough camera that enables users to see their surroundings and set up their “guardian” safety system and play area (Heaney, 2020), Oculus stated that most of their customers preferred seated experience (Parrish, 2018) and Sony recommended using their headsets while seated as it is safer and more comfortable (Shuman, 2016), therefore, it is important to provide protective area around the user while standing, and it is better to create virtual worlds to be experienced while seated as motion sickness would be reduced (Jerald, 2016).

Movement in the virtual world is referred to as *Locomotion*, it is either *Physical*; corresponds to the user’s movement, or *Artificial*; movement is done using controllers, like moving in the virtual world while the user is seated (Oculus VR, 2021), to improve the experience, Oculus provided some useful techniques for each movement for developers (Figure 13). Additionally, placing visual cues would reduce motion sickness when using moving vehicles, which could be achieved by showing the vehicle’s cockpit or by adding stable cues to the virtual world (Jerald, 2016).

Useful Techniques	Associated Locomotion Types	Comfort Risks and Usability Issues
Consistent framerate, Quick turns, Snap turns, Independent Visual Background (IVB), Vignetting, Instant velocity changes	Avatar movement, Scripted movement, World pulling, Steering movement	Vection
Spatial sound effects, Blinks, Warps	Teleportation	Disorientation
Artificial locomotion, Support seated use	Physical locomotion, World pulling	Fatigue
Artificial locomotion, Support seated use	Physical locomotion	Accessibility
Artificial locomotion	Physical locomotion	Space Limitations

Figure 13. Techniques for improving locomotion experience, Adapted from Oculus.

Retrieved from <https://developer.oculus.com/learn/locomotion-comfort-usability/>

2. The number of users: virtual worlds could be created for users to experience alone (also called *single-player*), with the option to mirror or cast the user's HMD to other screens or devices so other viewers would be able to watch, experiences could also be *multiplayer* so other users could share the same experience using multiple VR devices connecting online or to a local network, or involve in an *Asymmetrical VR* which involves non-VR users able to interact with the VR user using controllers or other devices such as mobile phones, computers, or consoles (Baker, 2020).

3. Type of VR experience: when creating virtual worlds, it is important to consider the type of VR experience needed for their project, Linowes (2020) described these types as follows:

- **Diorama:** a simple 3D scene where the viewer just observes it from a third-person perspective; the observer's eyes are camera focused on the scene.

- **First-person perspective:** the user is experiencing through the eyes of a character or avatar, the user can observe, and walk or move in the virtual world using an input device or controller.
 - **Room scale:** the user is in first-person perspective, with virtual guides that show the area boundary similar to the user's actual room, using cameras or tracking devices.
 - **Interactive:** the user is in first-person perspective, can observe, move, and interact with objects with physics and mechanics, goals and scores could also be included within the virtual world.
 - **Content creation:** the user could create 3D content or objects in the virtual world.
 - **Riding on rails:** the user is seated and transported in the virtual world.
 - **Social VR:** the user is having virtual communication with other VR users.
4. **User experience design (UX):** UX design is the process of providing a useful, delightful, easy to use, and applicable experience to the users, including usability, function, interaction, design, and branding (Deacon, 2020), it is essential to consider principles of UX design for VR in order provide the best immersive experience to users, and avoid losing their concentration. Additionally, existing design principles from other disciplines could also be used in VR design, Mike Alger (2015), a designer working for Google's YouTube VR, mentioned that principles from design (print, web, and interior),

motion graphics, architecture, theater, as well as many other disciplines, could be adopted into VR.

- **User interface design (UI):** the user interface is the way of communication between users and the product used to execute tasks that would accomplish users' demands through creating functional graphic elements such as menus, layout, text, icons, selection controls, colors, and animation (McKay, 2013), UI is one of the most essential things in VR creation as it serves as a visual aid and facilitates the interaction between the user and the VR application or game.

As mentioned before, VR makes it possible for users to interact with the virtual world using multiple ways such as controllers, motion controllers, voice commands, gestures, as well as hands, body, and eye-tracking, therefore, there are unlimited possibilities for designing interactive UI in VR.

For instance, a *Reticle* is a visual aid that could be added to the heads-up display (HUD) within the user interface to guide users to point, target, or select the interface and 3D objects, it could take the form of a small dot, crosshair such as in shooting games, or other shapes (Jerald, 2016) it helps users to visualize the center of their view when moving their heads, and to trigger actions when gazing on objects in the virtual world (Google, 2016).

Light rays or Raycasts are virtual light beams similar to laser pointers, they could be used as a cursor or a pointer for input

and interaction with targets, the downside of using Raycasts is that far objects are harder to interact with, so it is possible to extend the size of the end of the ray to make it easier (Alger, 2015).

Raycasting could be added to any controllers as well as the HMD within the virtual world to interact with objects or the interface.

Alger (2015) emphasized that UI design should be intuitive and easy to use by relying on human instincts, he also prefers using a minimalist approach when designing *icons* and *buttons*, keeping in consideration to create a visual form for buttons that communicate their purpose and their current state such as when pressed or hovered, as well as proper color selection, and placing labels with buttons, Purwar (2019) suggested avoiding the use of small buttons or placing them too close to each other.

It is also important to include *sound* and *visual cues* in the user interface, several design practitioners mentioned the importance of using them to provide feedback when touching objects or buttons even without the presence of haptic or tactile feedback (Alger, 2015; Faller, 2019; Hunter, 2016).

The text should be large and readable (Betts, 2016), it also should be short; Faller (2019) recommended using audio rather than long text blocks and text instructions as it could cause eye strain, Alger (2015) provided some useful concepts on how to place text, UI, as well as other content in specific zones, typically, users could rotate their necks comfortably to both sides as well as up and down (Figure 14), he suggested; based on Ergonomics, that

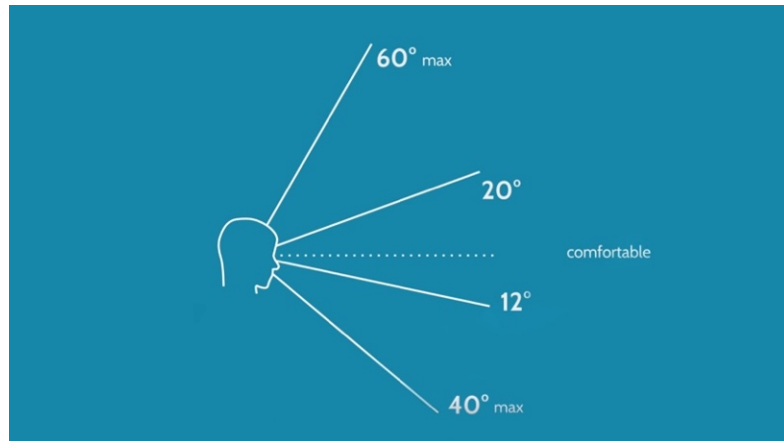


Figure 14. Comfortable Zones when looking up and down in VR by Mike Alger,
Adapted from <https://www.youtube.com/watch?v=id86HeV-Vb8>

the most comfortable way for reading text for a long time while setting on a fixed or non-rotating chair is by placing it within angles between 15 and 50 degrees downwards, and 1.3 meters away from the user (Figure 15).

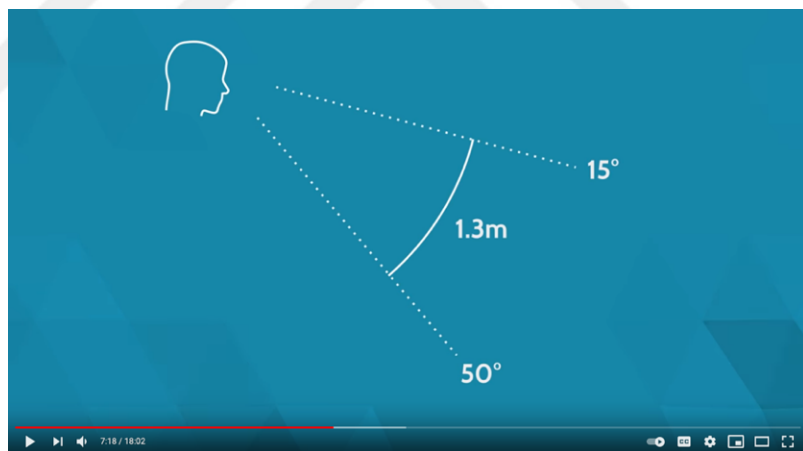


Figure 15. Reading zone in VR by Mike Alger,
Retrieved from <https://www.youtube.com/watch?v=id86HeV-Vb8>

Text and other content should not be placed in a close range or an area around 0.5m (the *No-No Zone*) as the user would lose depth perception and feel strained, other content could be placed in the *Main Content Zone* where content could be seen comfortably, the area between 0.5m and 10m has the strongest

depth perception, *Peripheral zone* is an area that users have to strain and turn their heads to see the content within it (Figure 16), additionally, creators should also consider user's arms reach which is between 50 to 70 cm (Payne, 2017).

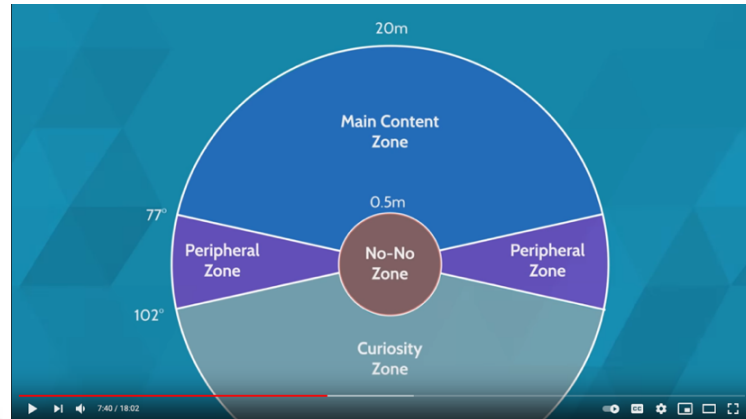


Figure 16. Content zones while seated in a fixed position in VR by Mike Alger, Retrieved from <https://www.youtube.com/watch?v=id86HeV-Vb8>

Alger (2015) used Oculus Rift DK2 to define these zones, he addressed that these zones would change according to the VR device; devices with higher resolution would view content better even beyond 20m, and the reading zone would be at almost 2.5 meters rather than 1.5 meters. According to Palmer Luckey, founder of Oculus Rift, 8K resolution per eye is needed to hide individual pixels (Orland, 2013), therefore, text, content zones, and reading zones in future devices would be different.

This research uses 2016's PSVR, with a resolution equivalent to 2014's Oculus Rift DK2 which is 1920 x 1080 (960 x 1080 per eye) (VRcompare, n.d.), the author owns both PSVR and Oculus Quest 2 and believes that display resolution has a great influence on text readability, the image quality might defer from

game to another according to the rendering engines they use as well as the budget and team size since some of them looks sharp and others look pixelated even using same VR device.

Hunter (2016) suggested adding freedom to the interactions with UI and menus like allowing users to move menus out of the way, hide them, or recall them as it would increase the sense of pleasure and immersion. It is also important to create meaningful animations for UI as it feels annoying to users when they slow them down or don't include a purpose (Babich, 2020).

- **Virtual world design:** the design *style* of virtual worlds and characters could be realistic, cartoon-like, or any other style, but it is important to keep it within a sweet spot and avoid users getting an *Uncanny Valley* feeling when creating avatars or characters at which the user feels uncomfortable with them as they look creepy rather than realistic (Jerald, 2016), therefore, a cartoon-like look would add magical properties thus getting a dreamy state of mind and make them more approachable, especially when using VR for therapy purposes (Sherman & Craig, 2003).

Planning and setting up the *attributes* for objects in the virtual world are introduced in the third chapter of this study such as color, shape, size, position (Karnik & Onah, n.d.), as well as other attributes such as being static, or animated should also be decided. For example, users should be able to interact with objects in VR if they look interactable (Dealessandri, 2020).

Colors have an enormous part in the design, not only in VR design, but also in other disciplines such as art, graphic design, visual communication design, interior design, cinematography, animation, and many others. Color is the most important and powerful element in design and visual communication as it gets the immediate unconscious response from viewers even before any other elements of design, it is important to know color theory, color psychology, and color symbolism to communicate a specific meaning, mood, emotion, or to bring attention and visual aid to viewers (Bleicher, 2012).

Jerald (2016) suggests using consistency when adding colors to the virtual world, avoiding extensive use of colors, providing a proper *lighting* condition by avoiding intensive lighting, and using modest variations of white light to provide the intended colors. Additionally, a proper lighting setting has a huge impact on the user's immersive feeling Field (Murray, 2020), lighting could also be used for guidance and getting the user's attention (Hunter, 2016).

Creators should pay attention to *audio design* as sometimes it is more important than the visuals (Linowes, 2020), audio could play role in user guidance since users could hear sounds around them and try to know the direction of the source (Faller, 2019). Sounds could be *realistic*, *abstract*, *ambient* (background sounds), *markers* (sounds that represent actions), and *Index Sounds* (sounds that vary to donate a changing value),

sounds would aid in setting the mood of the experience (Sherman & Craig, 2003). Also, *music* has an important role in evoking the user's emotions (Jerald, 2016).

In the virtual world, users should be able to have a *sense of distance*, it could be achieved by creators placing *visual depth cues*; visual indicators of distance, these cues could be *Monoscopic* using (shading and shadows, brightness, size, texture gradient, brightness, linear perspective, interposition, atmospheric effects such as fog and haze), *Stereoscopic* (using parallax effect), *Motion*, or *Physiological* (caused by muscle movements of user's eyes), sense of distance could also be achieved using audio through *aural localization cues* (Sherman & Craig, 2003).

In addition to users' ability to have a sense of distance, they should also have a *sense of guidance*, therefore, as mentioned before, creators should place visual and aural cues for aid and guidance, moreover, wayfinding aids and elements such as compasses, maps, and landmarks could be used for navigation and guidance (Jerald, 2016).

2.2.2. Augmented reality (AR).

Unlike virtual reality which users emerge within a 3D environment, Augmented Reality (AR) is a 3D generated content viewed directly or indirectly in a real-world environment to be watched or interacted with by users, thus enhancing or "augmenting" the environment, it could also be used to enhance perception any of user's five senses (Carmigniani & Furht, 2011), AR has three major types of displays; HMDs, handheld displays such as mobile devices and

tablets, and spatial displays such as holograms and video projectors (Ionitescu, 2012).

2.2.2.1. Types of AR

There are two types of augmented reality, *Marker-based AR*, and *Marker-less AR*:

1. **Marker-based AR:** refers to placing a specific marker printed on an object or placed within the environment in real-world, and using a camera within a device to scan and recognize the marker, which triggers a 3D object or media to appear on the device's screen on the top of the marker to be viewed from different angles (Gupta, 2019). The screenshot below (Figure 17) is an example of using marker-based AR for creating business cards; a short video by the card's owner could be seen by viewing the business card through the viewer's screen.



Figure 17. Using Marker-Based AR in business card design, Adapted from <https://www.youtube.com/watch?v=cidBVt0ZkJE>

2. **Marker-less AR:** achieved by using data from the device such as GPS, accelerometer, and image recognition to trigger and view media without the need for physical markers (Gupta, 2019). There are multiple types of Marker-less AR; *Location-based AR* involves media appearing when a user's GPS location matches a specific spot (Poetker, 2019), one of the most successful mobile games; *Pokémon GO* (Figure 18) is an example of Location-Based AR.

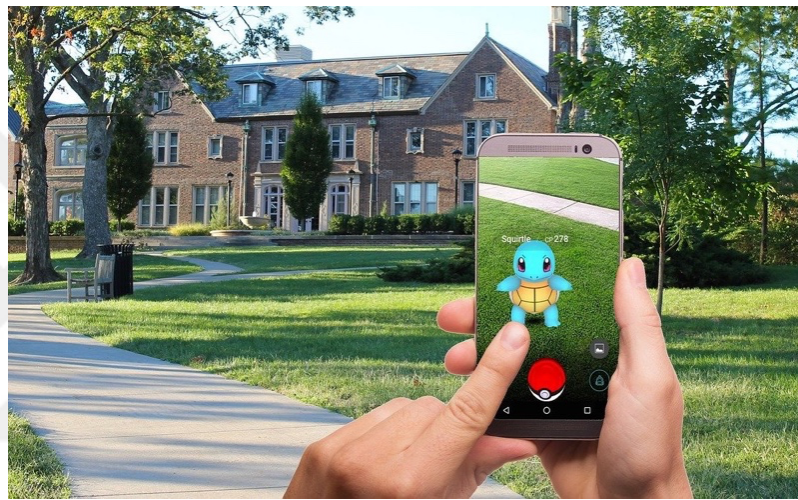


Figure 18. Pokémon GO uses Location-based AR. Adapted from <https://pixabay.com/photos/pokemon-go-pokemon-street-lawn-1569794/>

Superimposition AR is another type of Marker-less AR, it recognizes the object and replaces it fully or partially with an augmented view (Gupta, 2019), social platforms such as Facebook and Instagram are using this type of AR as filters.

Projection-based AR involves projecting lights on objects from the environment using special projectors to create interactable projections similar to holograms that users could interact with, *Outlining AR* identifies lines and boundaries from

objects and environments that our eyes consider hard to see, such as car parking screens that outlines the boundaries (Poetker, 2019).

2.2.3. Mixed Reality (MR).

Mixed reality is combining both the virtual world and the real world in a way that users could interact with virtual objects using real objects (Grabowski, 2021), *Magic Leap*, and *Microsoft HoloLens* are good examples of MR, HoloLens maps the space so the user would be able to interact with holograms that appear within the smart glasses using hand tracking (Figure 19), users could collaborate using smart glasses, they could also collaborate with VR users using Microsoft's collaborative platform; *Microsoft Mesh*.

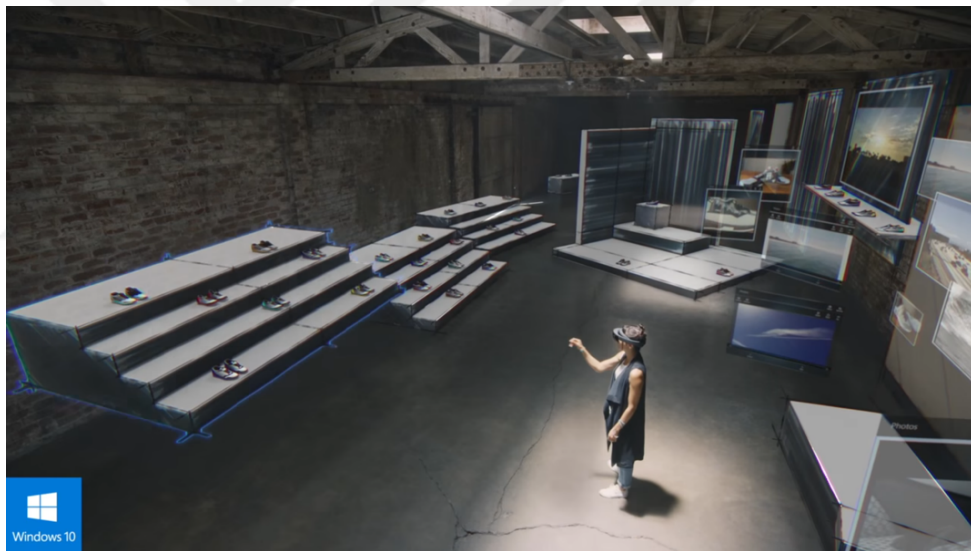


Figure 19. Microsoft HoloLens. Screenshot by author, Retrieved from <https://www.youtube.com/watch?v=2MqGrF6JaOM>

2.3. Using Games for Education

As aforementioned, using creative approaches would achieve positive educational outcomes, this study uses the immersive power of virtual reality to provide a motivational and inspirational atmosphere to visual communication design students, it could have been done by placing 360 videos, motion graphics, or by

simply placing media such as images and videos within VR, instead, the author decided to create an educational video game since there are currently no educational video games or VR games to support visual communication design education, additionally, games are very powerful tools for education.

The video game industry is huge, it is so huge it made wonders for the world, turned a countless number of YouTubers and online streamers into millionaires, and created enormous opportunities for employment and investment, according to Statista (2020), the market size of video game industry in the USA in 2021 is predicted to surpass 65.49 billion dollars.

Not only does it has a huge financial impact on the world, but they are also engaging, and bring people together, additionally, “video games have become platforms for conflict resolution, refuge for the disabled, forums for interactive storytelling” (Lee, 2020), furthermore, games lets people discover their capabilities, teach them problem-solving skills, collaboration, cooperation, self-motivation, urgent optimism, and how to get up after repeated failures, they spend so much time learning about the game and how to become better (Mcgonigal, 2010), they keep learning, exploring, while being hooked without external pressure (Cristea, Bittencourt, & Lima, 2018).

2.3.1. Serious games, educational games, game-based learning, and gamification.

- 1. Serious games:** games that are meant for reasons other than or in addition to pure entertainment (Becker, 2021), serious games are used to add fun and enjoyment to the user experience, motivate users, reach their emotions, adaptable, deliver immediate feedback, and could be used for both formal and informal purposes, such as *Exergames*; for physical

health activities, *Advergames*; for advertising and marketing, *training and simulation games*, *educational games*, and so on (Dörner, Göbel, Effelsberg, & Wiemeyer, 2016).

2. **Educational games:** a sub-group of serious games, they are used in the formal education (Dörner, Göbel, Effelsberg, & Wiemeyer, 2016), although educational games are a form of *games for learning (G4L)*, games for learning address both formal and informal learning (Becker, 2021).
3. **Game-based learning (GBL):** from the learner's perspective; it is the practice and process of learning through games, *Game-based pedagogy (GBP)*: is the practice and process of teaching using games, from the teacher's perspective (Becker, 2021), for instance, a creative math teacher used *Half-Life: Alyx*, a VR shooter game, to teaching math (Figure 20).

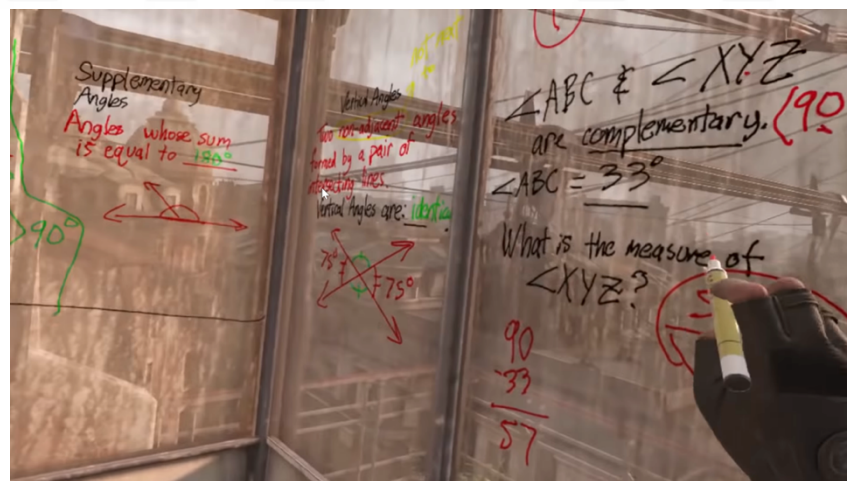


Figure 20. Game-based learning using *Half-Life: Alyx*, a VR game. Screenshot by author, Retrieved from https://www.youtube.com/watch?v=_T2-9MwA5JI

Another example is using *Minecraft* for learning, which is a sandbox crafting and building game, it holds records for the world's best-selling video game of all time (McIntyre, 2021) and the most-watched

game on YouTube for 2020 (Wyatt, 2020), it has another version created for GBL; *Minecraft: education edition*, it contains hundreds of lessons from various subjects such as art, design, science, math, and computer science, created by educators throughout the world (Minecraft, n.d.).

Multi-user Virtual Environments (MUVE) are online virtual environments in which users can meet and interact with each other using their 3D avatars, although they might contain games within the world, these platforms are not entirely considered games, *Second Life* is a good example of MUVEs (Livingstone, Kemp, Edgar, Surridge, & Bloomfield, 2009), encompasses a huge number of destinations available in their destination guide within their website, such as universities, museums, art exhibitions, as well as many others, users could visit universities such as Stanford, Western Australia, and North Carolina State University to learn, teach, or research (Second Life, n.d.).

4. **Gamification:** Gamification is a method of using game elements such as levels, achievements, and badges in a non-game activity to make it a more engaging (Routledge, 2016), it could be applied to massive open online courses (MOOC), education, user experience design, and visual communication design.

2.4. Learning Theories, Approaches, and Practices for and within VR and Educational Games

As previously described in the TPACK framework, it is important for educators to have *technological*, *content* knowledge, and *pedagogical knowledge* such as teaching and learning methods, theories, and practices, which will be discussed in this section alongside their embodiment within both VR and educational Games.

Since this study is about visual communication design “education”, it is necessary to address the definition of the terms “*Education*” and “*Learning*”, *Education* is “a process of teaching, training, and learning, especially in schools, colleges or universities, to improve knowledge and develop skills” (Oxford Learner's Dictionary, n.d.), while *Learning* “refers to an intellectual process of acquiring new skills and knowledge, through experience, study or teaching”, it is also “a continuous process and also a life long one. Learning can be intentional or unintentional, conscious or unconscious, for better or for worse” (Surbhi, 2021). Typically, learning is inferential; assessments are based on its outcomes through *direct observations*, *written* and *oral* responses, a *rating by other individuals*, and *self-reports* such as questionnaires and interviews. (Schunk, 2012).

Throughout history, people sought knowledge of how human learning occurs as well as aspects that might influence it, and scientifically acceptable theories that support education and research (Schunk, 2012), such as instructional design models and learning theories, which could be used as a platform for VR instructional strategies (Dreimane, 2020), learning theories helps learners to decide the choice of teaching methods, which they are determined by the context, a mix of methods could be used in teaching (Bates, 2015), however, VR still needs fixed principles and evaluation tools for learning that covers all aspects of training and education for different fields (Dreimane, 2020), additionally, testing VR experience is also crucial, Oculus stated in their *best practices guide for developers* that VR is still young medium to have fixed conventions to address all aspects of the experience, they suggested that user testing for content created by developers is crucial (Oculus, 2017).

A selection of components from theories, approaches, and practices below would explain how both VR and educational games would enhance learning, depending on learning situations:

- **Autonomous learning:** a learning approach in which learners set their goals, methods, the progress of learning, and evaluate their learning outcomes, VR provides an environment for autonomous learning as students could make decisions and control their learning progress and get feedback from VR and their teachers (Liu, Bhagat, Gao, Chang, & Huang , 2017).
- **Behaviorism:** a learning theory, while behaviorism assumes that learning occurs by rejecting mental activities, and gaining new behaviors, *operant conditioning* — one of the methods of behaviorism — is important, in which learner's behavior is either *reinforced* using rewards or *punished* when an unwanted behavior occurs (Pritchard, 2009), similarly, within the educational game, learners react to stimuli and they learn when they get rewarded due to a proper action or behavior (Maugard, 2019).
- **Blackbox thinking:** an approach that suggests that people should change their views and attitudes towards failure and create an environment where it is safe to fail, as committing multiple failures, comforting our mistakes, embracing them, and learning from them, would lead to a positive attitude, and great learning experience, therefore, success (Syed, 2015), similarly, virtual worlds within VR and educational games provide a safe environment to where it is safe to fail, users could fail multiple times in order succeed and learn, failure in VR and educational games is not destructive, it is productive.
- **Challenge-based learning (CBL):** a framework that promotes the idea of learning using technology to *engage* in a real-world problem or actionable

challenge, *investigate* and develop content and concept-based research to find practical solutions, and *act* with the implementation of documented and evidence-based solutions to get feedback and learn from their achievements and failures (Nichols, Cator, & Torres, 2016). Learning within VR technology, such as creating an environment-related challenge, could be implemented to solve real-world problems.

- **Cognitivism:** this theory promotes the idea that learning occurs by extending the current knowledge (Maugard, 2019), it also explores how our minds collect, organize, store and retrieve information, as well as the relationship and interaction between long-term memory and working memory (Michela, 2020), it emphasizes the role of tools that facilitate learning and helps to organize information in their minds by decomposing and simplifying knowledge, such as graphic organizers, illustrations, demonstrations, analogies, quizzes, hierarchical information, and chunked information (Ertmer & Newby, 2018), educators could use these tools and practices within educational games to facilitate learning (Maugard, 2019).
- **Conceptual learning:** a *concept* is a mental representation or construction that enables one to classify things sharing common attributes and differentiate between examples and non-examples of a category, including physical objects and abstract ideas, learners understand concepts better when they are provided with rules and classifications such as (if-then) form, and when they provided by instances or examples (Schunk, 2012), VR provides an environment to facilitate conceptual learning and understanding complex ideas (Whitelock, Brna, & Holland, 1996).

- Cone of learning:** a diagram developed by Edgar Dale (1969) based on his theory on audio-visual aids for learning (Figure 21), suggested that people tend to remember things better when they are actively doing it, based on this theory, Bakul, Auburn, and Ausburn (2013) proposed a multimedia cone of abstraction (Figure 22), it suggested that VR is the most effective and the least abstract among other forms of multimedia.



Figure 21. Cone of learning, Adapted from Dale's Audio-Visual Methods in teaching, 1969.

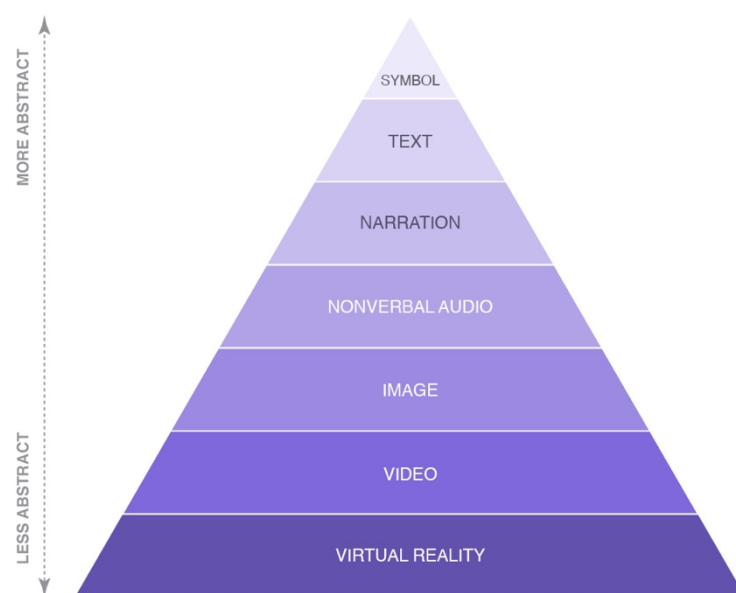


Figure 22. Multimedia cone of abstraction, Adapted from Baukal, Ausburn, and Ausburn, 2013.

- **Connectivism:** a learning theory that suggests that modern learning is a process in which the learners share their knowledge, interests, opinions, and expertise with other people, formed within the virtual learning settings such as internet sources from videos, articles, blogs, books, social networks, massive online courses (MOOCs), virtual reality, virtual learning platforms, and video games, people are nodes within a series and network of nodes that provide each other with knowledge (Kropf, 2013).
- **Constructivism:** a learning theory, implies that learning is constructed; new knowledge is built upon the learner's current knowledge, skills, concepts, and attitudes (Pritchard, 2009), it associates learning with creating meaning coming out of an experience (Ertmer & Newby, 2018), likewise, an educator could use elements from real-world within the educational game so students could apply the acquired knowledge to real-life situations (Maugard, 2019), such as simulation and training in VR.

Examples of how VR supports this learning theory are setting and interesting *problems* for students to solve, providing learners with a *collaborative* environment, supporting free *manipulation* and exploration within the virtual world to update existing knowledge, adding navigation and discovery to achieve *experiential learning*, also, the infinite number of viewpoints, meanings, and perspectives that could be done in VR provides *multiple perspectives* and adds diversity to approaches of thinking for the learner (Chen C. J., 2009).

- **Embodied learning:** an approach refers to the conscious physical use of the body to achieve learning, it supports the ideas that mind and body, work in sync to achieve learning, the conjunction between movement and concepts,

learning-by-doing, the importance of body and feelings (Paniagua & Istance, 2018), such as simulations, using gestures, performing tasks, actions, and using motion controllers in VR to manipulate objects within the virtual world, which would achieve fast and deep learning (Johnson-Glenberg, 2018).

- **Experiential learning:** it is the actively immersive engagement of a learner (physical, intellectual, emotional, and spiritual) by being present and active in places and realities to stimulate learning, and build an effective and memorable experience to and of learning, the learning cycle consists of *concrete experience, reflective observation, abstract conceptualization, and application* (Beard, 2010), VR provides a virtual simulated environment that would provide experiential learning or learning-by-doing for users' training, simulation, and education by being active in the virtual world.
- **Generative learning:** a learning theory, implies that effective learning occurs when learners engage in convenient cognitive processing, it involves *selecting* relevant key information, mentally *organizing* and arranging them, *integrating* them with relevant previous knowledge from long-term memory to solve new problems, and using learning strategies that support understanding such as summarizing, drawing, mapping, imagining, self-explaining, self-testing, enacting, and teaching (Fiorella & Mayer, 2015), for instance: students summarizing a segmented VR lesson would bring them positive learning outcomes (Parong & Mayer, 2018).
- **Learning retention:** the process through which new information is relocated from short-term memory to the long-term memory (Witte, 2020), studies show that using VR has higher learning retention than computers (Krokos, Plaisant, & Varshney, 2019; Witte, 2020), tablets, lectures, reading, audio-visuals,

demonstrations, and group discussions, as VR provides customized repetition as well as short educational sessions and breaks delivers effective learning outcomes (Witte, 2020).

- **Motivation theories:** there are two types of interest: *personal interest*; the positive feeling and belief that a certain object is personally important brings a feeling of enjoyment, the second type is *situational interest*; a temporary state of interest which has four phases (triggered, maintained, emerging, or well-developed) by a situation or environmental stimuli (Park, 2018), likewise, students could either have a personal interest in VR, or situational interest triggered by using VR in the classroom, which could lead to an increased sense of motivation, engagement, and positive learning outcomes, additionally, incorporating a feedback structure within VR and providing efficacy cues educational game would boost students' *Self-efficacy* (Parong & Mayer, 2018), which is a person's belief in his or her abilities to do something required to achieve a certain task (Park, 2018).
- **Observational learning:** the practice of learning by observing or watching others with a high level of *attention*, *retention* or remembering the knowledge, *reproduction*; applying the knowledge as actions, and adding *motivational* factors to the observer to reproduce this knowledge (Cherry, 2021), according to a study, adding this practice to VR would achieve positive educational results (Watson & Livingstone, 2018).
- **Sociocultural theory:** the key concept of this theory is that *social*, *cultural*, *historical*, *individual*, and *language factors* have major roles in the learning (Schunk, 2012), for example; socially collaborating with other students or more experienced people on a variety of meaningful tasks and sharing their

experiences has great learning outcomes (Polly, Allman, Casto, & Norwood, 2018), similarly, educational games connect students so they can collaborate, learn from each other's experiences, and have social interactions and discussions while or after playing together (Maugard, 2019).

- **Other attributes:** such as fantasy, representation of the real-world environment, challenge, sensory stimuli, mystery, assessment, control, as well as many other skills (Maugard, 2019).

2.5. Visual Communication Design

2.5.1. Introduction.

Within the TPACK framework, *content knowledge* describes the subject matter, which in this study, it is about Visual Communication Design.

It is being said that necessity is the mother of invention, since the existence of human beings, people from tried to find the best possible ways to express themselves, either by using gestures, or by creating their speaking language, they also needed to find a way to turn their thoughts, concepts, messages, and ideas into visual forms by using many kinds of objects they found or tools they created to carve, sculpture, or paint on different kinds of surfaces, whether it was for a purpose of communication, maintaining specific knowledge, art, or ritual activities.

Many great discoveries have been made over the years that show evidence of visual communication, cave paintings created by prehistoric people are one of the earliest discoveries, handprint paintings are one of the forms of early visual communication, created using hands as a stencil and blowing pigment on them (Meggs & Purvis, 2016). One of the most recent discoveries for hand stencils was found in the caves of Sulawesi, Indonesia, which has a minimum age of 39.9 kyr

and is now the oldest known hand stencil in the world. (Aubert, Brumm, Wahyu, & Hakim, 2015). Through the ages, inventions and contributions for the development of some important tools used for visual communication were being made, developed, and spread to many other parts of the world such as *Petroglyphs*; a carved or scratched signs, simple figures, or shapes on rocks, *Cuneiform*; abstract wedge-shaped signs made on clay tablets using a stylus or blunt reed, *hieroglyphics*, which is a picture writing system based on pictographs, all these inventions as well as many others led into the development of writing, papermaking, and printing. (Meggs & Purvis, 2016).

The invention of printing and papermaking brought the introduction of some of the tools and creations that we still use nowadays in visual communication design, such as *seals, trademarks, symbols, visual identifiers, watermarks, page layout, book design, posters, and typography*; a term for printing with movable letterforms, furthermore, the *Industrial Revolution* which occurred first in England in the years between 1760 and 1840 transformed society from being agricultural into industrial, it brought mass production of products, made them cheaper, and more available, which resulted in increased market competition, thus the demand of advertising and the creation of unique designs (Meggs & Purvis, 2016).

Over centuries, evolution in design kept advancing, people began to create unique typography, and add visual support from graphics such as illustrations, patterns, ornaments, as well as photographic images. Art movements such as *Art Nouveau, Arts and Crafts, Bauhaus, Dadaism, De Stijl*, as well as many others, contributed to the development of art, crafts, architecture, and

graphic design by introducing different philosophies, unique approaches, and design styles (Meggs & Purvis, 2016).

2.5.2. Graphic design and visual communication design.

The term *Graphic Design* has been used first by American book designer William Addison Dwiggins in 1922, as a description for his activities of making visual order for printed communications (Meggs & Purvis, 2016), the word “Graphic” was developed from the ancient Greek word “graphein” that meant mark-making, “Design” was from the French word “dessiner” and then from the Italian word “disegno” (Barnard, 2013).

Graphic design was originally developed in the publishing and printing industry as a result of competition and high demand for visually attractive designs (Harris & Ambrose, 2009), people in the early twentieth century who had the responsibilities of today’s graphic designers were simply called *commercial artists*, while graphic design today is a convergence of photography, design, and illustration (Hembree, 2008), it is a form of visual communication in which designer used to encode or send information or a particular message from a sender or a client to the targeted audience, it is a visual representation of an idea by choosing, creating, and organizing visual elements (Landa, 2013).

The profession of graphic design grew largely within the last quarter of the twentieth century and early twenty-first century as a result of the evolution of technology and digital computer, although many designers at the beginning rejected the idea of using computers, it was widely accepted as it made the process of both design and production easier and more efficient, aided by software such as Adobe Photoshop, Adobe Illustrator, QuarkXPress, and

Pagemaker, as well as technological advances such as digital imaging, and internet (Meggs & Purvis, 2016).

Today, graphic design is not only print-focused, it is much more expanded than before, as it includes interactive media, motion graphics, digital type design, design for portable devices, and much more (Meggs & Purvis, 2016) therefore, many researchers pointed out the importance of including digital media subjects to the curriculum of graphic design programs to adapt and keep up with the changes that digital media brought (AbuShawali, Lim, & Bedu, 2013; Fleischmann, 2013). Also, many graphic design organizations, institutes, practitioners, and educators suggested changing the name of the profession as it would limit it within 2D and print media, by replacing the word “graphic” with “communication”, many of them already changed it to reflect the change within the profession, (AbuShawali, Lim, & Bedu, 2013), as the main objective of the process is creating effective communication, the term “visual communication design” is more descriptive as it includes the medium “*vision*”; objective “*communication*”; and method “*design*”, however, the term “graphic design” is still the most globally recognized (Frascara, 2006).

Oxford dictionary (Hornby, 2005) defines the terms *visual* as “of or connected with seeing or sight” and “a picture, map, piece of film, etc.” (p. 1706), *Communication* as “the activity or process of expressing ideas and feelings or of giving people information” (p. 304), and *Design* as “The general arrangement of the different parts of sth that is made, such as a building, book, machine, etc.”(p. 413), also “the art or process of deciding how sth will look, work, etc. by drawing plans, making models, etc.” (p. 413), it is also “an arrangement of lines and shapes as a decoration” (p. 413) and “to decide how sth

will look, work, etc.” (p. 413), moreover, Frascara (2006) defines visual communication design as:

“The action of conceiving, programming, projecting, and realizing visual communications that are usually produced through industrial means and are aimed at broadcasting specific messages to specific sectors of the public. This is done with a view toward having an impact on the public’s knowledge, attitudes, or behavior in an intended direction.” (p. 2).

While the terms *graphic design*, *communication design*, and *visual communication design* are being used interchangeably, graphic design is a narrower and more specialized field and centered around creating certain visual elements to be used through different mediums to deliver a message within a visual communication process, on the other hand, communication design is broader, it is about using these visual elements and creating the entire strategic plan to communicate a specific message to the audience, while visual communication design is related to both of them, it is about creating strategic visuals, communicating a certain message to the audience, and utilizing any media channels available (Emily Carr University of Art + Design, n.d.; Terry, 2019).

2.5.3. Visual communication design education.

Visual communication design is an interdisciplinary study that intersects with many areas such as art, technology, culture, and business, supplemented by theoretical and practical courses, professor Julie Mader-Meersman (2013) created a poster design that serves as a visual explanation for visual communication design, aimed for students, universities, and communities (Figure 23), she demonstrated the principal efforts, the foremost shared areas of applications, the

property” (2015, p. 4), which also include advertising, marketing, design, art, and video games.

Within the study of visual communication design, depending on educational institutions as well as the program’s minors and majors, students learn about topics, fundamentals, principles, and theories including but not limited to:

- **Applied and digital illustration:** illustration refers to explanatory, exemplifying, or adorning artwork, created digitally or by hand (Ambrose & Harris, 2006).
- **Animation:** including 2D and 3D animation, motion, sound, light, ergonomics, character design, screenwriting, and digital sculpture.
- **Art:** including the history of art, aesthetics, drawing, painting, and sculpture.
- **Branding:** branding includes the whole process of developing a brand, including its name, logo, and visual identity, as well as various print, digital, and brand environment forms, along with qualities and characteristics that separate it from other brands in addition to the impression of the brand by people in general (Landa, 2013).
- **Color:** color is the most important element in design and visual communication, students learn about theory, psychology, symbolism, and perception of colors to communicate with viewers (Bleicher, 2012).
- **Interaction:** including web design, human-computer interaction, human-centered interaction, ergonomics, user experience, and user interface.
- **Layout and composition:** *Layout* is related to the distribution and positioning of elements within a design in relation to the space in which

they are used, to make complex things simpler and more exciting to the reader, taking into consideration the aesthetics, format, and the placement of the design using hierarchy, grid, and measurements (Ambrose & Harris, 2011), while *Composition* is about the organization and visual structure of the design elements by combining parts and elements to form a whole, it is about seeing and making a priority to the whole (Dabner, Stewart, & Vickress, 2016).

- **Photography:** a designer should realize what makes a good photo and how to utilize it to the greatest benefit (Arntson, 2012).
- **Semiotics:** Refers to the study of signs, it explains how humans get meaning from words, sounds, and images (Ambrose & Harris, 2006).
- **Typography:** it is the science and art of typesetting, done by arranging, designing, and selecting letters, text, and words, to provide esthetics, readability, legibility, and communication of information (Dabner, Stewart, & Vickress, 2016).
- **Other topics:** such as design thinking, problem-solving, creativity, communication skills, design methodology, creative thinking, research, and entrepreneurship.

While using the latest design software and advanced technology are foundations of the discipline, these technologies are built upon basic art subjects such as drawing, color, printing, and photography.

The discipline encompasses theory and practice, it is oriented with art, science, and language; design as art involves personal expression and content; design as science involves presenting information in a methodical manner; design as language involves viewing understandable information and content, within

their study, design students prepare themselves to be able to work in professional design companies through their portfolio of works done within practical courses, apprenticeships, internships, as well as anything that would support their resumes (Heller, 2005).

Since visual communication design is one of the professions within the spectrum of creative industries, creativity, is a very important skill, so important that many universities around the world require a special aptitude test for multiple skills including creativity for candidate students in order to be accepted in their departments as developing this skill increases their efficiency to get perfect and unique solutions to complex problems within and after their study.

Professional creative companies such as *Pixar animation studios* always consider building an inspiring atmosphere for their designers to maximize their creative potential, there were so dedicated to creating an inspirational atmosphere for their employees to a degree they let them create their own workspace and express themselves (Capodagli, 2010).

Physics professor Walter Lewin brought huge attention to the world and learners through his creative ways of teaching physics, his lectures and physics demonstrations are available on YouTube and being watched by millions, his creative ways of teaching are a great example of creating an inspiring and enjoyable learning experience to the classroom through creative teaching.

Building a creative and inspiring atmosphere should be always be considered in the education of visual communication design as it provides motivation for learning and inspiration to both students and educators, therefore, integrating VR into visual communication design classroom is one of the

approaches that would create a motivating learning environment and boost both students' and educators' creativity.

2.5.4. Visual communication design and extended reality.

If a picture is worth a thousand words, then VR would worth millions. Communication is one of the countless activities and purposes in which XR technologies are being used, Jerald (2016) suggested that VR is communication; a collaboration between creators and machines to communicate with users whether it was direct communication between users and the virtual world by interpreting and interacting with sensory stimuli, or indirect communication from users' internal thoughts as well as gestures that serves as a sign language, providing a simple communication between user and VR as well as the user experience is the creators' main objective, Jerald also suggested that VR is both Art and Science; as it requires creative and outside-the-box thinking and quality of experience.

The role of visual communication designer could include extended reality technologies as they are new platforms and mediums for communication, they both require communication strategies, art, and science, and they intersect with many other areas such as UX, UI, and motion, Santoro's book (2013) featured an excerpt by Barry Deck in which he mentioned:

“Although the practice of graphic design began with print, designers are being asked with increasing frequency to consider time, motion, and sound in their work. This is part of a general trend in communication, which may have started with cave paintings and could lead to the making of full-on virtual reality experiences. Most of the messages that were

conveyed in print only a century ago have now shifted to onscreen media, like movies, television, software, games, and the Internet.” (p. 10).

Moreover, Hembree (2008) pointed out that "graphic designer must be the proverbial "jack of all trades" when solving visual problems" (p. 13), as they are many different ways of communication, the designer needs to be provided with a wide range of skills to adapt with new ways and mediums of visual communication.

Many other design practitioners, authors, and innovators support the idea that XR technologies, user experience, and interaction design would be essential tools and practices for graphic design and visual communication in the near future (Andersen, 2018; Artwork Abode, 2017; Hastreiter, 2017; McCoy, 2021).

Designers would collaborate in developing different kinds of content for XR whether it was entertainment, training, education, healthcare, or virtual tours, create elements within XR such as UI, animation, motion graphics, symbols, and design different kinds of materials that could be used for branding, marketing, and advertising the end product.

XR technologies not only are new mediums for communication, but they could also change the way designers work as well as making their jobs easier, the author tried 3D software such as *3ds Max*, *Cinema 4D*, and digital sculpting tools such as *ZBrush* and *Mudbox*, the author found creation using VR easier, user-friendly, more natural, and it is code-free, using *Dreams*, the author created a 3D design for a supercar (Figure 24), although professional 3D and digital sculpture computer software are more powerful, it would have been a lot harder create using the mentioned software.



Figure 24. Supercar created by the author using PSVR and Dreams

Chennavasin (2019) agrees with the assumption that VR may transform the way designers work and as it makes creation easier, he also considered VR as a more natural way for creating 3D, animation, digital sculpture, and digital art, as designers could create by being within the 3D space itself, and use motion controllers as well as movement instead of input devices such as motion capture, keyboard, mouse, or tablets.

Alger (2015) considered VR an opportunity for UI design approach as will bring new possibilities for their interaction and animation, for instance; users are able to intersect their hands with sliders to choose a range, Hunter (2016) also considered VR an opportunity for UI design as menus could be placed or hidden within the virtual environment or objects and place physics.

Today, VR is being used for promoting and marketing different kinds of brands; *Volvo* created a VR mobile application so users could test drive their cars, *Lionsgate* launched a YouTube VR experience for their *Hunger Games* movie, and *Commonwealth Bank* launched *The Teleporter Adventures*; a financial educational app for iOS that includes a PDF book, users could merge into the story using VR, *British Airways* launched a VR campaign to encourage people in Europe to travel to the USA, *SS+K* launched a direct advertisement in which they

provided foldable VR headsets for their customers so they can view an animated holidays greetings, *Merrell* created a VR experience to promotes their new hiking boot that takes users on a mountain hike, and *New York Times* created *The Displaced*; a VR video documentary about refugee camps to promote empathy.

VR is also being used in animation and filmmaking and uploaded to platforms such as *Oculus store*, *PlayStation store*, *Veer*, and *Google Spotlight Stories*. Animation and storytelling in VR provide a new experience for the viewers as they can merge within the story and interact with it.

VR could be used as a creation tool for art and design, as well as art and design education, there are plenty of applications provided in VR devices' stores, including but not limited to:

- **3D creation and digital sculpting:** *Medium by Adobe* (Figure 25), *SculptrVR*, *Shapelab*, *Sketchbox*, *Kodon*, *Gravity Sketch*, *Blocks* by Google, and *MasterpieceVR*.

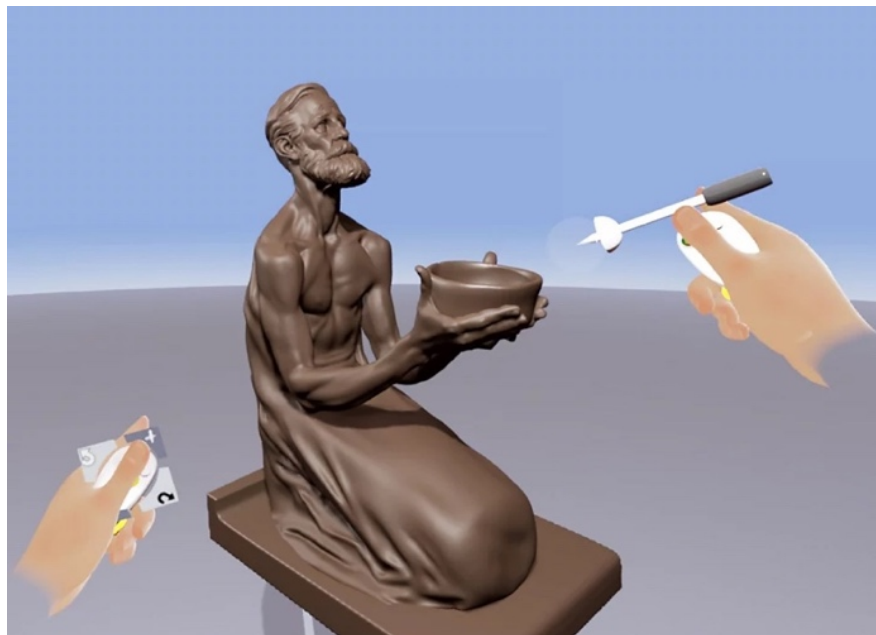


Figure 25. 3D creation in Medium by Adobe. Retrieved from <https://www.adobe.com/products/medium.html>

- **Animation creation:** *Flipside Studio*, a real-time animation and motion capture, *AnimVR* (Figure 26), and *StageX*.



Figure 26. Animation in StageX. Retrieved from <https://www.vrstagex.com>.

- **Education:** *Mona Lisa behind: Beyond the glass*, *The VR Museum of Fine Art*, *Smithsonian American Art Museum "Beyond the Walls"* (Figure 27), *The Kremer Collection VR Museum*, and *InductVR* simulation and training platform for tools such as 3D printing.

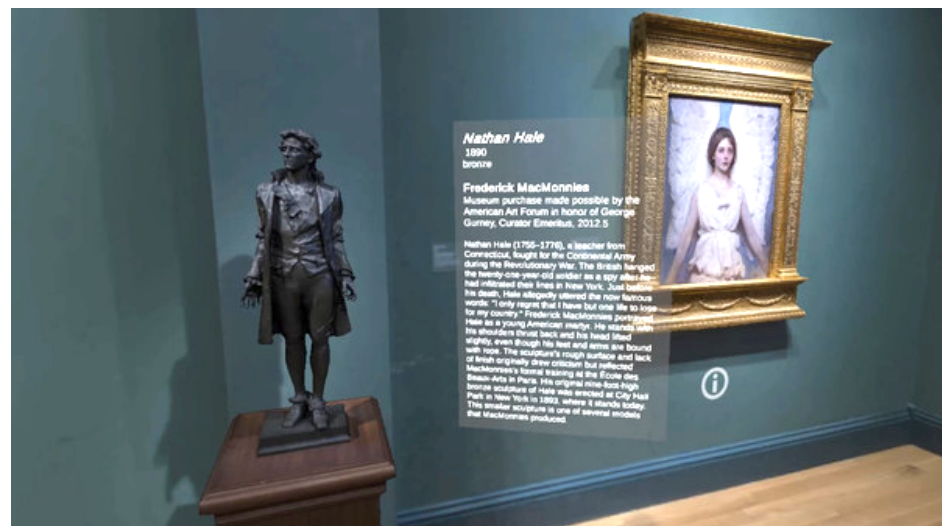


Figure 27. Smithsonian American art museum "Beyond the walls". Retrieved from https://store.steampowered.com/app/1087320/Smithsonian_American_Art_Museum_Beyond_The_Walls/

- **Prototyping:** *Tvori* (Figure 28), an application used for design, UX / UI prototyping, product prototyping, and collaboration, users could create VR and AR interfaces and products, *Microsoft Maquette* is used for spatial prototyping.



Figure 28. Prototyping in Tvori. Retrieved from <https://tvori.co/>

- **Sketching and illustration:** *Quill* illustration and animation tool (Figure 29), *Kingspray Graffiti*, and *Tilt Brush* by Google, there are also VR styluses and pens designed by *Logitech* as well as *Wacom* for sketching and drawing in VR space.



Figure 29. Illustration and animation created in Quill. Retrieved from <https://quill.fb.com/>

Augmented reality is also being used for different purposes such as advertising, marketing, design, and art, for instance; *Gucci's* mobile application lets people try their shoes, *Zappara* created a water packaging that tells a story of water's benefits (Figure 30), *IKEA* created an application for mobile and tablets that enables users to virtually place their products within their space (Figure 31),

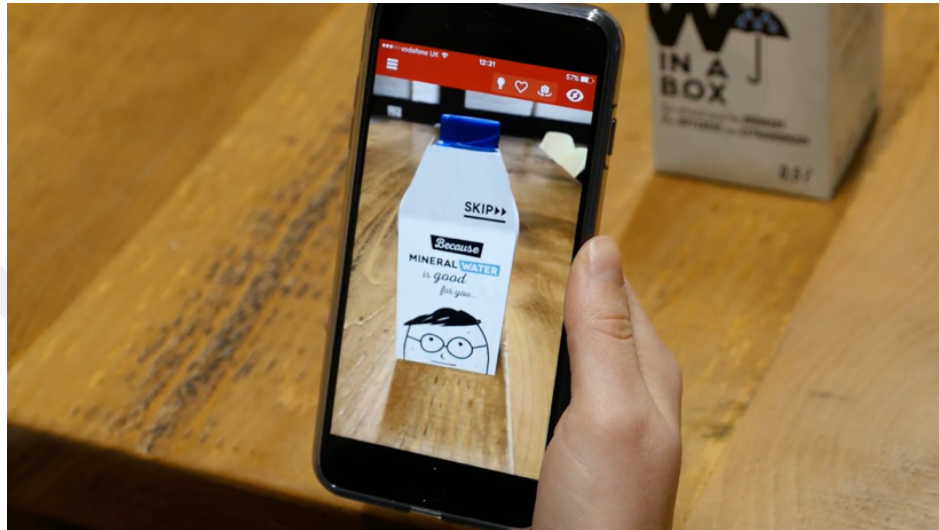


Figure 30. AR in packaging. Screenshot by author, Retrieved from <https://www.youtube.com/watch?v=8NNYgCks72I>

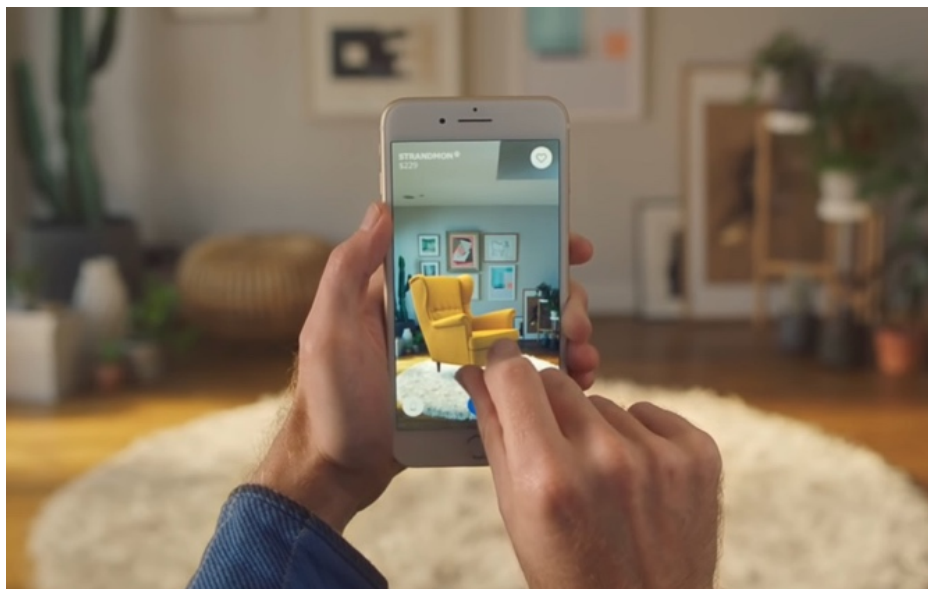


Figure 31. IKEA's used AR in their application for mobiles and tablets. Screenshot by author, Retrieved from <https://www.youtube.com/watch?v=UudV1VdFtuQ>

Adrien M & Claire B created an art exhibition in which users could view art pieces in AR (Figure 32).



Figure 32. AR uses in exhibitions. Screenshot by author, Retrieved from <https://www.youtube.com/watch?v=iD2MpbDwT4o>

There are few studies related to using XR in visual communication design education and profession, a recent study integrated both AR and VR in graphic design education, the study redesigned an undergraduate graphic design curriculum to include AR and VR, it also enabled second and third-year undergraduate students to explore using both technologies within their study to enhance printed designs using interaction, moving image, and typography, the students created 360 virtual tours for mobile VR using 360 cameras, this learning experience increased their sense of motivation, creativity, collaboration, thus, a positive learning experience (Sinfield & Cochrane, 2020).

Another study integrated VR to explore the benefits of VR sketching in visual communication and visual thinking for architectural students within the University of Cambridge, students used HTC Vive while standing and for a maximum time of 20 minutes, the study concluded that VR is a unique and very useful way for visual expression, it could be used to support paper-based and

CAD modeling, it facilitated large and detailed 3D models, enables the student to create rapidly and flexibly, but inaccurately (Oti & Crilly, 2020), however, accuracy could be enhanced by providing a physical surface and visual guides and grids (Rahul, et al., 2017) therefore, some of VR stylus products such as *Logitech VR Ink pilot Edition* and *Drawboard* introduced the ability to write or sketch on surfaces with pressure-sensitive enabled.

A study explored the relevance of VR to communication design, seven communication design professionals were interviewed before and after a VR experience; they were asked to sketch freely using *Oculus CV1* and software such as *Quill*, *Medium*, *Tilt brush*, and many others, none of the participants created designs for VR before, and most of them had little or no experience using VR, participants reported a positive experience, they considered using VR in communication design as a potential design tool for more natural way for creation to be used in web browsing, packaging, prototyping, signage, vehicle graphics, as well as communication with clients, and assessment, however, participants were unable to have reference materials and other design and typography functions similar to design software such as Adobe Photoshop and Adobe Illustrator, the study declared that the lack of integration was expected as the used programs were not developed specifically for visual communication design, it also stated the need for visual communication software made specifically for VR (Laing & Apperley, 2020), therefore, a recent study proposed construction strategy for a visual communication design software for VR, that enables designers to boost their creative potential, communicate with their audience, create stunning visual effects in 3D space, insert text, manipulate, adjust, and process image using layered design, add effects, interactions, lights,

textures, and materials (Jue & Ken, 2020). It is expected that specific software for visual communication design for VR will be created at some point in the near future as XR technologies are being rapidly developed.

At the time of writing, Facebook's CEO Mark Zuckerberg announced their new corporate name: *Meta*; as a reflection of their vision for the future of their company and their commitment to the *metaverse*, as well as rebranding *Oculus* into *Meta*, he described the *metaverse* as the successor of mobile internet and the next platform and medium not only for communication but also for our entire lives using XR immersive technologies, he predicted that these platforms are going to be mainstream within next five or ten years, additionally, internet, multimedia, and communications will be integrated within these XR technologies, they are improving these devices to be more realistic, interactive, and useful (Reuters, 2021).

Facebook predicted that education will be easier and more reachable, people could learn and teleport to anywhere and to any time period, or get simulated learning environments, businesses will place their products and advertisements, customize their workplaces, and place their logos and visual identities within virtual worlds, creators will be able to sell their creations and non-fungible tokens (NFTs) such 3D digital items and visual effects for people to use within these worlds or resell them to others, they added that within next decade, metaverse will reach billion people, provide jobs for millions of creators and developers, provide hundreds of billions of dollars of digital commerce, and keep supporting remote work (Reuters, 2021).

Zuckerberg also mentioned their mission of developing creation tools and development kits for creators and developers such as *Spark AR* and *Polar* for

Augmented reality, and *Presence* platform for Mixed Reality, his company will be allocating almost 150 million dollars to train creators, establish curriculum, and certification process for AR learning, present funding, and grants for researchers on XR, provide millions of dollars for investments in XR programs and external research with institutions such as *Seoul National University*, *The University of Hong Kong*, and *Howard University* (Reuters, 2021).

As these immersive technologies are growing fast, the demand for creators and developers with specific skills will rise as well, therefore, a skills gap will appear, a report by Bennet and Murphy (2020) provided that 97% of immersive companies in the UK believed that skills were lacking, therefore, this report provided the necessary skills as well as the gaps that existed, aimed for educators, investors, and policymakers to help in making decisions on how to educate and train current and future workforce.

Almost half of the immersive companies (51%) identified the creative roles as a barrier, and 44% addressed the lack of graduates with relevant skills, they also described the need for creativity, communication skills, an interdisciplinary and wide range of skills, survey respondents identified 43 roles for immersive experience production, among the top roles, were visual communication design-related roles such as; designer or UX designer, interactive designer, and graphic designer (Figure 33), the report also provided the respondents' response of the missing skills and gaps in immersive experience production (Figure 34) (Bennett & Murphy, 2020). This report indicates that visual communication design is needed for VR development; well-educated designers with technical and creative skills are required for VR development.

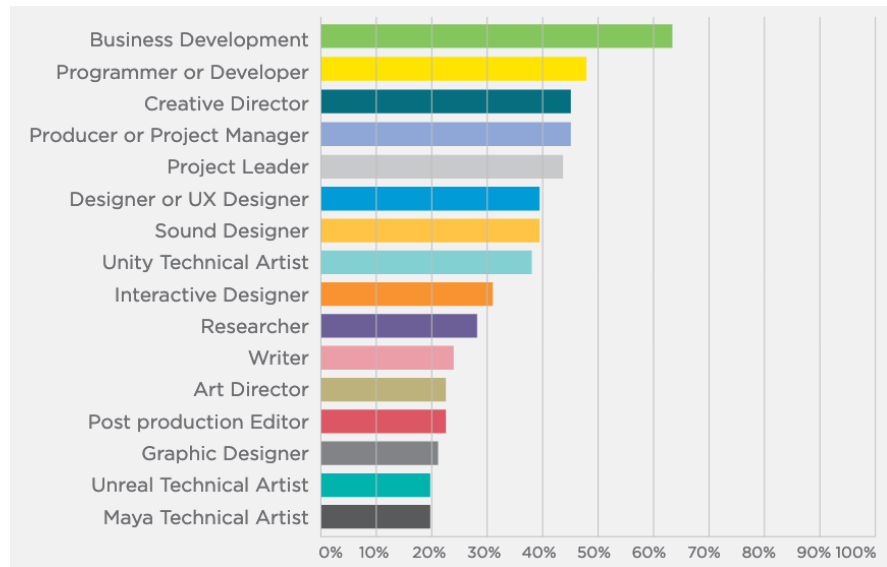


Figure 33. Top 16 roles for immersive experience production by Bennet and Murphy (2020).
 Reproduced from <https://www.storyfutures.com/uploads/images/SFICC-Report-2019-20.2.20.pdf>

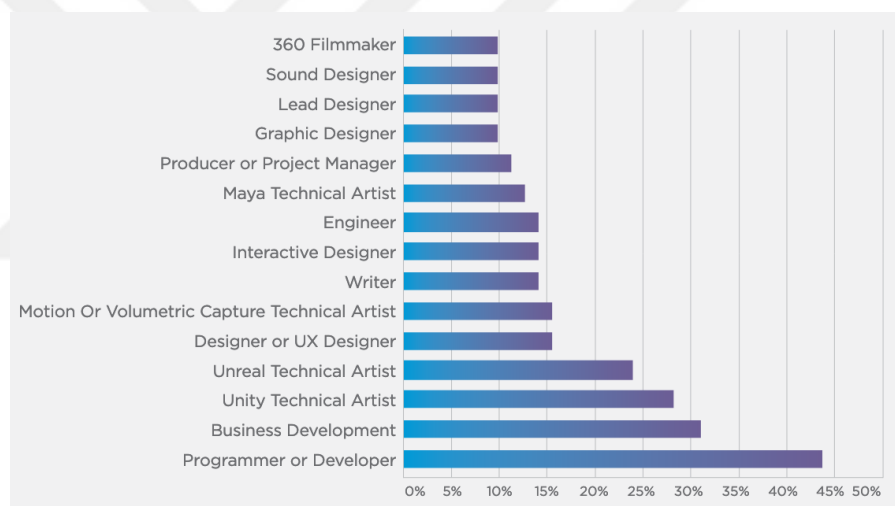


Figure 34. Key skills gap in immersive experience production by Bennet and Murphy (2020).
 Reproduced from <https://www.storyfutures.com/uploads/images/SFICC-Report-2019-20.2.20.pdf>

To adapt to these emerging methods of communication, and prepare students for the future of visual communication design, some educational institutions added XR to their visual communication design or graphic design programs, including *The University of Newcastle*, *Yale University*, *Yaşar University*, *Sampoerna University*, *University of South Carolina*, and *Birmingham City University*.

3. THE PROJECT

3.1. Overview

Throughout the author's education, *Logo* (1967) was the first and only educational game experienced, although the name may suggest logo creation, it was an educational game to introduce students to programming language, inputs of commands were used to produce vector graphics on DOS operating system, nevertheless, it was not enjoyable or usable. *Mario Paint* (1992); a video game for Super Nintendo Entertainment System had content creation features that enabled users to create animations, drawings, colorings, patterns, and compose music using an included mouse device, however, schools in Jordan never used it as an educational game.

Currently, there are no educational video games related to graphic design and visual communication for consoles or PC, but there are a few 2D games for tablets, mobiles, and web browsers, for instance, *True Colors* is a browser game that teaches color theory, *Typeconnection*, *Typewar*, *Kerntype*, and *Shoot the serif*, are type games for web browsers, and *graphism.fr* is a website that includes a variety of design-related games for web browsers (Westbrook, 2017), additionally, *Design Eye* is a graphic design educational board game, and *Singularity* is a motion graphic VR experience only but does not include educational materials.

This practice-based research used "Dreams" creation tool to design and develop the educational game as an artifact, further information is provided below.

3.2. About Dreams

When PlayStation announced *Dreams* for PS4, the author considered it a highly innovative tool for creation. *Dreams* is an award-winning creation tool by *Media Molecule* released in February 2020 exclusively for PlayStation 4 and

PlayStation 5, users could create many things (Figures 35, 36, and 37) including games, paintings, sculptures, animation, movies, and music to share with others to play and experience within the community across the world, users should own Dreams to discover and view experiences created by other users (PlayStation, n.d.). When Media Molecule announced that Dreams will support VR in July 2020 (Media Molecule, 2020), the author believed it was a great opportunity to create an educational video game for visual communication design education seeing that there was none available for PC, Console, or VR, as well as considering the importance of XR technologies for the future of education and profession of visual communication design as designers will have an important role in VR development, therefore, the



Figure 36. Creation within Dreams. Retrieved from <https://www.playstation.com/en-us/games/dreams/>



Figure 35. Diorama created in Dreams. Retrieved from <https://www.playstation.com/en-us/games/dreams/>

author managed to purchase both Dreams and PSVR to be used for the project since Dreams does not require knowing coding or programming language.



Figure 37. Game created in Dreams. Retrieved from <https://www.playstation.com/en-us/games/dreams/>

3.3. The Define-Make-Learn Cycle

Jerald (2016) suggested that VR development is an iterative process of the Define-Make-Learn cycle, within this cycle, the “Define” stage includes ideation and planning for the project, the “Make” stage includes prototyping and implementation, and the “Learn” stage includes learning and assessment on what is effective and addressing what is ineffective to refine it within the define stage (Figure 38), Jerald also suggested that VR design process is user-centered; it concentrates on the user’s aspect of communication between user and VR.

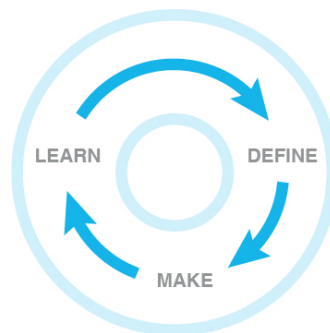


Figure 38. The Iterative process of VR development. Adapted from Jerald (2016).

Creating VR educational games requires good planning by pre assigning a proper development approach and setting the characteristics of a project to accomplish the objectives within a time frame, information below describes the structure and methodology used for planning for this project:

1. TPACK model was used to achieve successful integration of VR technology in education.
2. Considerations for creating virtual worlds were identified to provide a guideline for this project.
3. Learning theories, approaches, and practices for and within VR and educational games were discussed as they should be considered as they offer guidelines and strategies to accomplish positive educational outcomes.
4. The wide range of topics, fundamentals, principles, and theories within visual communication design discipline was mentioned as some of them could be included as the subject matter or the content of the project.
5. Frameworks and fundamentals of planning, creating, and assessing VR educational games will be demonstrated within this chapter.
6. Inspiration from other existing VR applications will be mentioned in this chapter.
7. Limitations and considerations will be discussed within this chapter.

During the educational game development, the “define” stage consisted of:

- Target: visual communication design students in Jordan, participation of first and second-year students were required as independent variables to measure their learning outcomes as the author required that students should have basic knowledge about color, visuals, typography, or students

who did not have any knowledge about these topics as this educational game aims to provide basic knowledge about design principles.

- **Timeline:** the author started learning about the game mechanics and development in the first week of November 2021, therefore, the educational game had to be ready by the end of February 2022 as students will start their second semester within the first week of March, therefore, the author had almost three months to finish, the author managed to finish it in 25th of February.
- **Gameplay and user experience:** the educational game should be enjoyable, appropriate, and comfortable for most users, the author needed the game to be experienced while sitting with the minimum amount of locomotion and to avoid heights and sudden movement, additionally, the text should be readable and world details should be clear and users should be provided with different cues to guide them throughout the experience, also, controls should be set in minimum numbers of buttons.
- **Content:** the educational material should include an introduction to the basics of visual communication such as typography, color, and space as the target were first and second-year visual communication design or graphic design students.
- **Story:** the author believed that the protagonist should be relatable by including a real-world scenario; by having a problem that needs to be solved, players would find the answers to these problems by getting inside his subconscious mind while he was sleeping and experiencing a lucid dream, users learn and get the answers by playing the games within the lucid dream, additionally, the story should include fantasy, and humor, it

also needed supporting characters and a companion to guide the users during their experience, with narrative in simple English language.

- Inspiration: This project took inspiration from VR games such as *Job Simulator*, and *Moss*, as well as VR animated movie *Allumette*.

The define-make-learn cycle was applied during the development of this educational game, prototyping, trial and error were essential; providing the most comfortable experience for users within Dreams, the best content zones, readable zones, reach zones, most realistic proportions, level of details, as creation engines and VR devices have different capabilities and limitations. During all development stages, the author offered user testing of this educational game for design colleagues, friends, and family members.

The author found creation using PlayStation controllers easier and faster than using motion controllers in “Dreams”, additionally, creation was also possible without the need of wearing a PSVR headset all the time. The section below describes the process of creation for “The Designer” educational game.

3.3.1. Characters.

The author believed that the protagonist should have a friendly companion to guide the users during their experience, the author got inspired by *Job simulator* VR game which included “*Jobbots*” as companions; a funny computer monitors that guide users (Figure 39), the author started to create a



Figure 39. Job simulator's Jobbot. Retrieved from <https://jobsimulatorgame.com/>

friendly and funny laptop character based on Apple's MacBook pro which many of both graphic and visual communication designers use, this character included simple animated blinking (Figure 40)



Figure 40. Laptop character created by the author. Screenshot by author from Dreams creation tool

As for the protagonist, using Dreams, users could start creating their “Puppets” from scratch by creating and rigging sculptures then connecting them to a puppet logic, or by doing modifications and sculptures on puppets they provided to users (Figure 41), the author did the second approach to create the protagonist; a young male, with casual clothes with some features that would indicate his job such as glasses, beret, and a laptop case, color choice for the clothing was blue for a T-shirt as it is a color of calm and trust and one of the most popular colors, black and white colors were added to the rest of his clothes to add contrast (Figure 42), this character was planned to be used within the first scenes before getting into the lucid dream scenes.

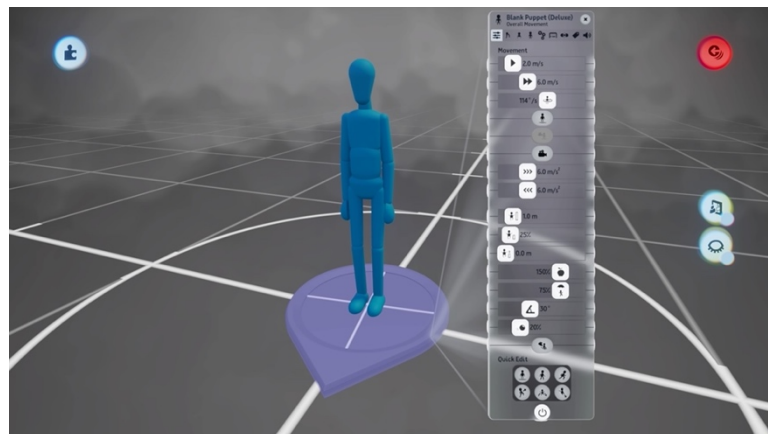


Figure 41. Puppets and their logic in Dreams.



Figure 42. Game protagonist created by the author.

The secondary characters were designed to be included within the first scene in the protagonist's neighborhood; an old man, a pedestrian, and a little girl their designs were minimal and cartoon-like to avoid uncanny valley (Figure 43).



Figure 43. Characters created by the author

3.3.2. Introduction scenes.

The main menu was created to be within the virtual environment itself using a minimalist approach for user interface design (Figure 44), users find themselves sitting on a desk with a computer similar to Apple's, objects such as Pantone's color plate, digital camera, books, pen tablet, and a mobile device were

placed to reflect design workspace, the player is surrounded with an empty white space, the computer screen included an interface similar to Adobe's, the game's title; "The Designer", as well as "Press enter to start the game" flashing text to get users' attention, users could start the game by clicking Enter button on the virtual keyboard, when users click Enter the scene fades into black, later, they could hear sound of a bus interior as well as the protagonist's thoughts accompanied with white text within a black screen, a small dot was placed in the text area before it starts so users could focus on that specific area instead of staring at darkness, darkness of black color was chosen as it represented his thoughts; the protagonist talks about his problems at work wondering how to make effective visual communication in design, next, users could hear the bus stopping and opening its door for the protagonist as he reaches his destination; a bus station within his neighborhood.



Figure 44. The main menu

The neighborhood scene design (Figure 45) was inspired from the neighborhoods in the USA as well as *The Simpsons* (1989) animated sitcom, characters were added to bring life to the scene and interact with the protagonist; an old neighbor greets him, a little girl singing while playing on the swing, and a

pedestrian, the scene included the protagonist getting back from work at dawn, users could control the character to go back to his home from the bus station, movement was set to be in two-dimensional way similar to side-scrolling games with minimum number of control buttons to make it easier for users getting the character back into his home while enjoying looking at the surroundings, camera movement was set to be panned while being fixed and focused on the character at all times, walking settings were set to be slow so viewers wouldn't get motion sickness while the camera is panning, game controls were placed within a blinking square as cue above the character to guide users and get their attention when starting the game (Figure 46).



Figure 45. The neighborhood scene

A color template for this scene was created to make all colors unified, the author wanted this scene to be colorful to make a great first impression, therefore, the author utilized the settings of saturation, atmosphere, and lighting were set to indicate dawn time so the sky was colored in red and pink, the main source of lighting was set in orange color and placed at a low angle to provide long beautiful shadows, also, the light poles and the houses were lit to indicate dawn time, and to indicate that there are people inside these houses, calm music,

ambiance, and sound effects were imported from Dream's library, assets and surroundings such as trees, houses, and streets were created within the scene taking in consideration their sizes and proportions being logical and similar to real-world. A large sun, mountains, buildings, and trees were added to add depth and distance to the scene, the fog was placed at the world's edges to hide them, simple motion effects for plants were added to add life and indicate gentle wind and beautiful weather.

Inspired by *Moss* VR game (Figure 46) and *Allumette* animated short movie for VR (Figure 47), the author started creating this scene before other scenes as well as assets, setting up lighting conditions, logic, and interior design (Figure 48). This scene was planned to be the place where the protagonist is careworn about how to create effective visual communication just before getting into bed to sleep as users could hear his thoughts and read them as they are placed within speech bubbles, users move the character to his bedroom to sleep after hearing him yawning and feeling sleepy, the character was animated to lean his back towards and loosen his hands to reflect that he got tired, the interior had



Figure 46. Moss (2018) included both first-person and third-person perspectives.

Retrieved from <https://www.polyarcgames.com/fanscreenshots>



Figure 47. Alurette (2016) is an animated short movie in a third-person perspective.

Retrieved from <https://store.steampowered.com/app/460850/Allumette/>

complementary colors of blue and orange as well as other colors such as grey and white, orange lighting was placed outside the house to imitate sunlight and create a calming and warm mood to the scene, the house included the character's pet; a sleeping cat to add life to the scene, it also included relaxing soft music to match the dawn time as well as sound effects for surroundings such as refrigerator and clock (Figure 48). A single stable camera was placed in this scene with a vignette effect so the user could only see the house's interior, wall invisibility logic was



Figure 48. Early stages for the protagonist's home design.

created so that the character could be seen while getting inside the bedroom, logic was also applied to the area next to the bed that shows a dialog box of “get to sleep” command, an invisible wall was placed and jump controls were removed to prevent the player from walking over the bed, iterative process for the development of this scene was utilized until it was done and ready (Figure 49).



Figure 49. The final version of the protagonist home design.

3.3.3. Waterfall scene.

The purpose of this scene is to introduce the companion to the users as they enter the protagonist’s mind and lucid dream and thoughts from his point of view so the camera was placed in first-person perspective and the VR hands were placed, the player enters an imaginary hall (Figure 50), the player meets a friendly talking laptop, it had a funny dramatic entrance with spotlight focused on it, the laptop explains that it is willing to help the protagonist to get answers on how to be a better designer by learning how to make effective visual communication, humor was used to the laptop’s to be more appealing and likable for users, the hall transforms by opening the ceiling and lowering the walls and

revealing a beautiful scenery with plants, waterfall, stream and floating islands created by protagonist's creative subconscious mind, the laptop offers the player a solution by entering three worlds; visuals, typography, and space, an animated icon for each world were created and text was placed below each one of them (Figure 51).



Figure 50. The main hall.

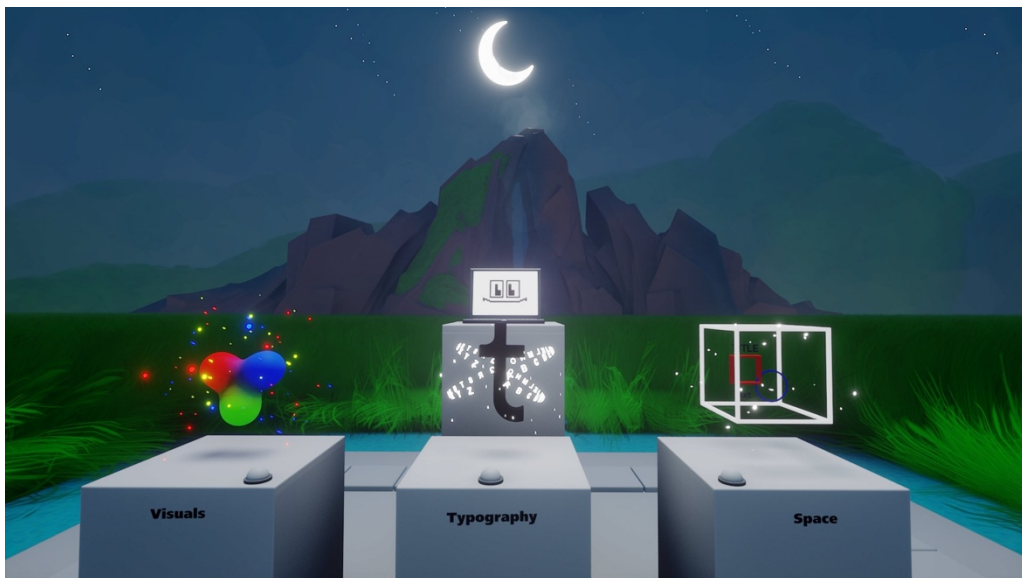


Figure 51. Selection of topics

Both audio and speech bubbles of short text blocks were placed so users could read and hear the laptop character as it speaks, pauses were placed between

sentences to provide users with time during the experience, the author recorded all voice-overs for the laptop character and did some audio manipulations such as pitch and effects to produce electronic and syntactic voice while being clear and audible. Speech bubbles and important objects were placed within two meters, users would choose one of the three worlds by grabbing buttons in front of them, logic was placed so these buttons could include sound cues as well as visual cues by setting up animation keyframes for colors and lighting to provide feedback for users when they push them, although buttons were placed outside player's reach. Dreams allows users to reach and grab objects even if they are far by extending the character's hands, the laptop mentions this fact to the user to add fun and fantasy to the game as players could see their extended arms.

3.3.4. Visuals scene.

Humor was used from the beginning of the scene as the user enters a place similar to “the construct” or “the loading program” scene from The Matrix (1999); the laptop had sun classes placed on one of the two maroon sofas, the scene also included an old T, white background and floor, and a white table (Figure 52), the laptop suggests choosing one of the red or blue pills as the

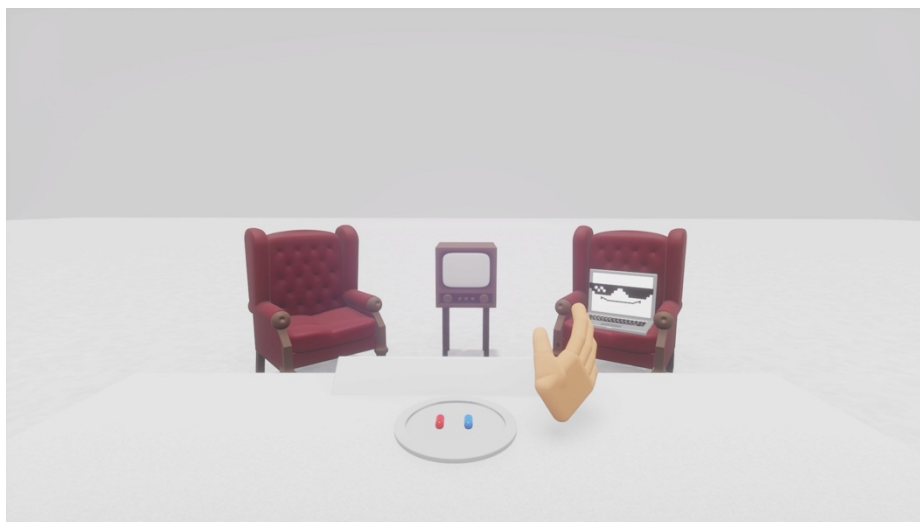


Figure 52. Visuals scene.

protagonist needed answers similar to the protagonist from The Matrix, the laptop suggests that it was joking and to throw them away, logic was placed on the pills so users could grab them and throw them, the laptop starts talking about the topics by bringing a huge whiteboard, the whiteboard becomes smaller and the laptop starts to explain all the topics related to visuals.

Pills were used to introduce color meaning topic as they also had meanings in the movie; red pill meant life-changing hard truth, and blue meant ignorance and getting back to the artificial world, the laptop character talks about how to communicate with users using colors, images, illustrations, and graphics, animated examples were shown on the whiteboard as the laptop explains, a quiz where placed to test the user's knowledge, a red cross and green tick figures were placed on the TV to indicate that user has chosen a right or wrong answer as well as placing red and green colors to buttons to indicate right or wrong answers, answers were place on buttons and rotated in 45 degrees within user's vision and reach, the laptop awards the users with gifts as they chose the right answers; a remote-controlled car, a blaster similar to Nerf toys with tiny robot that follows projectiles, these gifts included logic that allows user to control the car and shoot projectiles from the blaster so the robot would follow and jump towards these projectiles.

3.3.5. Typography scene.

Before creating this scene, the author placed all kinds of typefaces that could be included in this scene; Serif, Sans-Serif, and Display (Figure 53). This scene was about telling a story about human evolution in visual communication using written language since prehistoric people (Figure 54), the invention of typography (Figure 55), till the present days, users find themselves in a cave, the

cave included hand paintings on walls as well as the tools and objects used by prehistoric people to paint them, a torch was placed beside the painting to get viewer's attention, as time passes, the scene transforms by changing the walls, floors, platforms, and ceilings.



Figure 53. Available typefaces in Dreams.



Figure 54. Typography scene, hand stencils

Sound effects, light conditions, and music were selected to match every scene and human evolution, finally, the scene transforms into the present days where users are placed within a design office with modern interior and posters such as typography quotes and De Stijl, users find themselves on a desk with a computer and surrounded by office tools, the laptop explains ideas by presenting on a screen monitor, finally, the laptop suggests playing a game by hiding individual letters within the user's desk, the player should find these letters and place them within their suitable boxes by their category, labels of each category were placed on each box and the monitor included the number of found letters, users could grab surrounding objects and open drawers to find these letters (Figure 56).



Figure 55. Typography scene, the invention of typography and printing.

3.3.6. Space scene.

The scene starts with funny scene; the laptop character apologizing to the player as he didn't mean going into actual space as the player is in on the moon surrounded by floating objects as the author thought it would be more enjoyable to ignore gravity, the user is also surrounded by mountains and meteorite craters



Figure 56. Typography scene, the office.

and a beautiful view of stars and earth (Figure 57), the laptop suggests getting inside the space station so it could talk about space in visual communication design, users could pull a lever attached to the vehicle which player is seated on, a stable cockpit to the vehicle was created to reduce motion sickness while it moves in the space station, the vehicle follows the laptop character as it is attached to a space suit with robotic arms and wheels, motion and rotation was set to be at minimum velocity to reduce motion sickness, the user enters the space

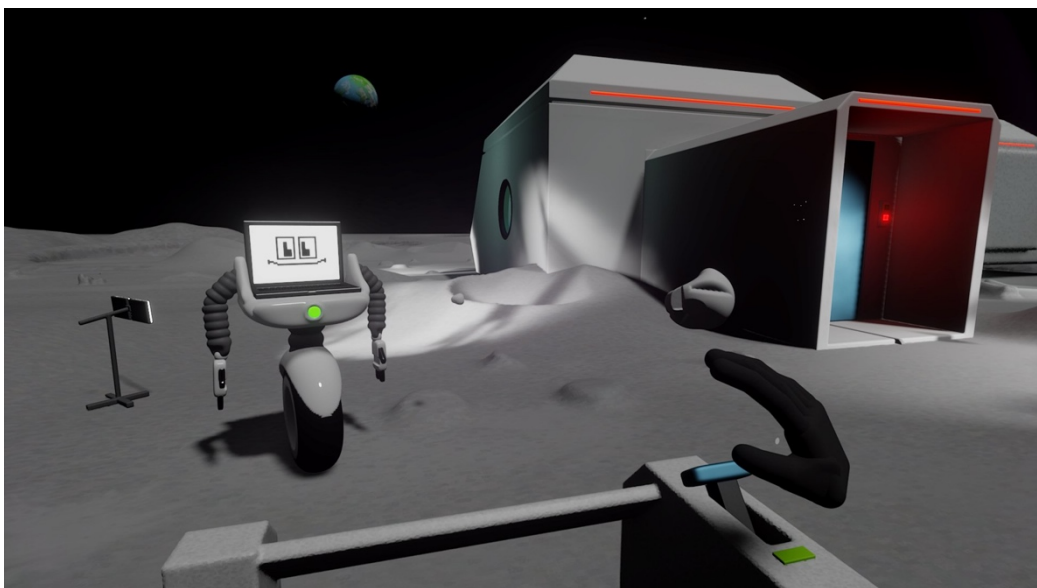


Figure 57. Space scene

station and greeted by an AI computer as the captain, the AI turns on a hologram device that shows information about space in design, both “collide” and “shadows” options for the hologram’s projected objects where turned off. The player is surrounded by floating objects to interact with, invisible walls were added so objects do not float into other rooms or the space if thrown, the player could turn off or on the light to add a beautiful mood to the scene while watching earth from the window while the user interfaces of surrounding devices are lit (Figure 58), topics about space in design are shown on a platform with a lit screen rotated in 45 degrees so user could keep up with current information and choose the next topics by clicking on corresponding buttons of next topics when they are ready, finally, the laptop congratulates the player for finishing the space information, it moves towards the player and raises it hand gives a “high five” gesture, the player slaps the laptop’s hand and exits the scene by pressing the red exit button on the platform.



Figure 58. Space scene, the space station.

3.3.6. Ending scene.

Each scene had an exit button so players could return to the main hall, the laptop suggests either selecting one of the three topics or waking up from the

dream by pressing on “wake up” button, grab logic was placed into this button instead of pushing it so users wouldn’t press it by mistake, a short music theme is played when pressing the button suggesting the end of the journey with black transition effect, another transition effect was placed to reveal the protagonist neighborhood in the morning (Figure 59), a speech bubble for a conversation between the protagonist and his art director is placed near his house revealed that he finally understood everything, finally, floating white text was placed in front of the house thanking players for playing the educational game along with credits and dedications.



Figure 59. Ending scene.

3.4. Educational Strategies and Approaches Within “The Designer” Educational Game

The English language was used in this game, the author made sure that the language was simple and easy to understand, both text and voice were used as sources of communication with users alongside all kinds of cues, and the text had to be readable within readable areas and voice had to be clear with pauses between sentences. The following educational strategies were implemented in the development of “The Designer” educational game:

- **Autonomous learning:** students have choices and could control their learning progress by choosing one of the three elements; visuals, typography, and space.
- **Behaviorism:** users' actions are reinforced using rewards and negative sound effects for correct answers, or punished when an unwanted behavior occurs such as using the red X symbol accompanied with negative sounds when choosing wrong answers in the visuals scene.
- **Blackbox thinking:** the environment of the game is safe to fail, users could commit multiple failures and learn from their mistakes, and there were no damage or death options to the character.
- **Cognitivism:** Simplifying knowledge using illustrations, charts, hierarchical and chunked information, which could also reduce the amount of *cognitive load* or overloaded information and information processing which would achieve a memorable learning experience (Schunk, 2012), as information were shown on either a whiteboard, a screen, or a hologram.
- **Problem-solving:** trial and error were implemented in the typography scene; users could try placing each letter in the right box according to their categories.
- **Repetition:** users could repeat the information by repeating any of the three elements; visuals, typography, and space.
- **Humor:** adding a sense of humor to the laptop character would make the learning experience enjoyable, repeatable, and memorable.

Every scene had its approach; “*Visuals*” scene has the longest duration and the most information, this information was presented continuously without any pauses except when they got to the quiz part, the scene was about visuals

so it was necessary to present information without any distractions, therefore, a minimal approach was used within the scene design as the background color was white so viewers could focus on presented information, additionally, the scene had no objects that users could grab or play with except when they are rewarded by a gift when they answer all the right questions as scene included multiple choice answers for questions, so the learning progress won't continue unless they answer all the right questions, they could enjoy interaction with the gift proceed their learning by pressing the "ready" button when they finish, so fun and interaction in this scene is rewarded by learning.

"*Typography*" scene included some animations, and a lot of objects to interact with, the background had animations, transformations, and infographics to grab users' attention, the scene included a small game where the user is supposed to grab and move surrounding objects to solve the game, therefore, fun and interaction in this scene is a needed to finish the learning progress.

"*Space*" scene included a few floating objects that users could interact with at the beginning, as the player enters the space station many floating objects as well as a light button, the laptop character, and information on the hologram were placed in front of the players to grab their attention, pauses were placed at the end of each section so users could interact with floating objects within these pauses then continue their learning progress by pressing on the next topic on the list, therefore, fun and interaction in this scene could be achieved during the pauses, a comparison between each approach along with their learning outcomes will be discussed later.

3.5. Learning Goals and Objectives of "The Designer" Educational Game

This educational game is a complementary tool for traditional methods of education, aimed at visual communication design and graphic design students in their

first or second year of study, it should not be considered as a replacement or equivalent to any kind of courses or lectures, total playtime is between 25 to 30 minutes, topics covered within the game took basic form as an introduction to large and rich subjects such as visuals, typography, and space, therefore, this educational game aims to introduce users to these three elements of design and address their importance to visual communication in an enjoyable and exciting immersive learning experience that produces eagerness and willingness to learn more about each topic.

As for the learning objectives, Bloom's taxonomy of learning objectives (Bloom, 1956) as well as the revised version (Anderson & Krathwohl, 2001) are used as guidelines to identify the cognitive learning objectives of this educational game, the revised version included six hierarchical levels of objectives within the cognitive domain; Remember, Understand, Apply, Analyze, Evaluate, and Create, therefore, users are expected to:

- Name the three main elements in visual communication design and classify visual elements according to them.
- Describe the methods and means of using colors in visual communication.
- Identify colors according to their temperature.
- Summarize the importance of using pictures, illustrations, and graphics.
- Define the meaning of typography in design.
- Classify typefaces according to their category.
- Compare between Serif, Sans-Serif, and Display typefaces and describe their usages.
- Explain the methods of communication with type using size, weight, letter case, and colors.

- Define the meanings of space, figure, composition, Balance, Symmetry, Asymmetry, layout, grids, and hierarchy.
- Organize figures according to their visual weight.
- Assess compositions according to their visual balance.
- Conclude the differences and similarities between Symmetry and Asymmetry.
- Break down the methods of using hierarchy in compositions.
- Create compositions that include gestalt principles.

3.6. Limitations

Below is the list of factors that affected and may impact the findings of this research:

- Dreams creation tool is made exclusively for Sony PlayStation devices, users need to purchase it to use it or to experience this educational game, additionally, users for PC and other VR devices will not be able to experience “The Designer”, also, users are not able to sell their creations or use them for business purposes unless they submit an application to Dream’s company; Media Molecule (Media Molecule, 2020).
- PSVR is a relatively old device, there are currently many superior devices with better performance and higher resolution, additionally, no information on Dreams’ compatibility with the next generation of PlayStation VR device “PSVR 2”, also, it will not be released within 2022, the author enforced sharper images by utilizing blur options within Dreams to make it less blurry, additionally, PSVR utilizes positional tracking using one camera that detects LEDs from both headset and motion controllers so it has tracking issues, especially when using motion controllers in 360 degrees as their lights could be blocked away from the camera, therefore, the author resorted to placing the

important objects within 180 degrees in the scenes where VR hands are visible.

- The number of participants could be lower than expected due to universities' hybrid teaching (blended learning) mode which was implemented after COVID-19, additionally, the total playtime of "The Designer" is between 25 to 30 minutes, moreover, classes are reduced during Ramadan between the third of April 2022 and the third of March 2022, also, sessions were held individually due to unavailability of multiple PSVR devices, PlayStation devices, and Dreams software.
- Although Dreams is a great and user-friendly creation tool, it is less powerful than other professional creation engines such as *Unity*, *Unreal Engine*, and *CryEngine*, therefore, the level of details for Dreams' creations is lower than creations used by these engines, scenes within Dreams include graphics thermometer that limits creations from being high detailed, consequently, some necessary operations for decreasing level of details were done for "The Designer", additionally, few scenes of "The Designer" had some undesirable white noises when viewed in VR, also, Dreams did not include text and paragraph options to be utilized in typography scene such as leading, kerning, and numbers for font size, it only included one option for text animation, and did not include options for extruding text so 3D letters used within "The Designer" were sculptured by author and sans-serif letters were imported from other user, moreover, grab controls were limited to only one hand, there was no options for importing fonts or media such as pictures or videos, or tools for animated lip sync to be implemented on characters, furthermore, objects sometimes overlap when physics options such as "collide" were enabled, and

colors did not include RGB color values panel or a color picker tool, perhaps future updates will cover these issues, additionally, Dreams does not include a tool for data analytics to get feedback from users.

3.7. Methodology

As this study aims to raise the awareness of the importance of using Extended Reality for both the education and profession of visual communication design since these technologies will become major tools for communication, the research questions included students' and teachers' perspectives on using educational games and extended reality in visual communication design education, and the effectiveness of using VR in visual communication design education, to achieve this aim and answer these questions, this practice-based study used a pre-experimental design as a method to obtain data from students using mixed methods of qualitative and quantitative data from direct observations, and surveys, as well as qualitative data from interviews.

3.7.1. Data collection methods and data analysis framework.

Jerald suggests that data collection of VR involves many kinds of measurements made into qualitative and quantitative data using direct observation, interviews, focus groups, questionnaires, automated data (2016), in this study, interviews, direct observation, and surveys were used as a method for data collection, the survey (Appendix A) included demographic information, users' background and experience of VR, questions related to "The Designer" educational game, a Likert scale for the user experience, engagement, a side-effects page provided by Jerald (2016), open-ended questions, and closed-ended questions. The final section of the survey included knowledge questions based on bloom's taxonomy of learning objectives in a form of multiple-choice questions and open-ended questions that covers both lower-order thinking skills and higher-

order thinking skills and assessment criteria were used to measure their learning outcomes, finally, semi-structured interviews with educators, design practitioners, and VR developers were planned (**Appendix**).

3.7.2. Participants.

The study involved eleven graphic design students from *Al-Zaytoonah University of Jordan*, five design and visual communication students from *German Jordanian University*, six “design for digital media” students as well as five graphic design students within the design and visual communication department at *Applied Science Private University*, seven graphic design students from *University of Petra*, six multimedia design students from *Al-Ahliyya Amman University*, the total number of participants was 40. Having a small number of participants as a limitation is a common issue in VR research as each respondent requires their own individual experience (Novakova & Štarchoň, 2021).

Semi-structured interviews with eight design academics, five design practitioners, and two VR developers were done using either recorded video calls, recorded phone calls, recorded interviews, or by sending the interview questions by email so they could fill them later.

3.7.3. VR Sessions.

Preparations for each session were made by placing the equipment within an empty classroom and connecting the PS device with either a monitor or a projector, sessions were held individually so other students were asked to wait outside till the end of each session to make the participants feel comfortable, and to keep information provided within the educational game from being disclosed.

Each participant was introduced to the equipment and controls, they were asked if they needed anything or to go somewhere before the experience and

make themselves comfortable, students were also asked if they have a proper understanding of the English language, sessions were supervised by the author to guide each participant and to get qualitative data from direct observation, students were asked to fill the survey after each session either in English or Arabic, after each session, the author made sure the PSVR device and motion controllers were perfectly clean and sanitized, the author followed oculus' guide of hygiene and safety for COVID-19 (Oculus, n.d.).

Sessions in *Al-Zaytoonah University of Jordan* (Figure 60) were done in two days; one before Ramadan, the other was in Ramadan so classes were held between 9:00 am and 2:00 pm, some participants needed help with translation for some of the survey questions, one student withdrew from the experience as she did not understand the English language very well, many graphic design students in their third or fourth year of study as well as students from other disciplines such as multimedia technology were interested to try the educational game but the priority was given to both first and second-year graphic design students due to time limit, some of them were able to try it as targeted students finished their classes and needed to leave; two multimedia students participated, their survey results were provided separately as their discipline included VR but it did not

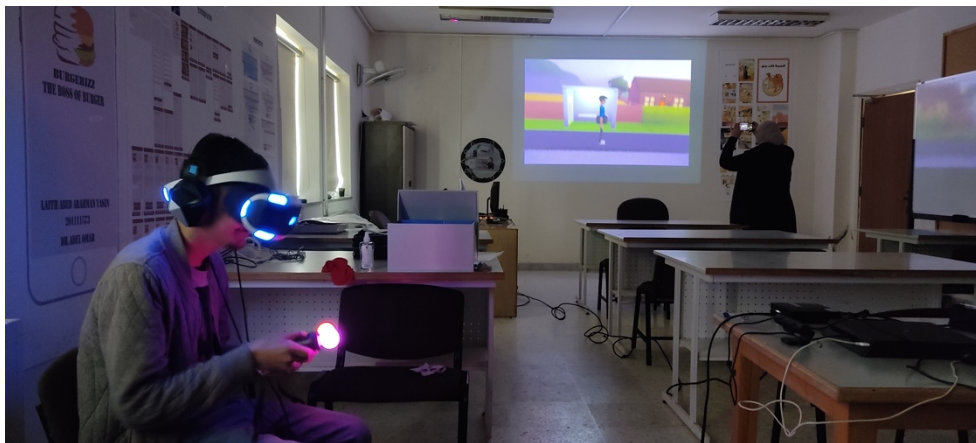


Figure 60. VR sessions at Al-Zaytoonah University of Jordan.

include Typography, the first concluded at 4:00 pm, and the second one concluded at 2:00 pm.

After the first session was done, the author did some refinements to things that were previously noted; the lab supervisor suggested changing the boxes within “Typography” scene from black to white to bring more contrast since the letters’ colors were black and a few students placed wrong letters and needed to change their places, the author took that note and changed their colors, additionally, the author noticed that few students were having difficulties when they tried to grab sans-serif letters within “Typography” scene, modifications were done by making these letters slightly bigger, additionally, “Visuals” scene included an animation where a huge “visuals” word appears when the user finishes the lesson, the “i” letter within the word “visuals” included the same rotating symbol used in the “waterfall” scene, students thought they should use the gift they just received “the blaster” to shoot this symbol as it was wrongfully perceived by students as the target, therefore, the author removed this small sequence from the game (Figure 61), the lab supervisor noted the changes during the second session.



Figure 61. Deleted sequence.

Participants from *German Jordanian University* did not need any help with translation as they had a proper understanding of the English language (Figure 62), the total number of participants was five as targeted students needed to attend their German language classes, therefore, the sessions concluded at 12:30 pm.



Figure 62. VR sessions at German Jordanian University.

VR sessions at *Applied Science Private University* were done during Ramadan so the classes were held between 9:00 am and 2:00 pm (Figure 63), sessions were done in two days; the first was for *design for digital media* students, the second was for graphic design students as the graphic design professor asked permission to turn the session into a workshop, many academics, students, along with the dean wanted to try the experience, but unfortunately,



Figure 63. VR sessions at Applied Science Private University.

there was a queue and time limit, some of the academics were able to try some of the scenes between each session, overall, the atmosphere in the classroom was very positive as both students and academics enjoyed watching the experience.

Participants from the *University of Petra* did not need any help with translation (Figure 64), the total number of participants was seven, again, many other students were interested in trying the experience but they could not as all labs closes at 2:00 pm.



Figure 64. VR sessions at University of Petra.

Participants from *Al-Ahliyya Amman University* did not need help with translation (Figure 65), the total number of participants was six, some fourth-year students requested to participate and the author graciously explained the situation to them, sessions ended at 2:00 pm.



Figure 65. VR sessions at Al-Ahliyya Amman University

3.7.4. Semi-structured interviews.

3.7.4.1. *Design practitioners*

The first interview was a recorded video call with Shahd Humaid; a graphic design PhD candidate studying at Yeditepe University in Turkey, and a motion graphic and UI designer with seven years of experience (Appendix B), Humaid believes that current students are digital natives, they are familiar with games so using them for education will help design students to understand topics related to design easier and faster especially within first years of their education, she also asserted that using games for education would provide them with positive and enjoyable learning experience as they are enjoying the class even if the duration was long, therefore, Humaid believes that she would consider using games for education in her classes when she graduates as she is willing to integrate any new and effective approaches.

Humaid described that she used both VR and AR for entertainment purposes, although she used VR rarely, she described that VR was a more enjoyable experience, she asserted that using VR for education would be very effective as it could be used for different purposes, she added that VR would make the learning process easier, faster, and safer, especially when it is used for training for real-life risky scenarios. Humaid noted that she tried creating designs for AR, but she found the process was very difficult as most AR programs were not user-friendly, she believes that learning how to create for these technologies would be an added value for designers.

Humaid believes that it is easier for designers to create in 3D space within VR as they could view objects in real-time, she added that visual communication designers have the proper knowledge to create within virtual space as they learn about fundamentals such as colors, UI, typography, and 3D space within their education, therefore, she believes that they are more qualified than many of VR developers at these aspects.

Humaid believes that using VR in visual communication design education would make the learning experience more enjoyable and memorable as students could spend hours learning in VR without getting bored and it expands their creative thinking, she believes that learning about design for VR would equip them with the necessary knowledge to keep up with the market requirements and new design trends, she also asserts that designers should not have to learn about programming language to create for VR as programming and design are completely different domains, Humaid also believes that VR could be integrated into design topics that student might consider them as least favorite such as history using interesting methods of storytelling and interaction and share these experiences with other people.

In a video call with both Mohammad Radaideh; an associate creative director with 17 years of experience in graphic design, and Firas Armoush; a creative director with 17 years of experience in graphic design (Appendix C), both designers agreed that games are great tools for education as they make information easier to interpret, they also agreed that games could provide a positive atmosphere to design classroom, both designers used AR and VR for entertainment purposes, however,

Armoush had an unpleasant experience of VR as he fell while playing a game which included an intense VR experience that included a lot of motion aimed for people who are more experienced in VR, however, he enjoyed playing “The designer” as well as other sketching games, he concluded that he does not like experiences that include motion or horror.

Both designers expressed that using VR for education has great qualities for training and simulation including reducing training costs, providing a safe environment for training, and reducing the possibility of failures, although both designers did not use XR for design purposes, they predicted that all XR technologies will become important tools for visual communication design profession, used for many design purposes such as advertising as well as industrial design, however, Armoush mentioned that it is too early to learn about the importance of these technologies as it depends on market demand, and Radaideh believes that both architecture and interior design will get more benefits from VR.

Both designers agreed on the importance of XR for visual communication design education, Armoush praised the approach of using the idea of using visual communication to teach visual communication within “The designer” and considered it very effective, he mentioned remembering most of the information provided within the game even it was in its early stage, both designers agreed that interactive and visual information in VR would be very effective, they both agreed that visual communication design students should learn about designing for these technologies, they both agreed that they would not want to learn about how to create for XR if coding and programming were necessary, but they

asserted that at some point, creation for XR will be easier, Armoush added even if they become easier and required no coding knowledge, these technologies would become like any other tools for design, the most important thing are the designers themselves, as it is about creativity not about the tools.

In a video call with Omar Qandeel, a senior 3D animator, tutor, and graphic designer with 16 years of experience (Appendix D), Qandeel considered games, gamification, and interactivity as great tools for education, he added that information provided within games will be remembered by design students as visual communication design discipline is linked to visuals, therefore, providing visuals along with sound and animation will provide an inspiring atmosphere to the classroom and interesting learning experience.

Qandeel used AR and VR for entertainment purposes, and had some knowledge of their applications in marketing, advertising, and creation, he considered these technologies very interesting, he expressed that although VR is a great tool for education, it is expensive, requires time, space, supervision, and a lot of equipment, he believes that they should become cheaper soon.

Qandeel never used XR for design or educational purposes, but he believes that they could be used in visual communication design profession for a few purposes such as presentation, sketching, and 3D design, he added that universities should provide these tools for visual communication design students as they are digital natives as these tools could become essential tools for them in the future.

In a video call with Mousa Abu Salem, a creative director at Kharabeesh (Appendix E); a well-known platform for digital creation, Abu Salem expressed that although he never used an educational game related to visual communication design, it would be great if games such as color harmony or character design existed as they could be fun and entertaining. Abu Salem believes that using any game methods such as gamification as well as digital media technologies within visual communication design classrooms would be inspiring for design students.

Abu Salem used both AR and VR for project purposes, his company created a VR experience targeted at children to make vaccinations less scary for them, his company also created an AR application for interactive book designs, he considers VR as a very important tool for education as both AR and VR as they enhance students' creativity and imagination, and simplify difficult subjects.

Abu Salem believes that XR are new important mediums that could provide new and creative solutions for customers, therefore, current visual communication design students should learn about how to create for XR as they expand their creativity and their knowledge, make boring subjects more interesting, and might become essential tools for creation, therefore, learning about these technologies would be an added value for them.

3.7.4.2. Academics

During VR sessions at *Al-Zaytoonah University of Jordan*, an interview was conducted with Dr. Alaa Al-Sharaa; the head of graphic design department (Appendix F), Al-Sharaa has 15 years of academic

experience, he completely supports using games for education as students are digital natives, also, he is against traditional methods in education or spoon-feeding, Al-Sharaa considers them as great tools to provide memorable knowledge as they provide learning about design through visual communication, he endorsed using “The Designer” within his classroom as students enjoyed the learning experience, he believes that using games for visual communication design education would be inspiring for students, Al-Sharaa considered using games for education, but he found some challenges as there was a lack of educational games for some necessary design topics.

Al-Sharaa used both AR and VR for entertainment purposes, he supports the idea of using VR for education, although teaching XR is not provided within the graphic design discipline at his university, he stated that learning about XR is available for their multimedia students, Al-Sharaa believes that visual communication design students should learn about these technologies, he believes that there is a lack of qualified people with experience in both VR and visual communication design in order to teach about these technologies, he added that creating educational materials for these technologies require a team of qualified people.

Al-Sharaa believes that XR is important for visual communication design profession XR are being used for many advertising and marketing purposes, he added that visual communication designers are equipped with proper knowledge and design basics required for creating for XR such as aesthetics, layout, typography, and colors, in comparison, programmers do not have such competencies.

Al-Sharaa is against learning about coding and programming for designers to create for XR, he added that it depends on the market needs, and he also believes that creating for XR will become easier similar to the website design as they were hard to create and became easier and more user-friendly, he added that XR could be integrated into visual communication design education by providing educational materials that students might find boring such as theoretical and historical topics to transform them into interesting ones, therefore, he endorsed the idea of placing a brief history of typography within “The Designer”.

In an interview during VR sessions at *Applied Sciences Private University* with assistant professor Mahmoud Abu-Shawali who has 15 years of experience as an academic and 15 years as a practitioner (Appendix G), Abu-Shawali commented that using interactive media, digital media, and games would provide a positive and inspiring learning experience to visual communication students as they will remember the information provided within the game, although he never used games within his classes, he used VR for entertainment and AR for education, he suggested that VR is a very effective tool for education that is being used by many disciplines, he mentioned that these disciplines integrated VR before the discipline of visual communication design did.

Abu-Shawali stated that his design for digital media students created character designs to be included in AR, but they did not create any VR experiences, added that graphic design profession has limited usage for XR as they could be used for promotion purposes, presentations, and packaging, in contrast, XR is essential for design for digital media

discipline, he explained that XR might be used for other graphic design purposes if someone thought of new ideas. Abu-Shawali asserted that all design disciplines should consider adding XR technologies to their curriculum even though some of them are not currently using them, especially after the COVID-19 pandemic, although he believes that these technologies could be expensive for some educational institutes as they suggested this idea before and got rejected due to financial issues, he assumes that they will become more affordable at some point.

In a video call with an assistant professor and the founder of the animation and multimedia department at the *University of Petra*; Tariq Rimawi (Appendix H), Rimawi supported the idea of using games for visual communication design education, he added that extracurricular activities provide students with qualities such as leadership, and creativity, and a great solution to a repetitive and boring routine, but he finds it challenging as it requires convincing students to play these games, he added that games should not be used to teach software, but they could be used to teach historical and theoretical topics or topics such as color theory.

Rimawi used a Kerning game for web browsers within his design classes, he mentioned that it brought an enjoyable learning experience and an inspiring atmosphere to the classroom, he added that he could not any other useful educational game, he also assigned his students to create a board game as a solution for students' guide book, he added that the idea was very successful to a degree that he used the same assignment for six years respectively.

Rimawi used AR and VR for entertainment purposes, and had some knowledge about their implementation in design, he also mentioned having a bad experience with VR same way Mr. Armoush did as they both went to the same place together, the author asserted that the poor supervision led to this incident, Rimawi added that he also gets side effects similar to VR when watching 3D movies, therefore, he suggested that VR should always be supervised as users would be isolated from real-world especially if they contain motion or movement, he added that although all of his VR experiences were unpleasant, he enjoyed watching *Allumette* as it was short, had no motion, and included a good story, in conclusion, he mentioned that he prefers AR over VR and that he is not so passionate about VR, he claims that VR will be discontinued at some point and replaced with MR and holograms as they are more comfortable.

Although Rimawi did not use XR for educational or design purposes, he considers XR technologies as important tools for both visual communication design and animation as XR would add new possibilities for creation, he added that XR is also important for visual communication design education as long it includes a good educational materials and learning outcomes, he added that many universities are starting their own XR discipline which suggests there is a high demand for them as UI and UX designers have an important part in game development, he suggested that XR could be added as elective courses for visual communication design discipline but students should also learn about the basics of UI, UX, and game design, he also believes that creation for VR and AR will also become easier in the future.

In an email replay for the interview questions, associate professor Demet Karapınar, who has 18 years of academic experience, teaches at *Yeditepe University* in Turkey (Appendix I), believes that using games for visual communication design education would be beneficial as long they provide actual benefits to learning, she also believes that games would motivate students and learn while having fun, she used web browser games in her classes for topics such as typography layout, color, and color theory. Karapınar used both AR and MR, but did not use VR, she designed AR and MR applications, and teaches the basic principles of XR design applications within her multimedia courses of digital art, and created AR and MR applications with her students, she believes that VR requires special equipment and could not be used in every environment but she also believes that it could be a useful tool for learning topics such as 3D design.

Karapınar suggested that XR technologies have great potential as an auxiliary tools for visual communication design education and addressed that well-designed XR tutorials are needed, she added that XR could be integrated into visual communication design education by developing educational games to be used in courses such as basic design education or computer-aided design, she also predicted that they will be used in visual communication design profession very soon due to their great potentials.

In an email replay for the interview questions, the chair of graphic design department at *Cyprus International University* in Northern Cyprus associate professor Dr. Elif Songür Dağ who has 23 years of academic

experience (Appendix J), stated that the concept of using games for education has been around since time immemorial, she stated that using games for education is being widely used in preschool, primary, and secondary education, she noted that using games in universities for design education is not widely used, therefore, she asserted that using games for visual communication design would be a good idea as they involve interaction and provide a positive learning environment, especially when we are currently experiencing both distant and mixed learning.

Dağ mentioned that although she considers using the idea of using games for visual communication design education as a good idea, she never applied it to her classes, Dağ never used XR technologies for educational, entertainment, or project purposes, but she asserted that design educators should learn and adapt to these technologies.

During VR sessions at *Al-Ahliyya Amman University*, an interview with the head of graphic design department Assistant professor Hanan Al-Sheikh who has 12 years of academic experience as well as the head of multimedia design department Assistant professor Faten Al-Jazzar who has 17 years of academic experience (Appendix K), both professors agreed that using games for visual communication design education would be an excellent approach, Al-Sheikh added that they could be used as tools for self-education, and competency-based learning, she believes that games provide a positive and inspiring atmosphere to the design classroom, and develop students' creative skills, and imagination when they are considered in the course learning outcomes (CLOs) and program learning outcomes (PLOs), however, Al-Jazzar believes that it depends on

situation as they could be used for teaching theoretical topics but not for practical topics, both professors used games within their classrooms for educational purposes; Al-Sheikh used regular games to teach theoretical courses, and Al-Jazzar used “The Bézier Game” to help students with the pen tool

Both professors used AR, but not VR or MR, they never used them within their classrooms, or for design purposes, however, they both considered XR very important for visual communication design profession, Al-Sheikh believes that design departments should teach their students about XR to provide them with necessary competencies, and Al-Jazzar believed that they could be used for to teach many design topics and enhance their cognitive skills, and they also provide a memorable knowledge.

Both professors agreed that XR technologies are very important for visual communication design education, Al-Sheikh predicted that within the next 5 years XR should be used for visual communication design and applied art education as these disciplines are late; they should have considered using these technologies earlier. Al-Jazzar mentioned that within her PhD research she wrote about using AR as a tool for wayfinding for many purposes including tourism, she also added that both she and Al-Sheikh worked on a research proposal related to this subject using AR, unfortunately, they could not complete the practical part due to the high costs, she added that COVID-19 brought new challenges to education and therefore, educators should consider these technologies, Al-Jazzar mentioned that XR could be included within design disciplines as

elective courses. Both professors added that students learning about programming and coding to create for XR is not necessary, they agreed that having basic knowledge would be an added value.

In an email replay to the interview questions, visual communication design professor Julie Mader-Meersman who teaches at *Northern Kentucky University* used games minimally within her design classes to engage students and facilitate their learning, she believes that using games in the design classroom could help to keep the spirit of the learning environment light and loose and provide creativity and problem-solving skills. Mader-Meersman used VR, AR, and MR; she has limited experience in VR and used it for personal entertainment, however, she believes that VR has various meaningful uses for education, she used AR in design classrooms to serve as case studies about digitally-based experiences and in reference to media experimentation including UI, UX, and media novelty for many digital applications and introduced discussions of tools that can be used to produce design-based AR products, moreover, she designed an MR application called “The Book Worm Tales”, it integrates the camera function of a smartphone into portions of photographic images experienced within the app.

Mader-Meersman stated that XR are important to both visual communication design and profession as they expand the ways that we think about how to engage people, and in imagining what digital experiences can be, she suggested that XR could be integrated into visual communication design education as they have the ability to demonstrate a nearly limitless range of ideas for how to connect people with one

another, with subjects and information, and with their environment/world, and used in research and case studies, which leads to expanding students' technical knowledge. Finally, Mader-Meersman believes that it is possible to create VR experiences without learning how to code, however, learning about coding languages would be an added value to designers.

3.7.4.2. VR Developers

In a recorded phone call with Moutaz Al-Husseini (Appendix M); a 3D and Motion designer with 12 years of experience, an instructor at *Al-Zaytoonah University of Jordan*, and Unreal Engine community manager - Jordan at *Epic Games*, Al-Husseini supported the idea of using games for visual communication design, he explained that using VR games could be used to turn written books into VR or AR, make hard concepts easier to understand, and boost students' inspiration, he added that game playing video games is also important for students as they need to understand the way they work to design for video games as any game created without a solid design, UI, UX, will not be that successful.

Al-Husseini tried all XR technologies, and uses VR for business purposes, he believes that VR is a very important tool for education as most of the students had a bad learning experience during COVID-19, Al-Husseini mentioned that still doing some experiments and research on MR using HoloLens for education and used VR at Al-Zaytoonah University of Jordan for both multimedia and architecture disciplines by creating 3D environments using Unreal Engine, or by using Autocad, RiVid, or 3Ds Max and exporting their creations to Unreal Engine.

Al-Husseini believes that visual communication design is a creative profession so it should have had a VR experience a long time ago as XR technologies are very important to the visual communication design profession, he also predicted that XR will be very essential for visual communication design education, he added that graphic design is the origin of most of the new disciplines, therefore, VR would be very bad without a well-designed UI, colors, or the 3D environment itself, he added that he has dealt with designers, 3D modelers, and developers, and most of the developers did not have a design background so the design aspect was always essential as many successful games had success due to their successful UI design.

Al-Husseini believes that there are many easy tools for game design and XR design for non-developers such as Autodesk UI builder and Blueprints within Unreal Engine, he added that visual communication designer students should learn about 3D space using any 3D program to create for XR as he had an experience of teaching XR for one graphic design student, he concluded that visual communication designers have a very important part in XR and game development.

In a recorded phone call, an interview with Amer Sawalha who is a managing director and a VR developer with 4 years of experience (Appendix N), Sawalha believes that games are very important for visual communication design education as they have immersive power and make information easier to understand, include many sensors such as visual, haptic, and hearing sensors, and provide an inspirational atmosphere as students could play or watch the experience and learn from their mistakes.

Sawalha created VR and AR projects for business purposes for architecture using 3Ds Max and Unreal engine, he believes that VR is a very good tool but they require professional academics with knowledge of VR so they could control the experience, he added that it is the best way possible to teach this new generation as there is a saying; “Tell me, and I will not forget, show me and I may remember, but involve me, and I will understand”.

Sawalha believes that XR is important for visual communication design profession, he added that graphic design still did not make the best use of VR yet as there are many possibilities such as NFTs, and advertising purposes such as exhibitions, interactive motion graphics, or artwork presentations, designers could create visually appealing UIs or work within 3D space, he believes that it would be added value to them.

Sawalha asserted that important for visual communication design education, as they are rapidly being developed and expanded, he added that the most important thing about using XR for education is the educational materials, he believes that designers should have some programming knowledge to create professional XR experiences, he believes that some point as Metaverse was recently announced so designers would need more user-friendly tools to create for XR. Sawalha added that VR could be used for design education using interactive educational games supported with other immersive tools such as full-body suits that provide haptic feedback, as well as haptic gloves.

3.7.5. Findings.

3.7.5.1. Interviews

The information below provides qualitative data required to answer some of the research questions, the interviews included questions:

1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

All respondents including academics, design practitioners, and VR developers agreed that using games for visual communication design education has many benefits; students could learn about visual communication through visual communication, remember the information provided within the game, and get a positive and an enjoyable learning experience as they are enjoying the class even if the duration was long as games are a great solution to a repetitive and boring routine, however, the educational materials and the learning outcomes are more important, one of the respondents asserted designs students must play video games to understand how to design for video games.

2. Do you think that using games for visual communication design education provides a positive learning experience and an inspiring atmosphere in the classroom?

All respondents agreed that games would provide students with a positive, motivational, inspiring atmosphere, and enjoyable learning experience, which is necessary for visual communication design as these attributes play a central role in the design process.

3. Have you considered using games for visual communication design education?

Information provided from the respondents suggested that while some of the interviewed design academics used games within their classroom, there was a lack of educational video games as some of them used web browser games.

4. Have you ever used XR (VR, AR, and MR)?

All of the interviewed design practitioners used VR and AR but did not use MR, almost all the interviewed academics used AR but half of them used VR and two of them used MR, one VR developer used XR, the other one used VR and AR.

5. If you used VR, what purpose did you use it for?

All of the interviewed design practitioners and the academics who tried VR used it for entertainment purposes, the interviewed VR developers used it for their projects.

6. What is your perspective on using VR for education?

All of the interviewed design practitioners agreed that using VR for education would be very effective, as it simplifies difficult subjects. enhance students' creativity and imagination, makes the learning process faster, the training process safer especially when it is used for training for real-life risky scenarios, it also reduces the possibility of failures and reduces the training costs, however, it could be expensive, requires time, space, a lot of equipment, and well-trained supervisors since one of the participants fell while using VR as a result of bad supervision.

All of the interviewed academics considered VR as a great tool for education, one academic asserted that although she never used VR, all academics should learn and adapt themselves to these technologies,

however, one academic claimed that VR will be discontinued or replaced with MR as VR is not comfortable, not for everyone, and it isolates the users from their actual surroundings, he also asserted that VR needs well-trained supervisors since he fell while using VR as a result of bad supervision.

Many interviewed VR developers asserted that VR is important for education due to the COVID-19 situation, a great tool to teach the current generation of students, and could be used to transform written books into interactive ones, however, one developer asserted that using VR in classrooms requires well-trained supervisors.

7. Have you used XR within your classroom?

The table below (Table 1) describes the answers provided by the interviewed academics as well as for instructors according to their usage of XR within their classrooms:

Table 1. Respondents' use of XR in classrooms according to their disciplines or courses

Discipline \ Course	VR	AR	MR
Graphic Design	No	No	No
Design for Digital Media	No	Yes	No
Animation	No	No	No
Graphic design: Multimedia courses, conceptual design courses, digital art courses	No	Yes	Yes
Graphic Design	No	No	No
Graphic Design	No	No	No
Multimedia Design	No	No	No
Multimedia technology, Architecture	Yes	No	No
Visual Communication Design	No	Yes	No

8. Have you used XR for design purposes or projects?

The table below (Table 2) describes the answers provided by the interviewed design practitioners according to their specialty:

Table 2. Respondents' use of XR according to their design purposes

Specialty	VR	AR	MR
Graphic Design, UI, Motion graphics	No	No	No
Graphic Design	No	No	No
Graphic Design	No	No	No
Graphic Design, 3D animation	No	No	No
Graphic Design, Advertising	Yes	Yes	No
Graphic Design	No	No	No
Animation	No	No	No
Animation, 3D, Motion, Architecture	Yes	No	No
Architecture	Yes	Yes	No

9. In your opinion, how important is XR to visual communication design profession?

All of the interviewed design practitioners predicted that XR technologies will be very important mediums for visual communication design, many of them believed that designing for XR would be an added value for designers, provide an easier solution to create in 3D, used for many design purposes such as advertising, and provide new and creative solutions for customers, however, some of them had concerns as they thought it is too early to learn about the importance of these technologies as it depends on market demand, also, they thought that both architecture and interior design will get more benefits from XR as they could be used

in visual communication design profession for a few purposes such as presentation, sketching, and 3D design.

Almost all of the interviewed academics believed that XR are important tools for visual communication design profession as they could be used for many advertising and marketing purposes since designers are equipped with the proper knowledge required for creating for XR such as aesthetics, layout, typography, and colors, and they add new possibilities, one academic believed that graphic design profession has limited usage for XR as they could be used for promotion purposes, presentations, and packaging unless there was some new ideas and considered XR as essential tools for design for digital media, one academic did not answer due to her lack of information.

The interviewed VR developers believed that XR is important for visual communication design profession, as VR would be very bad without a well-designed UI, colors, or the 3D environment itself, since the design aspect is essential for VR development, one of them believed that although graphic design still did not make the best use of VR yet as there are many possibilities such as NFTs, advertising, exhibitions, interactive motion graphics, and artwork presentations, he believed that designing for XR would be added value to the designers.

10. In your opinion, how important is XR to visual communication design education?

All of the interviewed design practitioners agreed that VR is an important tool for visual communication design education as it would make the learning experience more enjoyable, memorable, expands their

creative thinking, make boring subjects more interesting, equip them with the necessary knowledge to keep up with the market requirements and new design trends, provide them with knowledge about visual communication through visual communication, therefore, they agreed that universities should provide VR within their design schools as it could become an essential tool in the future and added value for them.

Almost all of the interviewed academics agreed that VR is important for visual communication education, many of them asserted that it is necessary for educational institutes to provide qualified people with experience in both VR and visual communication design in order to teach using these technologies and to consider adding XR technologies to their design curriculum and providing good educational materials with learning outcomes as there is a high demand for XR, especially after the COVID-19 situation, they believed that designers have an important part in the game and XR development, some of them believed that universities should have considered using these technologies earlier.

however, there are some limitations regarding financial issues, but many of them believed that they become more affordable at some point. One academic did not answer due to her lack of information.

The interviewed VR developers asserted that VR is necessary for visual communication design education students had a bad learning experience during COVID-19, one of them believed that visual communication design is a creative profession so it should have included VR a long time ago, the other one asserted that VR requires professional academics with knowledge of VR so they could control the experience, he

added that educational materials are the most important thing about integrating these technologies.

11. Do you think that visual communication designers should learn about programming and coding to create for VR?

The author did not include this question to some of the design practitioners, the rest of them agreed that designers should not have to learn about programming language to create for VR, many of them believed that creation for XR will be easier at some point as it the most important aspect is the creativity, not the tools.

The author did not include this question to some of the academics, however, although the rest of them believed it is not necessary to learn coding and programming, they believed that having basic knowledge would be an added value and XR will become easier and more user-friendly at some point, one academic believed that visual communication designers are equipped with the knowledge required for creating for XR such as aesthetics, layout, typography, and colors while programmers do not have such competencies.

The interviewed VR developers had different opinions; one developer believed that designers could design for XR without the need of having the knowledge of coding or programming since there are many easy tools for game design and XR design for non-developers, but they should learn about 3D design, the other developer believed that although designers could create a basic experience without having a programming or coding knowledge, they should learn it to create professional XR

experiences, however, he predicted that creation will become easier since there Metaverse will create a huge demand for XR designers.

12. In your opinion, how could we integrate XR into visual communication design education?

Many of the interviewed design practitioners that XR could be integrated into design topics that students might consider their least favorite such as history, or other topics such as sketching, and 3D design

The interviewed academics believed that they could be integrated into theoretical and historical topics to transform them into interesting ones, they also believe that XR courses could be included as elective courses but students should also learn about the basics of UI, UX, 3D, and game design, one academic did not answer due to her lack of information.

The interviewed VR Specialists believed that design students should learn about 3D space using any 3D program to create for VR, they also believed that VR could be integrated into design education using interactive educational games supported with immersive tools such as full-body suits or haptic gloves.

3.7.5.2. Direct observation

As previously mentioned in the educational strategies and approaches within “The Designer” educational game, every scene had its own approach; “visuals” scene included a quiz in a form of multiple-choice answers, “typography” scene included a small game in which players should find letters according to their category, and “space” included motion and many objects to interact with, it also included a choice in which the laptops says “turn off the lights if you like”, the

author recorded students' choice of turning the lights On or Off as an extra data for UX design.

The author documented the answers and choices of the students, in “visuals” scene, the quiz included the following questions (Table 3):

Table 3. Students' responses to the quiz in “Visuals” scene.

Question	Choices	Right answers
What is the meaning of color green?	Growth, Mystery, Love.	37 / 40
What is the positive meaning of color white?	Emptiness, Simplicity, Boring	34 / 40
Is color blue warm or cold?	Warm, Cold	37 / 40
Which one here is the visual cue?	Blue square, Green circle, Grey line	37 / 40
Which of these colors do restaurants use the most?	Yellow, Blue, Red	30 / 40
What does this illustration mean?	Balloon, Ball, Circle	39 / 40
That is the indirect meaning of this symbol?	Sun, Light, Idea	35 / 40
What does this chart mean?	Red=Blue, Red is less than blue, Circle	37 / 40

In conclusion, in “visuals” scene, 89% of the students' answers were right, and 11% of the answers were wrong. In “typography” scene, 60% (24 out of 40) of the students were able to pass the puzzle at first attempt. In “space” scene, 52.5% (21 out of 40) of the students choose to turn the lights Off, and 47.5% (19 out of 40) of the students choose to turn the lights On.

It has been noticed that a few students had some issues related to grabbing and pushing buttons; in the “waterfall” scene, the scene included

a choice to select one of the three elements in which they grab the buttons from far away to choose, although the laptop character mentioned that players could grab the buttons from far away, some of the students tried to reach the buttons instead since they got distracted by their surrounds, or felt immersed and did their natural behavior, or forgot about the fact that they could grab objects from far away, therefore, the author added both grab and touch sensors to the buttons and changed their colors from grey into red to add more contrast as the pointer's color was white.

3.7.5.3. Surveys

As previously mentioned, the survey (Appendix A) included demographic information, users' background and experience of VR, a Likert scale for the user experience and engagement, a side-effects page, open-ended questions, closed-ended questions, and questions related to "The Designer" educational game.

The total number of participants was 40 students, 31 were female students (78%) and 9 were male students (23%), two participants had an entire session but their results were not listed as their discipline was more related to development and programming than visual communication, one student withdrew from the experience as the student did not have proper knowledge of English language, additionally, one design professor tried "The Designer" and provided positive feedback. The survey questions included:

- ***How often do you use VR?*** (Figure 66) almost half of the participants (55%) did not use VR, while 18 respondents have used it before.

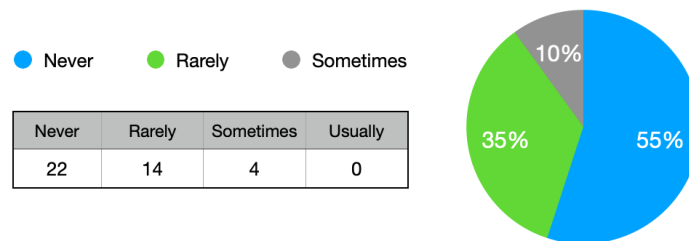


Figure 66. The respondents' frequency of VR usage.

- ***How do you use VR?*** (Figure 67) the 18 respondents who used VR before used it the most for gaming, only the frequency was calculated as students were able to choose more than one answer.

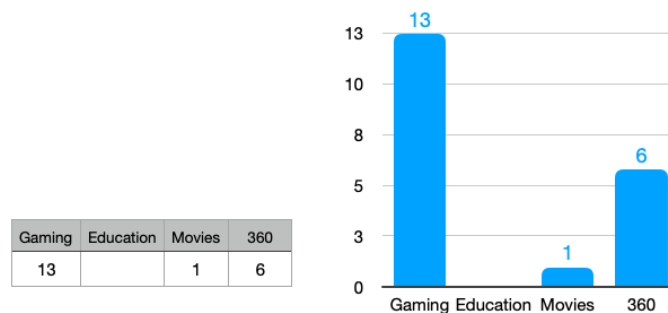


Figure 67. The respondents' purpose of use for VR.

- ***If you used VR, how do describe your experience of motion sickness?*** (Figure 68) most of the 18 respondents had slight motion sickness, none of them had severe ones.

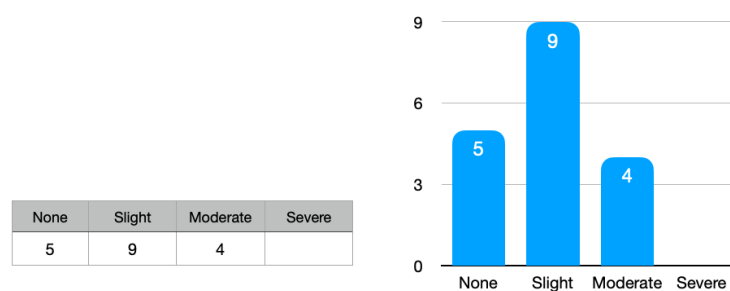


Figure 68. The respondents' previous experiences of motion sickness.

- ***If you used VR, did you enjoy your VR experience?*** 14 of the respondents considered their previous experiences of VR as “amazing”, three of them considered it “very good” and one of them considered it “it was okay”.
- ***Have you ever created in VR (such as drawing, animation, 3D creation)?*** none of the respondents created in VR before.
- ***Have you tried any educational game or educational VR game related to design?*** none of the respondents played an educational game or educational VR game related to design.
- ***Which of these scenes did you enjoy the most?*** only the frequency was calculated as students were able to choose more than one answer, “Space” scene had the most responses, followed by “Waterfall” scene, and the rest of the scenes had equal responses.

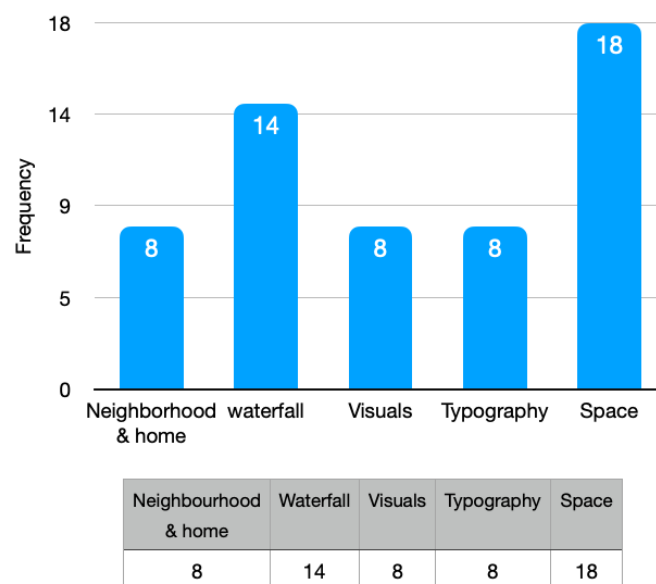


Figure 69. The most enjoyable scenes in "The Designer".

- ***Which of these scenes did you learn from the most?*** only the frequency was calculated as students were able to choose more than one answer, “Typography” scene had the most responses, followed by “Space” then “Visuals” (Figure 70).

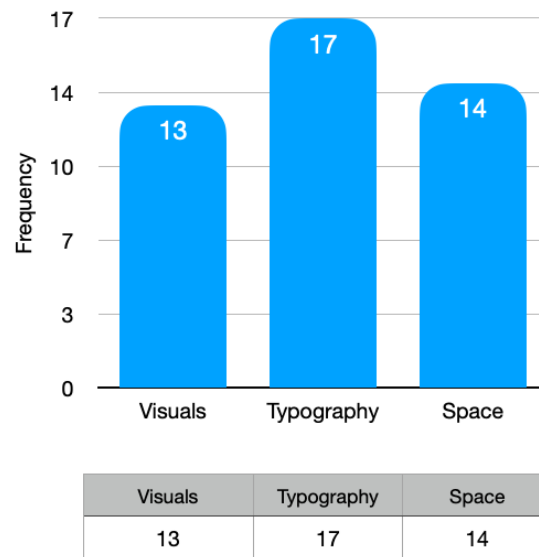


Figure 70. Respondents' choice of the most effective scenes

As for the user experience (Table 4) and engagement (Table 5), the following table provides insight into the student’s choices provided in the questionnaire that included a 5-points Likert scale, values were added to the answers to be X1 for *Strongly agree*, X2 for *Disagree*, X3 for *Neutral*, X4 for *Agree*, X5 for *Strongly Agree*, the Mean or the average answers was calculated by finding the sum of the total values and dividing the total by the number of students.

Table 4. The respondents' answers for the user experience.

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean
The user interface was easy to understand	0	0	2	12	26	4.6
Controls were hard to use	17	11	7	5	0	2.0
Text was clear and easy to read	0	3	5	19	13	4.1
Audio was not clear	26	10	3	1	0	1.5
Language was easy to understand	0	1	1	14	24	4.5
Image was clear and sharp	0	0	5	17	18	4.3
I preferred playing while standing	4	11	12	5	8	3.1

The data from the previous table suggests that students *strongly agreed* that the user interface was easy to understand, *disagreed* that the controls were hard to use, *agreed* that the text was clear and easy to read, *disagreed* that the audio was not clear, *strongly agreed* that language was easy to understand, *agreed* that the image was clear and sharp, and the answers were *neutral* regarding preferring to play while standing, therefore, we could conclude that the results of the user experience were positive.

As for the engagement factor, the table below provides insight into the student's choices provided in the questionnaire that included a 5-points Likert scale (Table 5).

Table 5. The respondents' answers for the engagement factors

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean
The game should have been longer	4	12	14	5	5	2.9
The game should have been shorter	13	18	8	1	0	1.9
This game should not be shorter or longer, total playtime is suitable	1	0	13	17	9	3.8
The story was good	0	0	0	13	27	4.7
Characters within this game were likable	2	0	0	15	23	4.4
I enjoyed this educational game	0	0	1	10	29	4.7
I learned from this educational game	0	0	0	11	29	4.7
I would use it again	0	0	3	12	25	4.6
I would recommend it to my friends	0	0	2	9	29	4.7
This game should be used in visual communication design education	0	0	1	4	35	4.9
We need more educational games related to visual communication design	0	0	0	6	34	4.9
VR should be used in visual communication design profession	0	0	2	5	33	4.8
We need more design software to be used in VR for creation	0	0	2	9	29	4.7
I would like to learn about how to design using VR	0	1	3	8	28	4.6

The data from the previous table suggests that students felt *neutral* regarding the game should have been longer, *disagreed* that the game should have been shorter, *agreed* that the total playtime was suitable, *strongly agreed* that the story was good, *agreed* that the characters were likable, *strongly agreed* that they enjoyed this educational game, *strongly agreed* that they learned from this educational game, *strongly agreed* that they would use it again, *strongly agreed* that they would recommend it to their friends, *strongly agreed* that this game should be used in visual communication design education, *strongly agreed* that they need more educational games related to visual communication design, *strongly agreed* that they need more design software to be used in VR for creation, *strongly agreed* that they would like to learn how to design for VR. Therefore, we could conclude that the results of the engagement factors were very positive.

As for the quiz, the author created 13 questions, three about “Visuals”, three about “Typography”, six about “Space”, and one for both “Visuals” and “Space, the learning objectives of the questions were based on Bloom’s taxonomy of learning objectives (Bloom, 1956) as well as the revised version (Anderson & Krathwohl, 2001) (Figure 71) to identify the cognitive learning objectives of this educational game. moreover, Bloom’s learning objectives verbs were also used in the process of writing the questions.

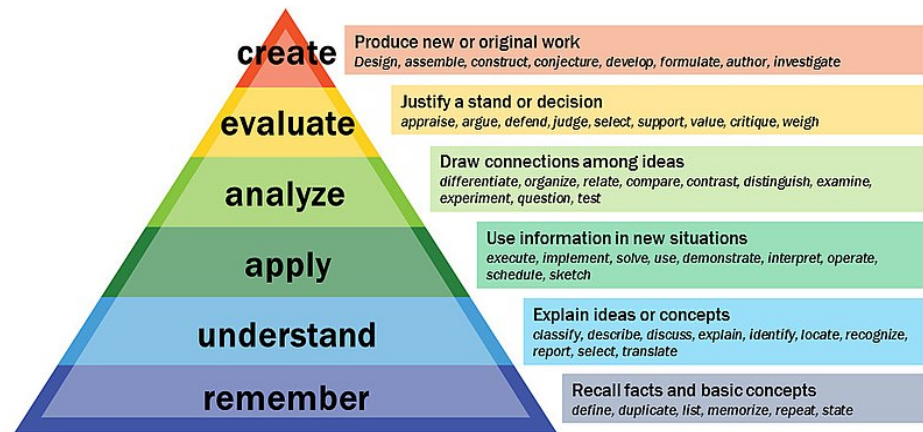


Figure 71. The revised version of Bloom's Taxonomy. Adapted from Wikimedia Commons.
Retrieved from https://commons.wikimedia.org/wiki/File:Bloom%27s_Revised_Taxonomy.jpg

The first six questions included multiple-choice answers, the level of the questions was “level 1: remember”, the rest of the questions were open-ended questions; the second set of questions included three questions based on “level 2: understand”, followed by a “level 3: apply” question, a “level 4: analyze” question, a “level 4: evaluate” question, and a “level 5: create” question, marks were distributed according to their levels (Figure 72).

● Visuals ● Typography ● Space

Question number	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total
Topic	V	T	V	T	S	S	V	T	S	S	S	V+S	S	
Question Level	LEVEL 1						LEVEL 2			L3	L4	L5	L6	
Total Marks for each level	12						7.5			4.5	3	2	1	30
Marks for each question	2	2	2	2	2	2	2.5	2.5	2.5					

Figure 72. Marks distribution according to their levels.

Questions 1 to 6 were categorized under level 2 “remember”; therefore, students had to recall the information and identify the right answers by selecting one of multiple-choice answers, the assessment criteria for questions 7 to 13 are described below:

Q7. Explain how we visually communicate using colors? (2.5 marks) This question is categorized under level 2 “understand”; therefore, students had to summarize or conclude information they received in the game to assess their levels of understanding, students were supposed to explain the methods of communication using colors such as color meanings and their relationship with culture, gender, age, temperature, as well as negative and positive meanings.

Q8. Compare between Serif, Sans-serif, and Display typefaces. (2.5 marks) This question is categorized under level 2 “understand”; students had to explain and compare these typefaces according to their looks such as classic, modern, futuristic, cool, or formal, and according to their usages such as headers, long text, short text, or decorations, and to mention their differences; such as having small strokes, and their readability.

Q9. What are the differences and similarities between Symmetry and Asymmetry? (2.5 marks) This question is categorized under level 2 “understand”; students had to compare between symmetry and asymmetry by mentioning their differences such as by mentioning that symmetry is created by aligning figures in the design space to look mirrored or regular to achieve harmony, while asymmetry is about arranging figures to look balanced without being mirrored or regular to

create excitement, additionally, students had to mention their similarities such as creating balance and using texture, color, size, and visual weight to achieve them.

Q10. Below is a website design, using your knowledge of SPACE, describe how would you modify its composition? (4.5 marks)

this question is categorized under level 3 “apply”; students were had to solve problems using the knowledge they acquired from the game, therefore, they had to propose a solution by suggesting placing figures within the design space to look more balanced.

Q11. Organize the figures below according to their visual weight, and mention the reason (3 marks) this question is categorized under level 4 “analyze”; students had to differentiate between each figure, create a comparison, and list them according to their visuals weight due to factors such as textures, and colors.

Q12. Using hierarchy and colors, what do you recommend to make this poster design better? (2 marks) this question is categorized under level 5 “evaluate”; therefore, students were expected to assess the presented design and make judgments and suggestions about the possible ways of design changes based on the information they received, therefore, the students were expected to mention that colors could be changed to reflect the subject and the mood of the advertisement by changing the cold colors into warmer ones, and rearranging the titles and figures according to their importance by placing the headline at the top, the figure at the middle, and the contact information at the bottom.

Q13. Using any simple shapes, illustrate within the following spaces using Gestalt’s principles of arrangements (1 mark) this question is categorized under level 5 “evaluate”; students were supposed to create or compose illustrations using their knowledge of Gestalt’s principles of arrangements.

The figure below describes the marks range according to the number of students (Figure 73).

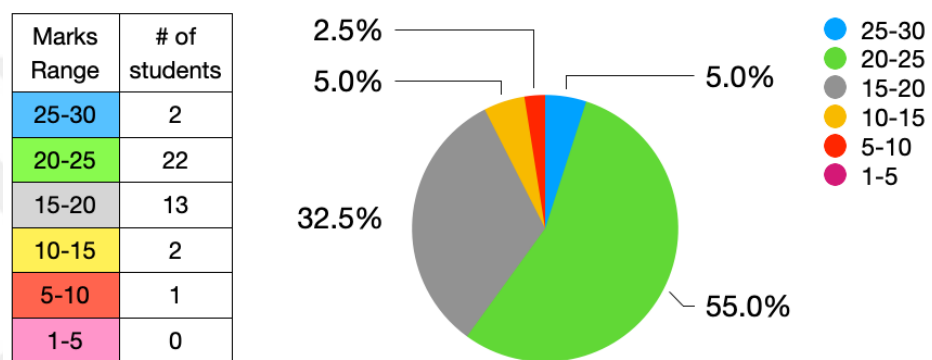


Figure 73. Marks range.

As demonstrated in figure 73, most of the students (60%) had marks between 20 and 30, and 92% had marks between 15 and 30, moreover, the following table provides insight into the student’s answers (Figure 74).

University	Question number	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total	University Average
	Topic	V	T	V	T	S	S	V	T	S	S	S	V+S	S		
	Question Level	LEVEL 1						LEVEL 2			L3	L4	L5	L6		
	Marks for each level	12						7.5			4.5	3	2	1	30	
	Marks for each question	2	2	2	2	2	2	2.5	2.5	2.5						
Zaytona 1	1	2	0	2	2	0	0	0.5	2	1.5	4.5	3	1	0	18.5	18.9
	2	2	0	2	0	2	2	0.5	2	1.5	4.5	3	1	0	20.5	
	3	2	0	2	2	2	0	0.5	0	0	4.5	3	0.5	0	16.5	
	4	0	0	0	0	2	2	2	0.5	1	2.5	3	1	0	14	
	5	2	0	2	2	2	0	2	2.5	2	4.5	3	1	0.5	23.5	
	6	2	0	2	2	0	0	1.5	2	1.5	4.5	3	1.5	0.5	20.5	
German	7	2	0	2	2	2	2	1.5	2.5	1	4.5	3	1	0.5	24	23.7
	8	0	0	2	2	2	2	2	2.5	2.5	4.5	3	1	0.5	24	
	9	2	0	2	0	0	2	2	2.5	2.5	4.5	3	2	0.5	23	
	10	2	2	2	0	2	2	1.5	2	2	3	3	1	0	22.5	
	11	2	0	2	2	2	2	2.5	2	1.5	4.5	3	1	0.5	25	
Applied 1	12	2	2	0	2	2	0	2.5	2.5	2.5	4	2.5	2	0.5	24.5	23.2
	13	2	0	2	2	0	2	2	2.5	2.5	4	2.5	1	0.5	23	
	14	2	2	2	2	2	2	2.5	2	2.5	4.5	2.5	1	0	27	
	15	0	0	2	2	0	2	2	2	2	4	2.5	1	0.5	20	
	16	2	0	2	0	2	2	2.5	2.5	2.5	2.5	2.5	1	0.5	22	
	17	2	0	2	2	0	2	1.5	1.5	2.5	4	3	2	0	22.5	
Petra	18	2	0	2	2	0	0	2	2.5	1.5	2.5	3	1.5	1	20	20.4
	19	0	0	2	2	2	0	2	2	2	4.5	3	1	0.5	21	
	20	2	0	0	2	2	2	2	1	2.5	4.5	2.5	1	0	21.5	
	21	2	2	2	2	0	0	0	1	1.5	4	3	0.5	0.5	18.5	
	22	2	2	0	0	2	0	2.5	2	1.5	4	3	2	0	21	
	23	2	0	0	2	2	2	2.5	0	2.5	2.5	3	2	0	20.5	
	24	2	0	2	0	0	2	2.5	2.5	2.5	4.5	1	1	0.5	20.5	
Zaytona 2	25	0	2	2	0	2	0	1.5	1.5	0	4.5	2.5	1	0	17	20.2
	26	2	2	2	0	2	2	2.5	1.5	1.5	4.5	3	1.5	0	24.5	
	27	2	0	0	0	0	0	2.5	2	1	4.5	2.5	0.5	1	16	
	28	2	0	2	2	2	0	1.5	1.5	1.5	4.5	3	2	0.5	22.5	
	29	2	0	0	2	2	0	2	1.5	2	4.5	3	1.5	0.5	21	
Applied 2	30	0	0	2	2	2	2	2.5	0	0	4	3	2	0	19.5	17.7
	31	0	0	2	2	0	2	2	2	0	4.5	1.5	2	0	18	
	32	0	0	0	2	0	2	1	1	0	4	0	1	0	11	
	33	2	2	0	0	0	2	2	1.5	0	4.5	3	2	0.5	19.5	
	34	2	2	2	2	2	0	2.5	0.5	0	4	1.5	2	0	20.5	
Ahleya	35	2	0	2	0	0	0	1	2.5	2.5	3	3	0.5	0.5	17	16.3
	36	2	0	0	2	0	2	2.5	0	1.5	4.5	3	1.5	0	19	
	37	2	0	2	0	0	0	1.5	2	0	4.5	3	1.5	0	16.5	
	38	2	0	2	0	2	2	1.5	2	2.5	4.5	0	0.5	0	19	
	39	2	0	2	0	0	0	1	0.5	1.5	0.5	1	1	0	9.5	
	40	2	2	2	0	2	2	1	0	2.5	0.5	2.5	0.5	0	17	
	Average	1.6	0.5	1.5	1.2	1.15	1.15	1.7875	1.6125	1.55	3.9125	2.5625	1.25	0.2625		
	Total	64	20	60	48	46	46	71.5	64.5	62					Average	20.0375

Figure 74. Students' marks.

As demonstrated in figure 74, the average marks of all students were 20 out of 30, therefore, we could conclude that the results of the quiz were good, however, it has been noticed that question number 2 had the least marks among the other six questions, therefore, the author did some investigations, the question included; *“In the past, typography was about”*:

- A. *Using alphabets.*
- B. *Arranging Serif, Sans-Seif, and Display letters.*
- C. *Arranging movable type to make words to make text readable before sending them to the printing press.*
- D. *Writing on clay tablets using sharp objects.*

Although “Typography” scene emphasized the definition of typography by showing the process of arranging movable type and placing them on the printer and mentioning “this process was called: TYPOGRAPHY” in a speech bubble using capital letters, most of the students choose “D” as their answer, therefore, the author contacted each professor to get some explanations; two professors explained that they do not focus on typography during the first two years, the other three professors explained that they teach their students about typography during the third and fourth years.

However, the other two questions related to “typography” had relatively good marks as question 4 had an average of 1.2 out of 2 which was even better than the average of other questions from the same level; “space” questions number five and six both had an average of 1.15 out of 2, moreover, question 8 which was related to “typography” had an

average of 1.6 out of 2.5, in comparison, question 9 about “space” had the same level but had an average of 1.55 out of 2.5.

Furthermore, in “Typography” scene, 60% (24 out of 40) of the students were able to pass the puzzle at the first attempt by placing Serif, Sans-Serif, and Display typefaces in their right boxes, in comparison, question 8 also included comparing between Serif, Sans-Serif, and Display typefaces but had an average of 64%, this comparison shows that students slightly developed.

Moreover, the author talked to most of the students that chose “D” as an answer, it has been noticed that they choose this answer since the “Typography” scene included the invention of writing, therefore, the author concluded that they chose it as they mistook it as the right answer.

Finally, the survey included open-ended questions on having any side-effects, as well as their feedback for “The Designer”; 8 students reported having slight motion sickness in “Space” scene, 2 reported that HMD was not comfortable, and one student reported that image was blurry due not wearing glasses, although the student did not mention this fact as all students were allowed to play while wearing their glasses if they had ones. One student that she felt a bit scared like drowning in space, she also reported that she had slight general discomfort, slight fatigue, moderate headache, moderate eyestrain, moderate sweating, moderate difficult concentrating, severe dizzy, although she reported that she felt “extremely enjoyed being in another world, I enjoyed the learning experience, it is a new way that we never forget”. Also, there was one case of slight sweating, and one case of moderate eye strain.

Regarding the question **“What did you like the most about this educational game?”**, three students replied: “Everything”, the rest of the answers included: the place itself, creativity, scenery, the way information was provided, the graphics, the friendly laptop, movement in space, typography puzzle, attention to details, interactivity, engagement, fun, playing with objects while listening to the laptop, the colors, the design looks very professional, entertaining, the story, being in another world, interactive learning, interaction with objects in space, informative, funny laptop jokes, The Matrix reference, the animations, the transitions, the sound effects, a memorable experience, easy to play.

As for **“What did you dislike about this educational game?”**, one student reported that the neighborhood scene was a bit boring, one student wanted more movement, one student reported that grabbing objects was sometimes difficult, one student mentioned that the dialogue was long, and one student reported that the image was not clear.

As for **“What suggestions or ideas do you have for improving this educational game?”**, 14 students wrote “none”, 5 students replied that it was perfect, great for teaching design basics, should be provided at universities, suggested that students should learn more about VR design, should have been longer as it was so fun, 4 students suggested adding more movement, the other suggestions included providing a higher resolution HMD, changing the camera into first-person perspective for the “neighborhood” scene, adding more games, more topics, adding subjects such as design programs, adding the ability to paint, improving the laptop’s voice, and improving controls.

4. CONCLUSION.

XR are great technologies for education, they provide a positive and enjoyable learning experience, the potential of these technologies is huge, data acquired from the literature review as well as qualitative and quantitative data from interviews and surveys gave us insight into the importance of these technologies for the education and the profession of visual communication design to achieve the aims and objectives of the study, therefore, in describing our findings, we revisit and discuss the research questions:

- **Why should we consider XR technologies for the profession and education of visual communication design?**

XR technologies are new mediums for communication, they provide new possibilities for design and creativity, many other professions and disciplines got the best use of them by integrating them into their curriculums and using them for many project purposes, therefore, we should keep up with these technologies by integrating them into visual communication design education by using them for education as complementary tools and infusing XR education into the curricula as elective courses as they could be used in a variety of ways such as animation, motion graphics, 3D design, digital sculpting, prototyping, illustration, 3D printing, advertising, and marketing, moreover, most of the students stated their desire to learn more about design for games and VR and they requested more educational games.

Learning about visual communication design through communication through visuals is an excellent method of education, additionally, these technologies would add a positive learning experience and an inspiring atmosphere to the design classroom, and therefore, it boosts students' creative potential, moreover, visual

communication designers are needed and have a significant role in XR and game development, therefore, they should be equipped with the necessary knowledge for XR development.

- **What are the students', educators', design practitioners', and VR developers' perspectives on using educational games and extended reality in visual communication design education?**

All Academics, design practitioners, virtual reality developers, and students agreed that using games for visual communication design education has many advantages: students can learn about visual communication through visual communication, remember the information provided within the game, have a positive and enjoyable learning experience because they are enjoying the class even if the duration is long, and games are a great solution to a repetitive and boring routine

However, there are few educational games related to visual communication design, and there are none in 3D and VR, therefore, educators and developers should create more educational materials.

- **What is the effectiveness of “The Designer” educational VR game for visual communication design education?**

Results from direct observation and surveys provided an insight into the importance of VR for the education and the profession of visual communication design as the results were positive; the results of the user experience were positive, the results of the engagement factors were very positive, the results of side-effects were very positive, and the results of the quiz were positive, the majority of the students believed that “The designer” should be used in visual communication design education and they would recommend it to their friends.

Although VR sessions were held individually, “The Designer” brought a very positive and enjoyable learning experience for both students and educators within each university, survey results provided us with valuable information including the most effective way to create VR educational games as most of the students enjoyed the “space” scene the most, the scene included slight motion through riding on rails, many objects to interact with, and pauses between speeches so students could interact with their surroundings and continue their learning process whenever they felt comfortable, although survey results were *neutral* regarding preferring to play while standing, it is better to create VR experiences to be in a seated position as motion sickness vary from person to person, moreover, Oculus stated that the majority of their clients preferred to be seated, and Sony stated that it is safer and more comfortable.

Additionally, most of the students stated that they have learned the most from “typography” scene followed by “space” and “visuals”, however, quiz results showed that “visuals” scene had the higher marks, followed by “space” and “typography”, therefore, it could be concluded that diversification for methods of VR design is preferable, as it brings a different experience to each scene, it is also important to include elements of motion sickness gradually as the laptop character advised the player to choose “visuals” scene followed by “typography” then “space”, moreover, the majority of students agreed that 30 minutes of playtime was suitable, which indicates that choosing 30 minutes as total playtime for VR educational games is preferable.

- **How can we integrate XR in visual communication design education and prepare students for the future?**

By using them for education as complementary tools and infusing XR education into the curricula as elective courses, however, it is advisable to teach students about 3D space, motion graphics, animation, UI, UX, and provide them with basic programming and coding knowledge, however, it is expected that VR creation will be much easier soon.



5. DISCUSSION.

Visual communication design education needs more educational games either in 3D or using XR, therefore, further research is needed using include pretest-posttest design to provide more knowledge of the effectiveness of integrating XR into visual communication design education, as well as using creation tools that enable developers to upload pictures and videos as “Dreams” did not include these features, moreover, the author advises using high-resolution HMDs, pauses and short text in along with rewind options to give students more time to read and listen and increase their capacity and decrease their cognitive load, moreover, it is recommended to add visual and auditory elements and cues to buttons so users could understand if they should either “grab” or “touch” buttons or by adding both logic options to buttons, as well as adding alerts or prompts such as “are you sure you want to exit” to prevent users from doing unwanted actions.

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Appendix A

THANK YOU FOR TAKING THE TIME
TO COMPLETE THIS SURVEY!



Demographic information

Gender: ☐ Male ☐ Female Academic year and semester: _____ Age: _____

Background/ previous experience of VR:

How often do you use VR? ☐ Never ☐ Rarely ☐ Sometimes ☐ Usually

How do you use VR? ☐ Gaming ☐ Education ☐ Movies ☐ 360 Degree Experiences

Which VR device did you use? _____

If you used VR, how do describe your experience of motion sickness?

☐ None. ☐ Slight. ☐ Moderate ☐ Severe

If you used VR, did you enjoy your VR experience?

☐ I did not like it ☐ it was okay ☐ It was very good ☐ It was amazing

Have you ever created in VR (such as drawing, animation, 3D creation)? ☐ Yes ☐ No

If you responded "Yes", which creation software did you use? _____

Have you tried any educational game or educational VR game related to design? ☐ Yes ☐ No

If you responded "Yes", which software did you use? _____

The following questions are answered after the experience of "The Designer" educational VR game:

Which of these scenes did you enjoy the most?

☐ Neighbourhood & home scenes ☐ Waterfall scene ☐ Visuals ☐ Typography ☐ Space

Which of these scenes did you learn from the most?

☐ Visuals ☐ Typography ☐ Space

A. User experience	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The user interface was easy to understand	☐	☐	☐	☐	☐
Controls were hard to use	☐	☐	☐	☐	☐
Text was clear and easy to read	☐	☐	☐	☐	☐
Audio was not clear	☐	☐	☐	☐	☐
Language was easy to understand	☐	☐	☐	☐	☐
Image was clear and sharp	☐	☐	☐	☐	☐
I preferred playing while standing	☐	☐	☐	☐	☐
B. Engagement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The game should have been longer	☐	☐	☐	☐	☐
The game should have been shorter	☐	☐	☐	☐	☐
This game should not be shorter or longer, total playtime is suitable	☐	☐	☐	☐	☐
The story was good	☐	☐	☐	☐	☐
Characters within this game were likable	☐	☐	☐	☐	☐
I enjoyed this educational game	☐	☐	☐	☐	☐
I learned from this educational game	☐	☐	☐	☐	☐
I would use it again	☐	☐	☐	☐	☐
I would recommend it to my friends	☐	☐	☐	☐	☐
This game should be used in visual communication design education	☐	☐	☐	☐	☐
We need more educational games related to visual communication design	☐	☐	☐	☐	☐
VR should be used in visual communication design profession	☐	☐	☐	☐	☐
We need more design software to be used in VR for creation	☐	☐	☐	☐	☐
I would like to learn about how to design using VR	☐	☐	☐	☐	☐

C. Side effects of the VR experience

Did you have any kind of discomfort or side effects **while** playing the game? ☐ Yes ☐ No

If you responded "Yes", which part of the game made you feel uncomfortable?

D. Side effects after the VR experience

Do you think your health is the same as it was before playing the game? ☐ Yes ☐ No

If you responded "**No**", please describe them below:

Side Effects	None	Slight	Moderate	Severe
General discomfort	☐	☐	☐	☐
Fatigue or body exhaustion	☐	☐	☐	☐
Headache	☐	☐	☐	☐
Eye strain	☐	☐	☐	☐
Sweating	☐	☐	☐	☐
Stomach discomfort	☐	☐	☐	☐
Difficulty concentrating	☐	☐	☐	☐
Blurred vision	☐	☐	☐	☐
Dizzy	☐	☐	☐	☐
Burping	☐	☐	☐	☐

Open-Ended Questions

What did you like the most about this educational game?

What did you dislike about this educational game?

What suggestions or ideas do you have for improving this educational game?

Knowledge questions:

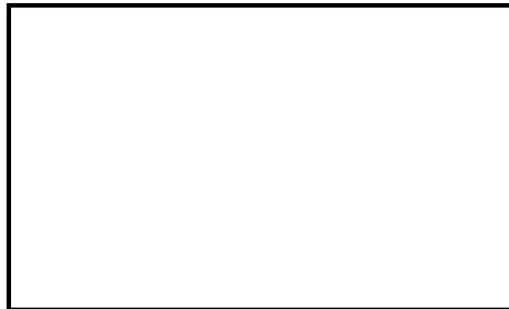
Q1. Visuals are: A. Charts, Colors, Space, Illustrations B. Illustrations, Graphics, Colors, Images C. Using symbols to make words D. Serif, Sans Serif, and Display	Q2. In the past, typography was about: A. Using Alphabets B. Arranging Serif, Sans-Serif, and Display letters C. Arranging movable type to make words to make text readable before sending them to printing press D. Writing on clay tablets using sharp objects
Q3. In visuals, the most powerful element is: A. Colors B. Illustrations C. Graphics D. Images	Q4. Today, typography is about: A. Arranging type to make it readable, beautiful, and clear B. Using Serif, Sans-Serif, and Display typefaces C. Arranging type to make it larger D. Using space and hierarchy
Q5. Space is: A. Arranging objects within an empty area B. Using balance to achieve harmony C. Sorting figures according to their color, size, and texture D. The empty area which our design is created on	Q6. Hierarchy is: A. Arranging objects within an empty area B. Using balance to achieve harmony C. Sorting figures according to their importance D. The empty area which our design is created on

Q13. Using any simple shapes, illustrate within the following spaces using Gestalt's principles of arrangements

Similarity



Proximity



Continuity



Closure



Appendix B

Date: March 19, 2022

Name: Shahd Humaid

Years of Experience: 6

Current position: Senior motion graphic designer

Other details: UI designer, and a PhD candidate

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

Of course, current students are familiar with video games so inserting knowledge within this game will make them learn it easier and remember it, it would be great to learn about motion graphics or UI using educational games, or learn about design basics such as gestalt principles, 2D and 3D perspectives, packaging, patterns, etc.

Q2. Do you think that using games for visual communication design education provides a positive learning experience and an inspiring atmosphere in the classroom?

Yes, games have positive energy, providing this positive energy to the classroom will add an inspiring atmosphere to the classroom, they could spend hours playing and learning without getting bored or having effort, while some traditional classes are very boring, therefore, teachers will be able to insert more information within this game.

Q3. Would you consider using games in your classrooms when you finish your PhD?

Of course!

Q4. Have you ever used XR (VR, AR, and MR)?

I tried VR once, I also used AR for entertainment purposes, VR was more interesting than AR.

Q5. If you used VR, what purpose did you use it for?

For entertainment purposes.

Q6. What is your perspective on using VR for education?

It is very important for both schools and universities, learning about science stuff such as anatomy as well as chemistry will become easier and less boring.

Q7. Have you used XR for design purposes or projects?

I tried to create an AR for a mobile app, but it was too hard to learn about it, so I canceled the idea.

Q9. In your opinion, how important is XR to visual communication design profession?

Designers have a very important role in XR, for example, if we are talking about creating a VR experience, visual communication designs are more capable of creating scenes and compositions for VR than most VR developers, as designers have proper knowledge of the principles of design, space, colors, typography.

Q10. In your opinion, how important is XR to visual communication design education?

Using VR, learning about 3D space will become easier and more natural as they can turn around these objects, the information provided within VR will be memorable, it increases their creativity, imagination, and problem-solving skills, additionally, learning about how to create for XR will be an added value to design graduates, they have to keep up with new technologies, mediums, and trends.

Q11. Do you think that visual communication designers should learn about programming and coding to create for VR?

I am completely against this idea, design and coding are different disciplines so they should complement each other.

Q.12. In your opinion, how could we integrate XR into visual communication design education?

We could use them to teach subjects that students consider boring, such as the history of art, where students could view paintings in actual size using storytelling, students could also record and re-watch their experiences and share them with others.

Author: great answer, I already implemented a similar idea in my project within the typography scene!

Appendix C

Date: March 19, 2022

Name: Mohammad Radaideh

Years of Experience: 17

Current position: Associate Creative Director

Name: Firas Armoush

Years of Experience: 17

Current position: Creative Director

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

M: Games are great tools for education, students could understand information easier using them.

F: The interactivity within games makes information easier to remember and understand than just listening or reading for information.

Q2. Do you think that using games for visual communication design education provides a positive learning experience and an inspiring atmosphere in the classroom?

M: Of course, they are fun and interactive!

F: Yes, I think it adds positive energy to the classroom, the value of teaching visual communication through visual communication is tremendous.

Q4. Have you ever used XR (VR, AR, and MR)?

M: VR and AR.

F: AR, and VR, you remember when I fell because of it (Jokingly), therefore, I don't like playing horror or games that include motion in VR, but I like to try VR for educational purposes such as the game you created as well as other creational games such as sketching.

Q5. If you used VR, what purpose did you use it for?

M + F: We used VR as well as AR for entertainment purposes.

Q6. What is your perspective on using VR for education?

M: I believe VR is a great tool for learning things that are usually complicated to understand, they could be used in training such as ship maintenance, they are extremely good for training for physical tasks, and they also reduce the cost of training through running simulations.

F: VR is already being implemented in many different disciplines and professions, imagine what would happen if people did not have flight simulation or VR simulation, or in surgeries such as in The Good Doctor TV show, using VR will decrease their possibility of failure, moreover, it is being used more widely in other disciplines, the educational game that you created is a good example; you integrated visual communication to teach visual communication.

Q7. Have you used XR for design purposes or projects?

M + F: No.

Q9. In your opinion, how important is XR to visual communication design profession?

M: Soon, designing for these technologies would be a market demand, and most advertising agencies will have to provide these services, there should be some courses within the discipline that teaches to design for XR, moreover, industrial designers would be able to create things naturally within VR.

F: I think it is early to answer this question, but I believe that in the nearest future, advertising agencies will have to learn about how to create for these technologies, it depends on market demand, I believe these tasks will become like any other design brief for designers, they are already being used in architecture and interior design.

M: I think architecture and interior design will benefit from VR more than visual communication design, but still, it would be important for future visual communication designers to learn how to create for these mediums.

Q10. In your opinion, how important is XR to visual communication design education?

F: I think they are very important, for instance, I still remember most of the information you provided within the educational game you created, it was even in its earliest stage, as I said before, learning visual communication through visual communication would achieve positive learning outcomes as our discipline is all about visuals, showing students things in VR is way more effective than describing them.

M: They would also play or interact with characters within these educational materials.

F: Exactly.

M: I believe that visual communication design students should learn about how to create for XR, they are new mediums for communication, like when we had to learn about designing for digital media and social media and UI.

F: I agree, they are new mediums that designers need to keep up with, they have to have digital literacy.

Q11. Do you think designers should learn about programming and coding to create for XR?

F: I would like to learn about creating for these technologies, of course, it won't be easy, but if coding got in my path, it would be a different story.

R: Exactly, programs are becoming easier and more user-friendly, so it is possible that creating for VR will become much easier.

F: It will be easy to create for VR, but not everyone will be qualified to create for VR as it requires creativity, they will become tools for creation, and like any other artistic or design tool, it is always about the designer's creativity, not about the tool itself.

Appendix D

Date: March 22, 2022.

Name: Omar Qandeel

Years of Experience: 16

Current position: Senior 3D Animator, Graphic Designer, and Tutor.

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

Games are great for education, as they are fun, interactive, gamification is being used today to bring interest to any interactive experience, they turn boring classes into likable ones, the information provided within games will be remembered by design students, maybe it is more desirable for school students, but still, it would be good for university students.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Our discipline is linked to visuals, providing visuals with sound and animation with games or VR will be inspiring and interesting to students.

Q4. Have you ever used XR (VR, AR, and MR)?

I used AR.

Q5. If you used VR, what purpose did you use it for?

I saw an AR application used for furniture marketing and advertising, I also saw an Ad for Burger King, users could see their ad when taking a picture for McDonald's Ad, it was very creative, and on the other hand, I used VR for entertainment purposes, I also saw videos for sketching and sculpting in VR and it was very interesting.

Q6. What is your perspective on using VR for education?

It has two sides; it is interesting and provides a positive learning experience, its being used in many disciplines such as medicine and marketing, on the other hand, it is expensive, requires time, space, professional people to set it up, and needs a lot of equipment, it is not easy to provide these devices for every student to use them while being at home, or to get some help from their parents as some of them could be old fashioned, but I think it will be easier to provide them nowadays as their prices are decreasing.

Q7. Have you used XR within your classroom? (Only for academics)

No

Q8. Have you used XR for design purposes or projects?

No

Q9. In your opinion, how important is XR to visual communication design profession?

I believe they could be used for presentation purposes; they could be used for sketching and 3D design, I can't think of something else.

Q10. In your opinion, how important is XR to visual communication design education?

They are very important, but universities need to provide VR and AR devices to students to create experiences, students nowadays do not use books the way we used to do, they use tablets and mobile devices to learn, so maybe these devices will be essential to them in the future, I am not sure, I think creation within VR would be interesting, I have to try it!



Appendix E

Date: March 21, 2022

Name: Mousa Abu Salem

Years of experience: 16

Current position: Creative Director at Kharabeesh

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

We created a game related to interior design and decoration, it was mainly for entertainment but it included a few educational topics, it was a good experience, I never played educational games that teach topics such as color harmony or character design, but I find the process of character or avatar creation within games and other platforms such as Snapchat very entertaining, it would be great if there was an educational game for visual communication design.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

In the past, cavemen used tools to carve on rocks to communicate visually, today, digital media and new technologies such as VR changed our world and are being used in many different ways, gamification is being used everywhere, we as visual communication designers use digital media on a daily basis so using any other digital media tools would be appropriate and inspiring.

Q3. Have you ever used XR (VR, AR, and MR)?

VR, and AR.

Q4. If you used VR, what purpose did you use it for?

We used both VR and AR for project purposes.

Q5. Have you used XR for design purposes or projects?

Yes, we created a VR experience targeted at children, to make vaccinations less scary for them, it included some animated characters. We also created an AR application for the Ministry of education in KSA as they needed interactive books, for example, kids could see animated moon and sun by scanning books using their mobile or tablet devices.

Q6. What is your perspective on using VR for education?

Very important, VR and AR expand the viewer's creativity and imagination, they also make difficult subjects easier to learn and understand.

Q7. In your opinion, how important is XR to visual communication design profession?

I believe that they are new important mediums that provide new and creative solutions for customers, whether it was for education, gaming, production, etc.

Q8. In your opinion, how important is XR to visual communication design education?

Again, they expand the viewer's creativity and imagination, they make difficult subjects easier to learn and boring subjects more interesting. Also, creating virtual

worlds requires creativity and a deep understanding of 3D space, lighting, etc., therefore, it would expand their potential and inspiration, and learning about these technologies would be an added value to them. Moreover, these technologies are also new tools for creation, it is quite similar to when digital tablets such as Wacom devices changed the way we draw, illustrate, and create, I believe they will become essential tools for creation.



Appendix F

Date: March 23, 2022

Name: Alaa Al-Sharaa

Years of Experience: 15

Current position: Head of graphic design department at Al-Zaytoonah University of Jordan

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

I support this idea a hundred percent, I am against spoon-feeding and old strategies, students nowadays could learn and get knowledge by themselves using the internet through online tutorials, e-books, and YouTube. It would be great to integrate games into the classroom as students will remember most of the knowledge within them, visual communication design is all about visuals and how to communicate with viewers, students will acquire this knowledge visually, and enjoy this learning experience as most of the traditional classes are boring to them, there is always a gap between students and teachers, students could easily get distracted, that is why most of the students today were happy to participate in your project as soon they heard it was an educational “game”, they felt fully immersed within the VR educational game you created!

Q2. Do you think that using games for visual communication design education provides a positive learning experience and an inspiring atmosphere in the classroom?

It is possible, I once saw a video about using games to teach color theory using a tablet device while the lights were turned off, it would be great if it was in VR, students could learn about the origins of color from Newton, DaVinci, or Goethe, students would enjoy this adventure.

Q3. Have you considered using games for visual communication design education?

I thought about it, there were some challenges, also, there was no educational game that I could use to teach topics such as logo design, visual identity, and Islamic art.

Q4. Have you ever used XR (VR, AR, and MR)?

Yes, VR and AR.

Q5. If you used VR, what purpose did you use it for?

For entertainment purposes.

Q6. What is your perspective on using VR for education?

I am with using VR for education, we as human beings are fond of new technologies, VR nowadays is a trend so students would love to use them, I wish our universities integrate VR into education as soon as possible.

Q7. Have you used XR within your classroom?

No, teaching XR is not listed within our graphic design discipline, but it is available for our multimedia students, they learn about creating for VR. Creating educational materials for design education needs a team of qualified people with experience in

VR, you are most probably the first researcher with graphic design experience to write about using VR for graphic/visual communication design education so you know what I am talking about.

Q9. In your opinion, how important is XR to visual communication design profession?

It is definitely important, XR is within the market demand nowadays, we can see that companies nowadays are using AR for posters, packaging, magazine Ads, AR is easy to use, available even on mobile devices, VR, on the other hand, needs more equipment to install, unless they are untethered devices, however, there are many uses for VR in advertising, 360-degree experiments, and animation, I believe both of them are very important, I expect that demand for both of them will grow even more within the next two years,

Q10. In your opinion, how important is XR to visual communication design education?

Again, it needs a team of qualified people with experience in VR to prepare educational materials and embed knowledge, skills, and competencies within them, it is also important for visual communication designers to learn about them.

Additionally, designers are qualified, have the proper knowledge needed to create for VR 3D environments, while programmers do not have the same knowledge and design basics, we are talking about aesthetics, layout, typography, and colors, although programmers could create VR experiences, their creations won't be visually effective, everyone could create an Advertisement nowadays, but not every Ad is well-designed, the same goes for VR.

Q11. Do you think designers should learn about programming and coding to create for XR?

No, but it depends on the market needs, companies sometimes require the designer to have programming knowledge to create websites, nowadays, programs are becoming easier, people could create websites without having coding or programming knowledge, maybe it is hard to create for VR today, but I believe things will get easier in the near future.

Author: I believe VR will be the next PowerPoint at some point in the future!

Q.11. In your opinion, how could we integrate XR into visual communication design education?

That's a good question, in short, we could use them to make design topics more interesting for students from the current generation as well as for the next generation as they are digital natives. For example, we could transform theoretical and tedious topics such as world history or the story of Mondrian into VR and have discussion sessions afterward, it would be more efficient and interesting than PowerPoint presentations, students could get a sense of accomplishment when finishing each stage of that educational game!

Author: I Agree, I discussed this issue within my research, this is exactly why I placed a brief history of typography and the invention of printing.

This is great! the invention of both writing and printing is one of the most important inventions in the history of mankind, and nowadays, we are moving into the digital world!

Appendix G

Date: April 05, 2022

Name: Mahmoud Abu-Shawali

Years of experience: 15 years as an academic, 15 years as a practitioner

Current position: Assistant professor, Applied Sciences Private University

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

Today's students are interested in digital media and interactive media, so adding games to education would provide a very positive learning experience although they require a lot of development time and effort.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Of course, learning visual communication through a visually interactive experience would be very beneficial, students will remember the information provided within the game for a long time contrary to traditional ways of education, especially when they are using all of their senses to learn.

Q3. Have you considered using games for visual communication design education?

No, but some assignments for students included doing designs for very basic interactive games.

Q4. Have you ever used XR (VR, AR, and MR)?

I used both VR and AR

Q5. If you used VR, what purpose did you use it for?

I used VR for entertainment and AR for educational and entertainment purposes.

Q6. What is your perspective on using VR for education?

These technologies are great and received a lot of affection from people. VR is being used today in many disciplines such as medicine and aviation. They integrated VR before we did, and VR became an essential simulation and training tool for these disciplines.

Q7. Have you used XR within your classroom?

Yes, our students created characters using Adobe software to be included in AR

Q9. In your opinion, how important is XR to the visual communication design profession?

If we categorize visual communication design to design for digital media and graphic design, I believe that the usages of XR for graphic design are limited, such as promotion purposes, presentations, and packaging, unless someone thought of new actual and useful ones, on the other hand, XR is essential for design for digital media, designers would have to design for both interactive digital experiences as well as XR experiences.

Q10. In your opinion, how important is XR to visual communication design education?

In design disciplines, most of the tools that students use are either physical tools such as art tools and materials, or other tools such as computers and software, virtual worlds are not included yet, but we all need to consider using these technologies in design education and to add them to our curriculums, especially after COVID-19 pandemic.

Q.11. In your opinion, how could we integrate XR into visual communication design education?

I believe that providing XR in educational institutions would be quite expensive, we proposed a suggestion to our university that we should get funding from one of the companies in the USA to provide VR labs but it was rejected as it costs too much, perhaps someday they will become more affordable.

Appendix H

Date: March 21, 2022

Name: Tariq Rimawi

Years of experience: 9 years as academic, 12 years as an animation filmmaker

Current position: Assistant professor at The University of Petra.

Other Details: Animation filmmaker, Director, Screenwriter, founder of animation and multimedia department at the University of Petra.

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

I always support non-traditional methods of education, including gamification and Edu-games. As long as the main purpose of these methods is learning, as the aim is not only about having fun, there should be learning outcomes. Games are great tools with rich history, they are already being used for educational purposes in schools, but there are few educational games aimed at university students, I believe it would be challenging to convince students to play a game to learn about something.

Author: I remember when Minecraft was released, I told a friend of mine who is a teacher that this game should be used for education, players could spend hours learning a complicated formula to create something, it develops user's creativity, years later, they released Minecraft: education edition!

This is the great thing about using games for education, extracurricular activities provide them with qualities such as leadership, and creativity, but we can't use them to teach about design software, we could use them to teach indirectly about historical and theoretical or other topics such as color theory.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Yes, I believe so, I remember using an online kerning game within my classroom, students were enjoying it as it brought a challenging and a very inspiring atmosphere to the classroom, therefore, they are a great solution to a repetitive and boring routine, games bring out the child in us, which is very important for design, art, and visual communication.

Q3. Have you considered using games for visual communication design education?

Yes, I mentioned using the online kerning game, I don't remember finding any other useful educational game for visual communication design education, I also used games as a solution; I asked my students to be separated into groups and create a board game for university's student's guidebook as most of the students does not read it, the project was very successful as the project was used for marketing purposes, I have been using this project for six years now.

Q4. Have you ever used XR (VR, AR, and MR)?

Yes, I did use VR and AR, I used AR for entertainment purposes, it was Pokémon GO, I have also watched some interesting videos about using AR in book design.

Q5. If you used VR, what purpose did you use it for?

You do remember how bad my experience was! both I and Firas fell! (Jokingly).

Author: Yes, that VR place was really bad, the employee let you play a game that include a high rate of motion sickness, which is very wrong, especially for people who are trying VR for the first time.

Exactly, I think VR should be supervised, I also tried a game somewhere else in which I was walking on a plank in a very high place, it was really scary, there are also VR treadmills, I think they bring more complicated and scary experience.

Author: I agree, this is why oculus provides a comfort rating for each game in their store, sorted as comfortable, moderate, intense, and unrated, the games you just tried are considered as intense, which was very wrong.

Yes, I think they just wanted people to have a very realistic experience.

Author: Their approach is very wrong, people supervising VR devices should educate themselves about comfort ratings as people receive VR differently.

Exactly, I can't stay within VR for more than 5 minutes, the same goes for 3D movies, this is why I prefer AR over VR, I guess VR will be discontinued at some point, maybe I am wrong, I know that VR has many great usages, but I believe everything is about user experience, maybe it will be replaced with MR and Holograms as it they more comfortable, I am not so passionate about VR.

Author: what about that animated VR movie that I invited you to experience (Allumette)?

Honestly, comparing this to previous experiences, it was the most enjoyable experience, I did not feel uncomfortable, which was strange, maybe because it was more related to my profession, maybe because it was a short movie, or because of the story as I felt emotionally attached to the characters; VR removed the barrier between me and the screen and I felt emersed.

Q6. What is your perspective on using VR for education?

VR is nowadays used in disciplines such as game design, medicine, military, architecture, and interior design, VR is an important tool, some people consider it the future, but again, I doubt it.

Q7. Have you used XR within your classroom?

No.

Q8. Have you used XR for design purposes or projects?

No.

Q9. In your opinion, how important is XR to visual communication design profession?

I think that they are important, I support using them, we have to use them to the maximum amount, they provide new possibilities for creativity such as using posters or animations within these mediums, they add new layers to creativity, we in Jordan do not use VR for educational purposes but other countries are integrating these technologies within their educational systems, we should not have this gap, in conclusion, both my profession and your profession are from the creative industry, we have to be open to any new methods or tools.

Q10. In your opinion, how important is XR to visual communication design education?

They are new and important tools for visual communication, I recently watched Netflix series called “The billion-dollar code” which was about VR, it was inspiring

as the message was about never giving up on big ideas, I believe the content and the learning outcomes are the most important aspects of creating a VR educational game, so it's about the content, not the tool itself.

Within our discipline of animation and multimedia, students could learn about these technologies if they are interested, they could also be integrated into other disciplines such as art or graphic design, it depends on the discipline itself, they are new tools for creativity, but many universities in Jordan are starting their own XR discipline which means there is a high demand for these technologies.

Q.11. In your opinion, how could we integrate XR into visual communication design education?

We could add them as elective courses for visual communication design discipline, but they should also learn about the basics of UI, UX, and game design, nowadays web design creation is easier than ever and I believe creation for VR and AR will also become easier, ultimately, UI and UX designers have an important part in game development as these projects require a large team.

Appendix I

Date: April 13, 2022

Name: Demet Karapınar

Years of Experience: 18

Current position: Associate Professor

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

I think using educational games as course materials are beneficial in terms of keeping the design topics learned in mind.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Yes, I agree. Using games for design education can help to motivate design students. They can learn and discover basic design theories while they have fun.

Q3. Have you considered using games for visual communication design education?

I use some of the online design games as part of my Graphic Interface Design, Vector Graphics, and Desktop Publishing courses. They are useful as supplementary course materials on topics such as typography, page layout, color theories, etc.

Q4. Have you ever used XR (VR, AR, and MR)?

Yes, I use and design AR / MR applications.

Q5. What is your perspective on using VR for education?

Since VR applications require special equipment, it may not be possible to use them in every environment. But I think it can be useful to use it for educational purposes, especially in three-dimensional design.

Q6. If you used VR, what purpose did you use it for?

I didn't use any VR applications in my class.

Q7. Have you used XR within your classroom?

Within the scope of my multimedia course, I teach the basic principles of XR design applications to my students and we create design applications together. I also encourage students to make XR designs in my Conceptual Design Project course.

Q8. Have you used XR for design purposes?

Yes, I use XR technology for my digital art projects.

Q9. In your opinion, how important is XR to visual communication design profession?

This is a rapidly evolving technology. I think it will take a prominent place in our lives very soon.

Q10. In your opinion, how important is XR to visual communication design education?

I think it has a great potential as auxiliary material in education. We need more XR-powered tutorials that are well designed.

Q.11. In your opinion, how could we integrate XR into visual communication design education?

It is possible to develop XR games that are prepared following the syllabus of basic design education and computer-aided design courses and allow students to do design practices.



Appendix J

Date: April 07, 2022

Name: Elif Songür Dağ

Years of Experience: 23

Current position: Assoc. Prof. Dr.

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

The concept of learning by the game has been around since time immemorial. The format of the game varies depending on the time. Today's technological possibilities are available for us to use the game as a learning tool in a digital environment. Digital game learning is mostly used in preschool, primary, and secondary education course materials. However, learning by a game in design education can be a different approach. Why not teach college students a game? Even though we are still playing games, why not use them in college for education when the game has never left our lives?

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Yes, I think it can create a positive learning environment. In particular, our recent experience with distance and mixed learning environments has shown us that everything that involves interaction is a plus in learning.

Q3. Have you considered using games for visual communication design education?

I didn't consider it, but I think it's a good idea. It is necessary for design educators to improve themselves in using new design tools.

Q4. Have you ever used XR (VR, AR, and MR)?

No, I didn't.

Q5. What is your perspective on using VR for education?

I haven't used it, but I think we need to learn and adapt ourselves to these new tools

Q6. If you used VR, what purpose did you use it for?

No, I didn't.

Q7. Have you used XR within your classroom?

No, I didn't.

Q8. Have you used XR for design purposes?

No, I didn't.

Q9. In your opinion, how important is XR to visual communication design profession?

I don't have enough information to comment on.

Q10. In your opinion, how important is XR to visual communication design education?

I don't have enough information to comment on.

Q.11. In your opinion, how could we integrate XR into visual communication design education?

I don't have enough information to comment on.



Appendix K

Date: April 19, 2022

Name: Hanan Al-Sheikh

Years of experience: 12 years as academic, 5 years as a practitioner.

Current position: Head of graphic design department at Al-Ahliyya Amman University.

Other details: Vice Dean for Accreditation and Quality Affairs, Assistant professor.

Name: Faten Al-Jazzar.

Years of experience: 17 years as academic

Current position: Head of multimedia design department at Al-Ahliyya Amman University.

Other details: Assistant professor.

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

H: Honestly, it is very important, especially after COVID-19, if we are talking about education for sustainability and the development of learning and education, they could serve as tools for self-education, and competency-based learning, I am currently working on research related to this subject.

F: Using games for education is an excellent approach, whether it was done using tablets, consoles, or PCs.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

H: Definitely, our discipline is based on visual communication, students would use all of their senses including their visual senses, they should be considered in CLOs and PLOs to develop students' creative skills, and imagination.

F: It depends on the situation; I believe they could use it to teach theoretical topics as the provided information would be easily remembered by students, however, it would be hard to integrate games for practical topics.

Q3. Have you considered using games for visual communication design education?

H: I use different kinds of games, especially for theoretical subjects, but not video games.

F: I used a web browser game called "The Bézier Game" to help students in using the pen tool similar to design software.

Q4. Have you ever used XR (VR, AR, and MR)?

H: I used AR.

F: No, I tried using Adobe Aero, however, it was very basic.

Q5. If you used VR, what purpose did you use it for?

H + F: I never did.

Q6. What is your perspective on using VR for education?

H: I believe we are at a very important stage as it is already being integrated into many disciplines, therefore, we should consider integrating them into art and design disciplines.

Q7. Have you used XR within your classroom?

H + F: No

Q8. Have you used XR for design purposes or projects?

H: No, but I recently wrote a research proposal in which we develop an AR mobile application to teach photography.

F: No.

Q9. In your opinion, how important is XR to visual communication design profession?

H: Of course, they are very important, the world is moving towards technical trends, we should prepare our students in order by providing them with the necessary competencies.

F: Very important, they could be integrated into many specialties within the umbrella of visual communication design, they would be very useful tools for learning topics such as basics of design, typography, color, perspective, as students will remember the provided information, these technologies would enhance their cognition.

Q10. In your opinion, how important is XR to visual communication design education?

H: I believe it is very important, I cannot fully answer this question as both I and Faten are working on a research proposal sent to our scientific research fund about using AR for different purposes such as education, photography, design for tourism, commercial design, and we decided to focus on the educational aspects, I believe that within the next 5 years XR should be used for visual communication design education as well as applied art education, I believe that we are very late, we should establish theoretical thoughts on how we could these technologies in a suitable way that fits our capabilities, and culture.

F: As Hanan mentioned, we are working on a research proposal related to this subject, although we covered the theoretical part, we have not completed the practical part due to the high cost. I also believe it is very important, we learned from our experience during COVID-19 that we should overcome such challenges as we had to use platforms such as Zoom and Microsoft teams, it would have been very helpful if there was an AR application that provides educational materials, especially for first-year students. Within my research for my PhD degree, I mentioned using AR as a tool for wayfinding that could be used for many purposes including tourism, therefore, I believe that using visual communication to teach visual communication would be very beneficial.

Q11. Do you think that visual communication designers should learn about programming and coding to create for VR?

H: Not necessarily, but they should be acquired with basic knowledge as the world is moving towards using interdisciplinary disciplines, however, learning about programming and coding requires a lot of time and effort, I believe that design students should learn about their discipline and work within a larger team that include

programming specialists, although it would be an added value, it depends on their specializations, capabilities, and interests.

F: Having background knowledge would be preferable, but it is not necessary, students should be provided with basic knowledge.

Q.12. In your opinion, how could we integrate XR into visual communication design education?

F: We need more research to answer this question, but I believe that could be necessary for some design disciplines, however, they could be included as elective courses.

Appendix L

Date: May 7, 2022

Name: Julie Mader-Meersman

Years of experience: 23

Current position: Professor, Visual Communication Design, School of the Arts,
Northern Kentucky University

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

I have used games at different times throughout my teaching career (minimally) for the purposes of engaging students and facilitating their learning.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Using games in the studio classroom can help to keep the spirit of the learning environment light and loose, which are helpful conditions for creativity and problem-solving.

Q3. Have you considered using games for visual communication design education?

I find game-based thinking and tools can be useful to teach about and facilitate a healthy and engaging design process.

Q4. Have you ever used XR (VR, AR, and MR)?

Yes, I've used VR, AR, and MR.

Q5. If you used VR, what purpose did you use it for?

I've only used VR minimally for personal entertainment.

Q6. What is your perspective on using VR for education?

I think VR could be used meaningfully for many educational needs that benefit from simulation. I can imagine that it has other meaningful uses, but I have limited experience in VR.

Q7. Have you used XR within your classroom?

Yes. I have primarily used AR in my classrooms to serve as case studies about digitally-based experiences, and in reference to media experimentation. This includes the presentation and study of various apps with sophisticated informational and/or emotional experiences, strong visual UI and UX, and media novelty. Examples of projects we've studied are: the Get London Reading app by Kent Lyons; Anne's Amsterdam by Triple IT; the book and app, "Fantastic Flying Books of Morris Lessmore" by Moonbot Studios; Amarynth Borsuk and Brad Brouse's digital pop-up book entitled, "Between Page and Screen;" and AR-based signage systems, to name a few.

I've also introduced discussions of tools that can be used to produce design-based AR products, such as Processing, BlippAR, and Spark, as well as the AR-based production tool called ClipDrop that uses a device camera to grab images of objects from your real environment to be dropped into design files as isolated objects with clipping paths. In terms of creative production, my students have created design ideas

that make use of AR concepts, incorporating visualizations of their ideas into mock-ups and prototypes.

Q8. Have you used XR for design purposes or projects?

Yes. I conceptualized and designed an app called “The Book Worm Tales” that makes use of MR by integrating the camera function of a smartphone into portions of photographic images experienced within the app. The app is a self-authored, digital artist’s book (not a client-based project), which allowed for a high degree of experimentation with the concept and the media approach. It’s a digital publication in three volumes inspired by the observation of worm holes inside of a 1632 Shakespeare edition in the special collections of the Cincinnati Public Library. Each volume is a photographically-based visual experience where the person using the app “tunnels” through a sequence of micro-photographs of the pages of three real-life rare books: the aforementioned Shakespeare, a common Vulgate bible from c.1400 (from the collection of the Blegen Library, University of Cincinnati), and a copy of Bilz Das Neue Naturheilverfahren from 1894 at the Lloyd Library & Museum (Cincinnati, Ohio). The design has the user pan and tap through a series of screens, deploying the camera at the end of each image sequence, which takes the journey through the historic book into the user’s own, lived space.

Q9. In your opinion, how important is XR to visual communication design profession?

I think XR continues to be important in expanding the ways that we think about how to engage people, and in imagining what digital experiences can be.

Q10. In your opinion, how important is XR to visual communication design education?

This is identical to the answer directly above.

Q11. Do you think that visual communication designers should learn about programming and coding to create for VR?

Given the expanding range of no-code tools, it's possible to design for and create VR experiences without knowing how to code. I don't have personal experience with VR coding; however, if it's anything like no-code tools for web design and development, such as WebFlow, the more experience and understanding a person has with how code works by itself, the easier it is to create with the no-code tools. Knowing the coding languages can significantly reduce the amount of time in the learning curve.

Q.12. In your opinion, how could we integrate XR into visual communication design education?

XR can be integrated into visual communication design education in many ways. I believe it should primarily be considered for its ability to demonstrate a nearly limitless range of ideas for how to connect people with one another, with subjects and information, and with their environment/world. Successful examples can be used in research as case studies for students to consider when ideating and when considering form. It also offers learning opportunities about media and production workflows, expanding students' technical knowledge.

Appendix M

Date: April 06, 2022

Name: Moutaz Al-Husseini

Years of experience: 12

Current position: 3D & Motion designer

Other details: Animator, instructor, Unreal Engine Community Manager - Jordan at Epic Games, experience in VR, AR, and Unreal Engine.

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

In my opinion, gamification is a great and positive approach to any learning experience, I have done many projects during the period of COVID-19 such as interactive experiences for both school and university students by turning written books into VR or regular 3D experiences, the learning outcomes were very positive, students could easily learn about concepts such as solar and lunar eclipses, these concepts were hard for me to understand when I was a kid, but it was very easy for them to understand, therefore, I believe using games and interactive experiences provided with educational consultation will be very good for visual communication design.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Of course, to be honest, visual communication design has a very important part of the game design whether it was an educational game or any game, any game created

without a solid design, UI, UX, will not be that successful, it is essential for designers to play games and understand the way they work to create for them to provide gamers' needs, most of the current games UI designers has visual communication background, I believe it will be very inspiring for them.

Q2. Have you ever used XR (VR, AR, and MR)?

Of course, the three of them.

Q3. If you used VR, what purpose did you use it for?

I used VR for business purposes.

Q4. What is your perspective on using VR for education?

I believe it is a very important tool for education, during COVID-19, most of the students had a bad learning experience while using video conferencing applications, we needed VR as students could've learned things by doing or creating something within the virtual worlds.

Q5. Have you used XR within your classroom?

We are still doing some experiments and research on MR using HoloLens for education, we used VR at Al-Zaytoonah University of Jordan for both multimedia and architecture disciplines; students created 3D environments using Unreal Engine, or by using Autocad, RiVid, or 3ds Max and exporting their creations to Unreal Engine, to be viewed in VR using Oculus Rift S as fully immersive experiences.

Q6. Have you used XR for design purposes or projects?

I mentioned using AR for educational purposes, additionally, I recently created an immersive mixed reality video using Unreal Engine for TV weather broadcast by “mixing” the broadcaster into a 3D environment.

Q7. In your opinion, how important is XR to visual communication design profession?

I heard that you did the first educational game for visual communication design when you visited at Al-Zaytoonah University of Jordan, I believe we both are walking on the same path as these technologies are very important to visual communication design, there is a saying or idiom in Arabic: “The carpenter’s door is always broken”; visual communication design is a creative profession so it should’ve had a VR experience a long time ago!

Q8. In your opinion, how important is XR to visual communication design education?

Graphic design has been always considered as creating designs for 2D, but lately, graphic design added digital media such as UI and UX, so I believe XR will be very essential for visual communication design education, as I said before, VR without a well-designed UI would be very bad; menus in VR should be easy to see and interact with, colors should be used in thoughtful consideration, as well as the 3D environment itself, so basically, UI design is a fundamental aspect of VR, graphic design is the origin of most of the new disciplines such 3D animation and VR gaming, most of these disciplines include computer science as well as UI design, I was a

project manager for many projects such as game development, during my work experience, I have dealt with designers, 3D modelers, and developers, most of the developers did not have a design background so the design aspect was always essential, have you played a game called Dead Space?

Author: Yes, I did!

I believe that this game included a revolutionary design for interactive UI, I think it was awarded “The best UI design” as well as “The game of the year”, so basically, this is a solid proof that UI or graphic design is a very important aspect for game and VR development.

Moreover, Autodesk introduced their UI builder; it’s a graphic design tool where you can create menus for games or experiences, without having a background in graphic design no one would be able to create a proper UI to be used for these projects.

Within Unreal Engine, there’s a UI tool called UMG; creators could export their creations from other programs such as Adobe Photoshop or Illustrator to this tool to be used or edited in VR environments.

Q9. Do you think that visual communication designers should learn about programming and coding to create for VR?

Unreal Engine has been working on 3D and game design for non-developers, using a visual scripting tool called Blueprint, it is a simplified scripting tool for non-developers, there are many other tools and templates that they also could use to create VR, MR, or AR.

Author: so basically, it is a logic tool.

Exactly, most of the functions are already placed within the tools so users do not have to write their functions but users should place them well, it could be used within the interactive design, UMG, as well as the Material editor.

Author: do other engines such as Unity include a similar tool?

I think Unity included a plugin visual scripting tool, I am not sure, I am not too familiar with Unity or how dependable this tool is, but using Unreal Engine 5 you can create your projects without writing a single line of code.

Q.10. In your opinion, how could we integrate XR into visual communication design education?

I have a graphic design student in my VR class, he did not have any background in 3D design or coding, so I had to teach him almost everything from scratch but I did not teach him about coding, to be more specific, before learning about creating for VR, students should learn about 3D space using any 3D program, VR will always need 3D designer to create the 3D environments, game developers, and UI as well as UX designers, so to conclude it, visual communication design is an essential part of XR development.

Appendix N

Date: April 08, 2022

Name: Amer Sawalha

Years of experience: 3 years in architecture, 4 years in VR.

Current position: Managing director, and VR developer for Titan visualization.

Other details: Trainer for software such as 3Ds Max, Photoshop, V-Ray, as well as many other programs.

Q1. What is your perspective on using games (educational games, serious games, and game-based learning), for visual communication design education?

I believe gaming has immersive power; information could be easily understood by students using games.

Q2. Do you think that using games for visual communication design provides a positive learning experience and an inspiring atmosphere in the classroom?

Of course, VR has very impressive power, especially as they include many sensors such as visual, haptic, and hearing sensors, they could be used as 360 experience or 3D experiences, these educational games could include multiple choice answers or right/wrong answers, other students could watch the experience and learn from his or her mistakes.

Q3. Have you ever used XR (VR, AR, and MR)?

I used VR and AR

Q4. If you used VR, what purpose did you use it for?

I used them for business purposes, we create VR experiences to show our clients architecture design suggestions, so they could see them before being implemented.

Q6. What is your perspective on using VR for education?

It is a very good tool, they require professional academics with knowledge of VR so they could control the experience, it is the best way possible to teach this new generation, there is a saying “Tell me, and I will not forget, show me and I may remember, but involve me, and I will understand”

Q7. Have you used XR for design purposes or projects?

Aside from VR, I created an AR application for architecture purposes, as well as many other projects using 3Ds Max and Unreal Engine.

Q9. In your opinion, how important is XR to visual communication design profession?

I believe so, there are many applications for VR in graphic design, but I don't think that graphic design made the best use of VR yet, but I believe NFTs will take it to a whole new level, I am not sure how VR and AR could be used for graphic design but I believe they could be used for advertising purposes such as exhibitions, interactive motion graphics, or artwork presentations. Furthermore, visual communication designers could use Unreal Engine's built-in UI system; Unreal Motion Graphics (UMG) to create visually appealing interfaces or UIs, so they will work within 3D space, which would be an added value to them.

Q10. In your opinion, how important is XR to visual communication design education?

Very important for everyone, and they are rapidly being developed and expanded, again, they are very immersive, but the most important thing is the educational material itself, not the equipment, all of these technologies are equally important, for example, MR in South Korea is being rapidly developed.

Q11. Do you think that visual communication designers should learn about programming and coding to create for VR?

From my experience of VR, they should have some programming knowledge to use blueprints within Unreal Engine to make logic, special effects, motion, or animation, when I first started creating for VR, as an architecture, I needed to learn about programming language such as C++ to learn more about blueprints and it was not easy, although users could create basic experiences or UIs using blueprints, if you want to create a professional game such as Half-Life Alyx you will need a team, I believe VR creation will become easier at some point as Metaverse was recently announced so people need more user-friendly tools to create for it.

Q.12. In your opinion, how could we integrate XR into visual communication design education?

I believe they could be integrated using interactive educational games, especially VR as it is a very powerful tool, imagine using Teslasuit; a full-body suit that provides haptic feedback, or other tools such as haptic gloves, it would be phenomenal.

