An Overview of How VR/AR Applications Assist Specialists in Developing Better Consumer Behavior and Can Revolutionize Our Life

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Abstract Augmented reality (AR) and virtual reality (VR) have become the presence of daily life. We draw on outstanding research to substantiate that VR/AR are scientific tools that can be integrated in many fields of research, in learning, in marketing campaigns and product design, in psychology, medicine, economy, etc., meeting the principles of circular economy at the same time. Due to the fulminant evolution of communication and interconnected modern devices, VR/AR are more and more present in every business, in every research field. VR/AR facilitate the implementation of simulations and experiments under a safe environment, avoiding possible damages and spending money on expensive technologies. Our study, using references on VR and AR applied in current activities and different fields of business, shows what the current state of knowledge in the field is and opens interesting perspectives regarding the impact of VR and AR on the future market and research, building an interdisciplinary bridge between technology and learning, psychology, medicine, economy (marketing, tourism, and industry). The context in which these technologies will be developed must be seen not only from the perspective of a particular field, but especially as a concrete impact on humans.

Keywords VR · AR · Real life · Psychology · Medicine · Economy · Consumer behavior

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Introduction

Advances in technology, such as the Internet of things (IoT), augmented reality (AR), virtual reality (VR), mixed reality (MR), or artificial intelligence (AI), bring significant value to many fields today (education, economics, medicine, architecture, etc.) but also improve our daily lives. These technologies are already attractive to most people, from vocational training to personal development as a way to improve reality.

VR is a computer-generated experience taking place within a simulated environment that provides auditory, visual and sensory feedback, simulating a real-world event/place and offering the possibility of experimenting fantastical environments or finding innovative future applications in different fields. AR overlaps the physical environment of a person with digital images usually generated by a mobile device. On the other hand, VR is an immersive reality technology that involves wearing a headset that creates a 360° simulation that places the user in a digital environment. AR offers the ability to view three-dimensional images due to a live camera feed into a headset or through a smartphone or tablet device (Bucea-Manea-Ţoniş, Pistol, & Gurgu, 2019). VR uses headsets or multi-projected environments, and the person using virtual reality equipment is able to interact with virtual features or items. Furthermore, VR is frequently immersed in entertainment, scientific research, social networks, artistic creation, and psychotherapy. In art therapy, VR is used for three-dimensional painting, an immersive creative experience, dynamic scaling, and embodied expression, due to its characteristics, such as presence, immersivity, point of view, and perspective (Hacmun, Regev, & Salomon, 2018).

On the other hand, AR was defined as augmenting natural feedback to the operator with simulated cues, being a form of virtual reality where the participant's head-mounted display is transparent, allowing a clear view of the real world (Milgram, Takemura, Utsumi, & Kishino, 1995). Now, MR represents an AR+ that places objects or creatures just like AR, but with an ability to engage in the real, physical world around them and vice versa. Most likely, they will evolve in mobile AR and location-based VR. These technologies offer new methods and tools for environment protection, increasing the online traffic, reducing the footprint of carbon dioxide, air and soil pollution. 3D game engines are used for environmental research allowing system multimodal interaction, gesture capturing, and voice input. The participants (Kefi, Hoang, Richard, & Verhulst, 2018) prefer voice command for best performance. Taking into account the amount in which they will be produced in the next few years, it is necessary to evaluate their impact over the environment, in the context of different usage patterns. Virtual technologies should be an integral part of the circular economy. Furthermore, the relationship between economy/industry and education has been a pillar of creativity regarding evolutionary technologies as shown in the model of innovation and creativity exchange between universities and the business field (Englund, Olofsson, & Price, 2017). The interaction with the business field is crucial, because it comes with the technology (e.g., VR, AR, halo effects) that offers students and specialists a certain environment and tools for exploration and re-creation of the world. Modern students are coming to classes in order experience interactive and experimental learning through bending reality, not just for listening. The interaction with the business field is crucial, because it comes with the technology (VR/AR, halo effects) that offers students and specialists the environment and tools for exploration and re-creation of the world. These technologies have been adopted even in real-life activities (Akçayır & Akçayır, 2017; Alexander, Westhoven, & Conradi, 2017).

Virtual technologies are clear, strong tendencies for the communication and education of the future. The advantages are obvious and positive, both for the individual and for society as a whole. Despite some studies showing a possible negative impact on humans (Garrett et al., 2018; Klempous, Kluwak, Idzikowski, Nowobilski, & Zamojski, 2017; Plechawska-Wojcik & Semeniuk, 2018; Ribeiro, Martins, & Garcia, 2019; Stepanova, Quesnel, & Riecke, 2018; Zaidi, Duthie, Carr, & Abd El Maksoud, 2018), these technologies are part of our lives and will continue to develop and become ever more present. In the age of technology, imagination, innovation, inspiration is the only limits of human growth. This overview shows the extent to which virtual technologies can help specialists in improving but also in revolutionizing their lives, in the context of a better consumer behavior.

VR and AR Immersion in Real Life

The study is limited to the research results regarding the application of VR technology in the field of science and academics, which is their trend, and if they can be widely applied in education. This is a comparatively short period for academic research, meant to show the increase in the importance of VR/AR in recent years and not an exhaustive study. Also, besides VR/AR applied in current activities and different fields of education and business, we show if these technologies can affect human health.

VR and AR are becoming more and more popular, offering unlimited possibilities to improve computer applications in education, using this technology (Bucea-Manea-Ţoniş et al., 2019):

- VR is associated with the feeling of being transported effectively to a new event or place, and this feature is called presence.
- A pleasant and intense presence is associated with the user's tactile response when immersed in VR, this phenomenon being called haptic.
- Users can more easily focus on a VR experience if they use an head-mounted display (HMD).
- For an intense and interesting experience, the manager must add interactivity in VR.

- The VR experience can be enhanced with 360° videos, even without wearing a VR headset, allowing customers to see everything around using a mouse, trackpad or moving their physical phone.
- Adding the fourth dimension to a VR adventure is another way to enhance the experience—4D VR.
- Adding the stereoscopic effect, capturing two photographs/videos at slightly different angles and looking deeply if viewed together.
- Creating a 360° experience using many cameras.
- Moving pictures and videos at the same time as users' positions in the head or eyes.
- Maximizing the "field of view," extending as far as possible the VR experience, to get closer to the 360° view.
- Confuse the interval between a VR stimulus and a response.
- It creates confusion when a person receives visual cues of a movement, without being physically registered.

VR/AR are frequently used for collaboration and for sharing knowledge between different scientists, helping them to discover and develop new brain comprehensive models with clinical dimension empowered by computer science, engineering, and allied sciences (Cipresso, Giglioli, Raya, & Riva, 2018). The therapist can explore a wide variety of controlled stimuli and measure the participants' responses based on which they may suggest a therapeutic solution. VR offers the illusion of a parallel life for the participants, of a different body, experiencing new activities in different places than the ones where they really are: white people embodied in dark-skinned virtual bodies diminish the racial bias; offender males embodied in women bodies (victims) changed perspectives on domestic violence; adults embodied in a child body play more, etc. (Barberia, Oliva, Bourdin, & Slater, 2018; Bergstrom, Papiotis, Saldanha, Azevedo, & Slater, 2017; Hasler, Spanlang, & Slater, 2017; Seinfeld et al., 2018; Skarbez, Neyret, Brooks, Slater, & Whitton, 2017). Furthermore, the interaction between neuroscientists and engineers led to the development of hands with contactless devices (i.e., without gloves), the leap motion device, tactile and haptic device, the motion tracking system, and the concept of "sonoception." These newly developed devices allow almost natural interaction with virtual environments (VE) and an increased sense of presence (Azevedo et al., 2017; Di Lernia, Cipresso, Pedroli, & Riva, 2018a; Di Lernia et al., 2018b; Riva, Wiederhold, & Mantovani, 2018). VE technology is used to expose individuals to live information in an experiential learning game, in which participants use water for different tasks. Participants received exaggerated feedback to intensify the negative consequences of water consumption and/or environmental damage that emphasized personal affective responses (Hsu, Tseng, & Kang, 2018). Furthermore, VR is frequently immersed in entertainment, scientific research, social networks, artistic creation, and psychotherapy. In art therapy, VR is used for 3D painting, a deeply engaging creative experience, dynamic scaling, and embodied expression, due to its characteristics, such as presence, immersivity, point of view, and perspective (Hacmun et al., 2018). Also, the 3D games engines are used for environmental research allowing system multimodal interaction, gesture capturing, and voice input. For best performance (Kefi et al., 2018; Schmidt, Beck, Glaser, & Schmidt, 2017), participants prefer voice command.

Immersive virtual environment technology is now used in Taiwan to expose individuals to live information in an experiential learning game, in which participants were situated in a virtual bathroom and asked to repeatedly use a 600-ml bottle to fill a specific water tank for washing tasks. Participants received exaggerated feedback to intensify the negative consequences of water consumption and/or environmental damage that emphasized personal affective responses. The game has caused significant changes in cognition and behavior intention for Taiwan' residents, helping the water conservation. These experiences can be reproduced in other countries characterized of water shortages (Hsu et al., 2018).

These technologies bring interactivity, dynamics, learning by doing effect, testing in a virtual safe environment, 3D visualization, experimenting new sensations (e.g., flying imponderability), in a safe mode. Most of all the subjects of VR experiences declared that they were having fun when testing it and had the feeling of mindfulness, freedom, and higher curiosity.

VR and AR—A Bright Future in Psychology and Medicine

In psychology, VR tools help the specialists analyze where experiment subjects consider that their bodies are located (e.g., in one or more specific part(s) of their body), due to the perception and self-consciousness. The VR headset showed that subjects mainly located themselves in the upper face and upper torso (Van der Veer, Alsmith, Longo, Wong, & Mohler, 2018). VR is also used for analyzing crowd behavior in order to avoid collision risk in pedestrian traffic and mass events (Meerhoff, Bruneau, Vu, Olivier, & Pettre, 2018).

Moreover, VR technology and social robotics were designed to help children with autism disorder. The system integrates a virtual teacher instructing sight words and included a humanoid robot emulating a peer. The results were very good: 100% of the words were acquired, maintained, and generalized by participants. It improved the operator's reaction time, awareness, hit-rate, and performance (Oyekan et al., 2019; Saadatzi, Pennington, Welch, & Graham, 2018; Tang, Webb, & Thrower, 2019). Commercially, VR and video games are used as active distraction methods to mitigate subjective discomfort, increasing pain tolerance (Boylan, Kirwan, & Rooney, 2018; Erra, 2019). A VR scenario was created in order to asses and treat people experiencing paranoia in social situations (Riches et al., 2018).

Very similar with psychology, in medicine, the VR therapy gained notoriety in clinical conditions such as anxiety disorders (most of the studies), eating disorders, addictions, phobias, stroke rehabilitation, posttraumatic stress disorder, pediatric cancer-related treatment, hemodynamic in cerebral aneurysms, and for pain management, autism, depression, psychosis, schizophrenia although there are negative aspects, too.

As Tsai et al. (2018) demonstrated, the VR/AR therapies are very efficient in claustrophobia: In VR environment, the participant's heart rates variability (HRV) is significantly better. In the therapy of mental illness, VR/AR are also recognized as effective intervention and care therapy (Wiederhold, Miller, & Wiederhold, 2018). Thus, technologies such as VR/AR and brain–computer interfaces (BCI) can be successfully used as therapy for auditory verbal hallucination (AVH) in patients with schizophrenia (Fernandez-Caballero et al., 2017). Oculus rift head-mounted-display is a potentially powerful tool for a wide array of basic research and clinical applications (Chessa, Maiello, Borsari, & Bex, 2019; Liu et al., 2018). Other studies in hemodynamics had successful results in cerebral aneurysms magnetic resonance imaging (4D pcMRI) immersed in AR environment (Karmonik et al., 2018). Introducing serial section immunological original 3D model viewing and annotation in VR was a major breakthrough in quality control (Steiniger, Wilhelmi, Berthold, Guthe, & Lobachev, 2018). Nowadays, VR offers viable software for testing the effect of acute static stretching (ASS) on the lower limb reaction time. ASS decreases the risk of falling and injuries in situations requiring a rapid reaction (Ameer & Muaidi, 2018; Schuster-Amft et al., 2018). Additionally, physiotherapy is one of the forms of healthcare for which VR/AR have many advantages, especially in terms of monitoring and analysis of muscle activity and patient movements. Postolache (2017) indicates a set of technologies that can detect and monitor from a distance the rehabilitation of upper and lower limbs: sensors based on microwave Doppler radar and infrared technologies (e.g., infrared LED, laser, and thermograph). Likewise, the vestibular otolithic disorders can be rehabilitated through Curator subjective visual vertical (SVV) assessments that allow the ability to perceive verticality. It can be used in clinical contexts, such as at the bedside or in head and body positions (Martelli, Xia, Prado, & Agrawal, 2019; Chiarovano, McGarvie, Szmulewicz, & MacDougall, 2018). VR was also the proposed solution for rehabilitation of lateropulsion patients (Tsatsis et al., 2017), and in surgical medical practice, and professional education (Yu, Lee, & Luo, 2018a, 2018b). There are studies that debate hand grasps identification in VR due to signals acquired by FMG (force myography), a muscular hand gesture recognition method, and also by leap motion (Jiang, Xiao, & Menon, 2018; Van Dam & Stephens, 2018). These technologies support therapies and should become a current part of present and future medicine. Although there is now a tendency to increase the number of publications regarding the impact of virtual technologies in medicine, studies show that they are rather used in investigations—computer-assisted surgery, three-dimensional imaging, and computed X-ray tomography, and less in therapy, showing a clear trend in technologies assisting the actual treatment of patients, compared to technologies in a training environment (Eckert, Volmerg, Friedrich, & Christoph, 2019).

In veterinary medicine, VR and AR can be used for teaching anatomy (Seo et al., 2018), and surgical planning (Xu et al., 2018). As well, one of the VR technologies with a good applicability in veterinary medical training is the haptic simulator, a combination of haptic feedback to palm and fingers, and a visual digital simulation of the anatomical structures, while AR technologies are helpful to clinicians in viewing complex data from 3D scanning (Son & Park, 2018).

VR/AR Will Undoubtedly Have a Major Impact on the Economy

The efficiency of these technologies should not be seen only as an impact on the individual; in short, individuals live in a society and carry out an activity. In the economy, VR technologies bring benefit in the management of urban facilities. In this regard, Google Tango software tracks the life cycle of the underground infrastructure and gets exact location and orientation in just a few minutes without using additional markers or hardware (Gregorio, Ortega, & Feito, 2018). Similarly, in domestic and industrial robotics, as well as autonomous vehicles, VR facilitates simultaneous localization and mapping (SLAM). The latter allows selecting and configuring the appropriate algorithm, hardware, and compilation path to meet performance, precision, and power goals (Saeedi et al., 2018). Likewise, VR is very useful in electro-energetic industrial plants in order to track virtualization at work through an AR system for mobile devices, as a tool for protecting health and safety, as well as to secure performance of tasks in a technological process (Tatic, 2018), which shows the impact of these technologies both in industry and medicine at the same time.

In construction, architecture for example, these technologies are also beginning to find their place. VR brings key advantages for indoor simulations like room acoustics. During processing a dynamic scene, it is easier to obtain a visual rendering, but much more difficult to get high-quality audio rendering, because sound waves propagate substantially slower than light. Through VR has been introduced a hierarchical state-based data structure with time history, which fulfills the requirements for outdoor auralizations and for indoor simulations (Wefers & Vorlaender, 2018). VR technology is also used with success in archaeoacoustics for reconstruction of the historical sound inside heritage buildings, in order to characterize the sound of the past inside that building by using virtual sound reconstruction. A test had been done in Islamic temples—West the Aljama Mosque of Cordoba, where the original state of the Mosque has been reconstructed in the different spatial configurations throughout its history from the eighth to the tenth century (Suarez, Alonso, & Sendra, 2018). In addition, the interactive system based on VR provides users with a real-world experience in the development of open architecture products. The system allows users to review a product design by operating and evaluating the product in VR, by recording user operations and sending feedback to designers to improve the product (Song, Chen, Peng, Zhang, & Gu, 2018). The maintenance of complex products can save substantial costs and reduce incidents and accidents throughout the life cycle of the products and therefore should be fully considered in the early design stages.

Nowadays, innovative products are the result of an open communication between client and producers. Thus, VR/AR are an extraordinary tool for product maintainability design through immersive and non-immersive simulations. The method of virtual maintenance integrates human motion data from simulations, diminishing the problems regarding cumbersome operation, time-consuming labor, and inadequate precision that arise in complicated and repeated operations (Geng et al., 2018). A manual in AR compliance to Industry 4.0 principles was designed (Gattullo et al.,

2019) as innovative productivity increases accordingly with the principles of circular economy. A multi-user design review experience in which all designers, engineers, and end-users actively cooperate within the interactive VR with their own head-mounted display, seems more suited to detect relevant errors than standard systems characterized by mixed usage of assets (Rigutti et al., 2018). The maintenance of complex products can save substantial costs and reduce incidents and accidents throughout the life cycle of the product and should be fully considered in the early design stages. In the virtual environment, the user can have intuitive feelings and can interact with virtual objects, which offers unlimited possibilities of immersive simulations for collecting and analyzing the state of maintenance. A case study that applies immersive maintainability verification and evaluation system (IMVES) in an aero-motor project is presented to demonstrate the system's effectiveness and feasibility (Guo et al., 2018).

In marketing, VR experience has to be accepted as a lasting change to consumer behavior (Verhulst, Normand, Lombart, Sugimoto, & Moreau, 2018). Moreover, organizations have to be in permanent contact with customers to evaluate the function and performance of the product (Gârdan et al., 2018). VR and AR dedicated to future personalized learning systems.

VR and AR Dedicated to Future Personalized Learning Systems

Nowadays, students must be seen by universities as consumer of knowledge, because knowledge brings value added to economic system and will have a returning positive impact on the universities that offer the most performant specialist to the market.

Millennials cannot be caught up in the old educational system. They learn by experimenting, by creating their own 3D virtual reality, by bending reality. Some studies analyze how children collaborated to create their own stories in a 3D VR environment (Lin & Hsu, 2017; Schmidt et al., 2017; Yeh, Lan, & Lin, 2018). Various studies reveal the fields in which students consider VR/AR a useful tool for sharing and comprehending knowledge and creates for those who have experimented a strong sense of perception, involving the students in the activity, and motivating them in the future: *Mathematics and Natural Sciences* for simulation and testing, *Social sciences* to enrich the students environment with a simulated reality, *Economic sciences* for simulations, *Technical sciences* for developing models/blueprints, *Humanistic sciences* to achieve specific environment in accordance with the taught theme, *Arts and architecture* for models/blueprints, *Medicine,* for the study of anatomy and dissections, for simulating laser operations (Detyna & Kadiri, 2019; Kharitonova, Kharitonova, & Pulyaeva, 2019; Zhihan, Xiaoming, & Wenbin, 2017). Virtual reality technologies bring benefits in the teaching process and can be a useful tool in creating innovative and educational experiences, and helping students to improve their skills and knowledge (Ardiny & Khanmirza, 2018; Mikolajczyk, 2019).

According to Mekacher (2019), the virtual environment allows us to develop the ability to interact and experiment, in a similar way to the real world. Through visualization, the AR-Glass offers additional virtual information that, inserted in a context and with objects associated with cognitive and psycho-physiological objectives, and pedagogical strategies oriented to the teaching objectives, allows the application of these technologies in different areas of education. VR is often used in learning for ludic activities (e.g., gamification), comprehension, and conceptualization. VR/AR engagement in learning is associated with a high degree of motivation, creativity, and innovation in students. From a neurological perspective, AR doubles the visual attention in the brain. AR experiences have a very high rate (70%) of encoding into memory (Fombona, Pascual-Sevillano, & Gonzalez-Videgaray, 2017). Additionally, e-learning comes to support the balance between lucrative, learning, and social life (Sousa & Rocha, 2019). VR/AR facilitate better comprehension of studied material, due to 3D visualization, interactiveness, clarity, and learning by doing effect (Sousa & Rocha, 2019). Professional career is enhanced by the knowledge acquired through the e-learning method, exercised during the spare time, offering a work-life balance (Encalada & Sequera, 2017; Mumtaz et al., 2017; Yip, Wong, Yick, Chan, & Wong, 2019). Although the use of virtual platforms requires digital education for teachers, studies have shown that they are able to accomplish the tasks with 37–64% less user operations, and up to 72% less machine operations (Horvath, 2018). Fernandez (2017) proposes a six-step methodology to aid adoption of these technologies in education: “training teachers; developing conceptual prototypes; teamwork involving the teacher, a technical programmer, and an educational architect; and producing the experience, which then provides results in the subsequent two phases, wherein teachers are trained to apply augmented and virtual reality solutions within their teaching methodology using an available subject-specific experience and then finally implementing the use of the experience in a regular subject with students.” This proposal can be solution for including VR technologies in education.

Other studies converge in the same direction: a study conducted by the Open University of Catalonia shows that collaborative skills are developed by gamification, MR, and social media, having a much more positive impact than other Information and Communication Technology (ICT) tools (media, wikis, open educational resources, cloud for sharing files with peers, etc.) (Martinez-Cerda, Torrent-Sellens, & Gonzalez, 2018). Similar studies conducted in the Middle East University show that VR allows students to discover and explore their own knowledge, making learning more interesting and fun (Alfalah, 2018; Voinescu & David, 2019). Other authors identified and taxonomized the elements and the factors that affect learner engagement in virtual worlds, when hybrid virtual learning models are used. This method mitigated the drawbacks of each educational approach and broadened the network of interactions (Christopoulos, Conrad, & Shukla, 2018). Modern students prefer collaborative learning and to be placed in contextual environments, through VR and halo effects, while taking social interactions. Thus, they are “projected in time, in the era of study” (Alonso, Prieto, García, & Corchado, 2018). It is naturally somewhat for these generations to look for and to find in their future work/activities such applications.

Applications such as Nearpod VR or AVR creator EON (developed by the Technical University of Graz) and Social Internet of Things (SIoT) allow virtual interaction on Facebook. SIoT allows teams to interact in VR and AR with real-world objects through 360° selfie video in order to develop projects together. It also allows realistic 3D student–teacher interaction in the virtual world, making available to the student/teacher VR/AR libraries or the analytical database. In this way, the teacher can grant mixed feedback through the AR application (Fig. 1).

Nowadays, activities in every field become more digital, due to the 5G, cloud computing, and VR revolution. These technologies change the way we work and interact, which is likely to create new opportunities, but also challenges. Some jobs are assimilated and done by computers, but other new digital jobs arise into the new circular and virtual economy. Digital competencies are essential for current and future employees. Lately, high-skilled qualifications and labor have increased. Overall, although VR and AR technologies already exist, they are not adopted in most of the universities or companies because teachers, students or workers aren't qualified to use digital technologies, companies are naturally much more likely to use them (Andrews, Nicoletti, & Timiliotis, 2018). Here comes the university key-role

Fig. 1 VR and AR immersed in education process (www 1–6)

in adopting new approaches, adding new programs, changing curricula, including data literacy, designing new courses, using the most advanced technologies and creating new learning environments dedicated to research and education as to prepare specialist able to face current and future challenges. The physical learning environment has to be improved with environments for problem-based learning and learning by doing activities for interdisciplinary teams, that use blended learning. Students from different fields such as computer science and social sciences can be brought in the same team to solve problems due to cross-fertilization knowledge (an example on how digital skills promote entrepreneurial and management skills). These specialists will shape the digitally transformed society, that have already started to be present (cyber-marketing is more efficient and more convenient than classic publicity in newspaper and TV, online transactions, distance learning, e-commerce, etc.). For students with digital competences will be fun to use it in their future work and thus the economy will benefit on it, the more so as are in accordance with the green and circular economy principles.

As a practical solution, we recommend a symbioze between universities and VR/AR software development companies. The universities should be able to rethink a new strategic management regarding the request of digital competencies and implement it in the education process. The VR/AR software development companies have the role to develop new VR/AR applications, dedicated to different type of course, to be taught in the university.

The complexity of user data that can be produced or recorded in VR experiences is the main advantage that universities must benefit. It does not really matter whether such information is gathered for user testing/playtesting, for scientific or clinical inquiries or as an outcome measure for training or educational VR/AR applications—fact is that VR/AR applications can produce rich datasets of significant value for the modern student. The immersion of VR/AR technology in education "brings the advantage of covering multiple intelligences, it facilitates the observation and exploration, it drives to consolidation performance and achievement, experimental self-learning, increases motivation and interactivity between students, in contrast to the traditional educational style that present the content in a two-dimensional format. AR learning involves many senses: seeing, touching, hearing, and smelling (Takkaç Tulgar, 2019)." Thus, VR/AR technologies would increase the innovation and would represent a solution to OECD concern regarding the Europe's sovereignty, that will no longer be dependent by American or Chinese technology.

The university has also the role of informing the students regarding new opportunities arising in the labor market based on ICT facilities beyond the walls of higher education institutions. They also have to emphasize the importance of an ethical behavior when using VR/AR technologies.

Furthermore, the gap in generations could also limit the use of this technology, with the millennial students being more used to technology in everyday life, while the more senior academics could be reticent to change of established practices and methods. Nevertheless, all users and developers should be aware and understand the benefits and disadvantages of these virtual technologies and be able to identify when and where these can be effectively used, with the aim of increased efficiency and quality.

VR/AR Have Positive Factors Leading to Consumer Happiness

Positive psychology has begun to study a new concept: happiness. Happiness can be understood as a function of endogenous factors (biological, cognitive, personality, and ethical subfactors) and exogenous factors (behavioral, sociocultural, economic, geographical, life events, and aesthetic subfactors). According to Farhud, Malmir, and Khanahmadi (2014), biological (endogenous) subfactors were considered significant predictors of happiness. The results showed that genetic factors correspond to efficacy on happiness, mainly associated with emotion and humor (between 35 and 50%). The neuroscience has demonstrated the importance of neurotransmitters (such as dopamine, serotonin, norepinephrine, and endorphine) in the control of happiness, while other studies have defended the role of cortisol and adrenaline (adrenal gland) and oxytocin (pituitary gland) in the control of happiness. These chemicals generate happiness.

In order to briefly explain the role of these chemicals in promoting happiness, a brief concept is presented below: The first one is dopamine, which is the great feeling that favors achieving a goal, and it is turned on when the efforts are rewarded, the result being something like "I have done it!" feeling. On the other hand, it is recommended to be aware that dopamine is addictive; the second is serotonin, which is produced when the individual feels useful, important, belonging to the community; the third is oxytocin, which gives a good feeling, making one feel safe; the final one is endorphin, which is a brief hormone that keeps the goal going, overcoming the physical pain (Breuning, 2012). According to Baixauli Gallego (2017), dopamine was associated with happiness, and serotonin regulates our mood.

Aiming to assess the impact of digital technology on happiness, a survey was developed by Mochón (2018). The scientific approach considered that happiness was measured according to explanatory factors such as well-being, and the benefits were associated with happiness. These benefits were analyzed in terms of: (i) connecting people; (ii) broadening the structure of communities; (iii) crucial intelligence, which allows for evolution in different social dimensions (e.g., health, safety and science); (iv) contentment aiming to empower people to improve; and (v) continuation toward quality. According to the author, technology can have a positive impact on well-being when used well, without excesses.

VR is used with success in tourist consumer behavior. Travel agencies incite human curiosity related to experience new activities, sceneries, and cultures through VR expeditions, offering 360° scenic landscapes, popular museums details, and various attractions. Airline companies invited tourists with nausea and fly sickness to take VR flight experiences. Most of them were likely to try a real flight after the VR experience (Botella, Fernández-Álvarez, Guillén, García-Palacios, & Baños, 2017). A study on students from a technological university in Taiwan reveals that a virtual reality tour-guiding platform is a very useful tool for choosing remarkable tourist experiences. The tourist behavior was analyzed and conceptualized in a technology acceptance model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Chiao, Chen, & Huang, 2018). A study conducted by Marasco, Buonincontri, van Niekerk, Orlowski, and Okumus (2018) investigated whether the perceived visual appeal (PVA) of VR and the emotional involvement (EI) of users had a positive impact on the behavioral intentions to visit a cultural heritage in a destination. The results of the study revealed that this experience had a positive and significant effect on behavioral intentions compared to the site presented in the virtual experience but even more, it had a positive effect on EI (Marasco et al., 2018).

Moreover, an increased degree of satisfaction was noticed for tourists who visit museums that integrate VR experience: Posters were replaced with VR projections and/or videos were inhabited within virtual objects and shaped cross-objects user interfaces (COUIs) (Sun, Zhou, Hansen, Geng, & Li, 2018). Collecting and analyzing data from 36 visitors to a theme park for 12 months suggested that users appreciated their participation through feelings such as control, involvement, vividness, effectiveness, living, temporal association, and the pleasure of the VR experience (Wei, Qi, & Zhang, 2018). An experience that maximizes user satisfaction in the consumption of sports materials is virtual reality spectatorship (VRS). Kim and Ko (2019) show in a study that VRS "*amplified flow experience by vividness, interactivity, and telepresence to the grater extent than the traditional medium* (*2-D screen*)." Moreover, this experience has strongly influenced those less interested in sports compared to fans of extreme sports (Kin & Ko, 2019).

VR is used for evaluating the negative impact of windfarms on tourist behavior. If the tourists use a VR tool to conceptualize windfarms, their perceptions, attitudes, concerns, and behaviors related to it are altered: Their reactions are rather negative than in case of using text or drawings for conceptualization wind turbines (Teisl, Noblet, Corey, & Giudice, 2018). Technical equipment is so much easier to be sold through VR technology, due to the detailed specifications and distance testing.

Leading companies treat their employees from a consumer perspective, being very sensible to their needs and happiness. These companies create spaces dedicated to relaxation, VR/AR environments for meditation when having a work break, kindergartens for employees' kids, team-building events, special medical insurance, gym membership, yoga and pilates hour during work break, etc. Relaxing spaces enable employees to devote a few minutes to relaxation during the day, the kindergartens offer the mental comfort that their kids are safe and happy, can be visited from time to time, during the day. The VR/AR gaming or relaxing applications used for a short period will stimulate adrenaline or oxytocin that has as consequence the employee happiness. The medical insurance and the gym membership make the employees feel that they are important for the company, that their work counts, and become more responsive to company objectives and more responsible in achieving the performance in the tasks' implementation. These companies have been proven to be the most innovative and productive (Fig. 2).

Fig. 2 Space for relaxation during working hours (www 7–10)

Furthermore, nowadays there is an expending trend regarding the positive impact of developing the activity/ the job that a person love, alternating working hours with relaxing breaks, eliminating stress, sleeping well, encouraging competition with themselves, and not with other colleagues, called mindfulness (Vonderlin et al., 2020; Wiencke & Cacace, 2016). This trend is expanding in university activities and research: "loving-kindness meditation (LKM) has been shown to improve well-being and positive emotions in clinical and non-clinical populations" (Totzeck et al., 2020; Van Dam et al., 2018).

Has VR/AR Negative Impacts on Consumer Health?

In the literature, we found concerns regarding the ethics of VR effects on mental health risks. Other concerns refer to the neglect of users' own actual bodies and real physical environments and the use of new technologies affecting personal privacy and manipulation of users' beliefs, emotions, and behaviors.

VR can also blur the distinction between the real and illusory, and it could affect mental health (Klempous et al., 2017; Plechawska-Wojcik & Semeniuk, 2018; Stepanova et al., 2018, Zaidi et al., 2018). Nowadays, the IoT spreads all over the world and brings many advantages, but mobile devices (e.g., cell phones, VR devices) affect children's eyes and their brains absorb substantially higher local radiation doses than adults'. Thus, public education regarding manufacturers' advice to keep phones off the body, and prudent use to limit exposures, particularly to protect the young, are important (Fernandez, de Salles, Sears, Morri, & Davis, 2018; Spiegel, 2018; Teisl et al. 2018). The disadvantages of using VR in therapy are the problems of separating effects of media versus medium, costs, lack of technical standards, and practical in vivo issues (Garrett et al., 2018; Ribeiro et al., 2019). The negative effects associated with VR and AR are cyber-sickness (when eyes and the vestibular system send opposite/disrupted signal—the brain is confused and nausea appears), vertigo effects, derealization/dissociation effect (after removing the VR headset people tend to be detached, using their hand as they would use the controllers and feeling that they are in the virtual world, for another few minutes or hours), strain or fatigue of the eyes (people blink less than normal when using a digital screen device, but this can be compensated by the 20–20–20 rule: every 20 min, shift your eyes to look at an object at least 20 ft away for at least 20 s will be sufficient for long time usage). All these effects have proved to be manifested on short-term (Transon, Verhulst, Normand, Moreau, & Sugimoto, 2017; Vaziri, Liu, Aseeri, & Interrante, 2017; Yu et al., 2018a, 2018b). In any case, the positive impacts of XR overwhelm the negative ones. Even more, if the content of XR experience is positive (e.g., by meditation, holiday experiences, hobby experiences), the impact of XR on human health is positive (Navarro-Haro et al., 2017; Van Kerrebroeck, Brengman, & Willems, 2017).

Conclusions

Together with AI and automation, VR/AR have been attractive for a few years now as types of technology that can have a profound transformation effect on the way people live and work. Modern technology (e.g., VR, AR, IoT, 5G) has enriched innovation in many research and study areas, having as a result new tools, methods, and implementations in fields such as medical or psychological treatment, product design, database management in industrial companies, marketing campaigns, interactive face-to-face or distance learning, and modern design architecture.

Since each coin has two faces, similarly VR/AR have disadvantages, in addition to having many advantages. It depends on how the technology is applied in each sector or field. Therefore, we should mention some of the negative effects of VR/AR on our health, such as VR disease, eye strain, dizziness, distortion, early myopia for children, security breach, no control over personal details, and addiction. Certainly, in our opinion, the benefits outweigh the weaknesses.

Many examples from different fields of study show that VR is increasingly adopted by enterprises and industries for all the value-chain steps, by research centers for deep insights and simulation, by clinics for complex cutting-edge treatments and innovation and more importantly in universities for creating learning VE that stimulates comprehension and learning through experiment, simulation, and innovation, or by common consumers for fun activities. Thus, VR improves our everyday life though the symbiosis of neuroscience, computer engineering, and social sciences. Tracking the evolution of VR/AR influence in sciences, we assume that future research will bring exponential benefits to humanity.

Universities have a responsibility to ensure that graduates have the skills to make use of new technologies, and they need to prepare them for labor markets where the probability of disruption is high, and the companies have to anticipate their future employees' capacities and abilities. Researchers and students can simulate and experiment under the security of VR environment.

Technology provides the tool, but the impact on happiness depends on how it is used. The sensation of being physically present produces enough adrenaline to influence the perception. The sensation of being transported into the event or place associated with the pleasant and intense feeling of the user's tactile response (haptic) and interactivity, results in the production of some hormones associated with happiness. The ability to focus and concentrate can also be developed. It is suggested to diversify the efforts aiming at achieving the best possible impact on happiness. It is expected that the organism produces enough hormones (dopamine, serotonin, oxytocin, and endorphin) to feel happy during learning.

Nevertheless, the future application of this technology is still in its early stages, and while it is desirable for the VR/AR to be more widely used within the education system, it is necessary for the products to be more cost-efficient and adequate training to be provided. Considering the now established eco-friendly trend, it would be also desirable for the devices to be made from recyclable materials, to be easy to use and carry, to have a powerful processing power, and to cut across several applications and scientific fields, like psychology, medicine, economics, or product design.

If VR is expected to be a future staple, universities either through government grants or partnerships with the tech industry could provide valuable research in the development of better technologies and the overall user experience.

Once improved, and technology, cost and scale is achieved, the VR could become integrated in most aspects of our life. Furthermore, VR/AR have the great advantage that is in accordance with the circular economy principles, protecting the environment, reducing the cost (of planning, designing, scraping).

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