Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva / Italian Journal of Health Education, Sports and Inclusive Didactics - Anno 6 n. 4 - ISSN 2532-3296 ISBN 978-88-6022-456-9 - ottobre - dicembre 2022 - CC BY-NC-ND 3.0 IT-

MAXIMISING ACCESSIBILITY IN MUSEUM EDUCATION THROUGH VIRTUAL REALITY: AN INCLUSIVE PERSPECTIVE

MASSIMIZZARE L'ACCESSIBILITÀ NELLA DIDATTICA MUSEALE ATTRAVERSO LA REALTÀ VIRTUALE: UNA PROSPETTIVA INCLUSIVA

Lucia Campitiello
University of Salerno
lcampitiello@unisa.it

Amelia Lecce
University of Sannio
alecce@unisannio.it

Aldo Caldarelli
University of Cusano
aldo.caldarelli@unicusano.it

Michele Domenico Todino
University of Salerno
mtodino@unisa.it

Pio Alfredo Di Tore
University of Cassino
pioalfredo.ditore@unicas.it

Stefano Di Tore
University of Salerno
sditore@unisa.it

Abstract

In recent years, several studies have been conducted to examine the use of virtual reality within museums to aid in the process of teaching and learning about cultural heritage. This contribution aims to illustrate the nitial phases of the development of a virtual museum inspired by the principles of *Universal Design for Learning* in order to create an immersive environment that is accessible to everyone, particularly those with special educational needs. More specifically, a virtual museum was created using the 3D digital assets of the excavated archeological remains available at the National Sannio Caudino Archeological Museum in Benevento and the Archeological Museum of Carife in the province of Avellino. The article focuses on cultural accessibility, examining the potential of virtual reality systems to create an inclusive environment that makes communication dynamic and accessible to a heterogenous audience.

Negli ultimi anni sono state condotte alcune ricerche volte ad indagare l'utilizzo dei sistemi di realtà virtuale all'interno dei musei per favorire il processo di insegnamento-apprendimento del patrimonio culturale. Il seguente contributo mira a illustrare le prime fasi progettuali per lo sviluppo di un museo virtuale, ispirato ai principi dell'*Universal Design for Learning*, al fine di creare un ambiente immersivo accessibile a tutti, in particolare a persone con bisogni educativi speciali. Nello specifico, è stato realizzato un museo virtuale con i *digital asset* dei reperti archeologici scansionati, presso il Museo Archeologico Nazionale del Sannio Caudino di Benevento e il Museo Archeologico di Carife in provincia di Avellino. Il contributo pone l'attenzione sull'accessibilità culturale, analizzando le potenzialità dei sistemi di realtà virtuale per creare un ambiente inclusivo in cui rendere la comunicazione dinamica e comprensibile ad un pubblico eterogeneo.

Key-words

Keywords: virtual reality; educational museum; inclusion; accessibility.

Parole chiave: realtà virtuale; didattica museale; inclusione; accessibilità.

Introduction

Nowadays we are witnessing the transition from analog to digital, this period is known as Digital Transformation and consists in the increasingly frequent use of intelligent machines connected to the network, not only as regards the productive dimension of our society but also for that which concerns the interaction between people and machines (De Giorgis, 2021). In fact, in the history of man-machine interaction an attempt has been made to make the relationship between man and technologies similar to that of the real world and, currently, virtual reality represents a new form of interaction that is closest to the real one, as it is possible to create experiences that can change people's lives. However, what distinguishes virtual reality from videogames is the level of immersion and use of the user's body in interacting with the virtual environment, which is not limited to the use of the joypad. or a keyboard, but it is possible to move in space via head rotation, eye movements or specially designed controllers. The first to coin the linguistic expression "virtual reality" was Jerome Lanier to describe projects that had been carried out by universities and research centers. By virtual reality we mean a reality built by the mind of man but there are other definitions, even distant from each other, which have described virtual reality as: 1) a digital simulation of a real or fantastic environment (Heim, 2000); 2) an alternative world that responds to human movements through the use of a suit, stereoscopic glasses and fiber optic gloves (Greenbaum, 1992); 3) a set of computer devices that offer a new type of human-machine interaction (Ellis, 1994). Certainly, virtual reality is not to be understood as a simple technology, which is increasingly spreading outside academic laboratories, but it is a new mode of knowledge and communication that places the person at the center of one's experience. In scientific research, this revolutionary technology has proven to be an effective tool for promoting mental well-being and its limits were related to the high cost and difficulty of use (Pallavicini, 2020). Since the 2000s, however, we have seen a decrease in costs and a use aimed at non-expert users which has made this technology democratic. In particular, since 2012 more and more people have tried virtual reality thanks to the marketing of headsets such as PlayStation VR, HTC Vive, Oculus Go and Oculus Quest. Virtual reality systems differ according to the level of immersion, which involves measuring "quantitatively" how much a technology allows you to immerse yourself in a virtual world (Slater et al., 1996), dividing virtual reality into: 1) *Immersive virtual reality*, in which the user is immersed in the digital environment at a sensory level through a display device and a position sensor, for example using the systems of Oculus Quest and PlayStation VR; 2) *Semi-immersive virtual reality*, we refer to rooms in which the environment created by the computer is projected on the walls, such as the CAVE (Automatic Virtual Enviroment), which allow a group of people to share an experience; 3) *Non-immersive virtual reality*, which consists in designing 3D digital environments that can be viewed on 2D displays, that of the smartphone or computer (Pallavicini, 2020).

Virtual reality, augmented reality and mixed reality are often referred to as "synonyms" even if they have differences in the technological and application aspects, in particular:

- *Virtual Reality* (VR) offers the opportunity to immerse yourself in a 3D digital environment and live a multisensory experience using *head-mounted displays*, in which it is also possible to interact with the elements that are present in this space. The virtual environment is configured as a parallel world that can be the result of imagination or a faithful reconstruction of real places.

- *Augmented reality* (AR), unlike virtual reality, consists of a superimposition of images, texts, or 3D models (that are not manipulable) to implement the vision of reality with virtual objects and provide more information about a location or a product through a mobile app or a viewer. In augmented reality, contact with the real world is not lost but enriched with virtual elements that allow the user to listen to sounds and observe the surrounding environment. In recent years, this technology has become mainstream thanks to the release of the *Pokémon Go* game (which has become a mobile phenomenon) and the viral *Dancing Hot Dog* filter on the Snapchat platform.

- *Mixed Reality*, in which the real and virtual world are represented within the same screen. The virtual elements do not "overlap" but mix with the real environment so that they can be manipulated by the user (Pallavicini, 2020).

Virtual reality (VR) and augmented reality (AR) are innovative technologies that can be used to “break down” barriers in communication and design customised *user experiences* (UX) to find solutions to problems that may arise in everyday life. Virtual reality systems can also be used together with other technologies, such as 3D Printing, Human-Machine Interface (HMI) and the Internet of Things (IoT) to create innovative projects and solutions for special education.

Virtual Reality to “break down” social barriers

As reported in the previous paragraph, virtual reality can be understood as a new form of human-machine interaction capable of offering experience and knowledge (Morganti & Riva, 2006). Users who use virtual reality go from the feeling of "receiving information" to being in the "place of since its peculiarity lies in the possibility of creating an inclusive relationship between the virtual environment and the user (Bricken, 1994). Other elements that characterise virtual reality systems are: 1) *the level of immersion*, understood as objectively measurable sensory fidelity; and 2) *the sense of presence*, that is, the subjective psychological response relating to being really inside the virtual environment (Pallavicini, 2020). In this case, *immersion* refers to the objective measurement of the sensory fidelity of a technology, such as extensive, inclusive, surrounding, and vivid displays (Slater & Wilbur, 1997). What contributes to defining the level of immersion in virtual reality are the rendering software and the display device, but also the sensory information of the system at the auditory and movement levels (Bowman & McMahan, 2007). In addition to these elements, the level of immersion is also determined by the modality of interaction with virtual reality, understood as the extension of sensory channels and the fidelity of motor inputs and sensory stimuli (Bohil, Alicea, & Biocca, 2011; McMahan et al., 2012).

For this reason, there are two main dimensions that determine immersion: 1) *sensory fidelity*, understood as the correspondence between the sensory information generated by VR and that perceived in reality (Biocca, 1997); 2) *interaction fidelity*, or the degree of reproduction of the interactions in virtual reality (McMahan et al., 2012). This possibility of extending our knowledge in virtual worlds, which we perceive as real, is possible thanks to the complex phenomenon of "presence," which has changed over time in relation to the evolution of technologies (Kim & Biocca, 1997). Generally, various definitions of "presence" have been provided in the literature, namely:

- *spatial presence*, understood as the psychological state in which the individual loses that awareness of mediation with technology and has the illusion of actually being inside the virtual environment (Morganti & Riva, 2006);

- *social presence*, that is the psychological state in which the individual has the sensation of being connected with others within virtual reality (Biocca, 1997);

- *personal presence*, with reference to the perception of the body, of the emotional states and of the identity of the users in the virtual environment (Biocca, 1997). In other words, self-presence is found when individuals do not have the avatar as different from themselves.

As far as the concept of presence in virtual systems is concerned, we can consider two approaches that have developed, namely *descriptive models* and *structural models*. Descriptive models consider presence as a multidimensional concept, so they are oriented towards tracing the components of presence (Lee 2004; Witmer & Singer, 1998). As far as structural models are concerned, the focus is on the cognitive processes that give life to the experience of presence (Schuemie et al., 2001; Seth, Suzuki & Critchley, 2012). In the literature we find other conceptualizations on the sense of presence within virtual reality, including:

- *Human response to sensory immersion*, considers presence as a subjective sensation of the individual that is physically perceived within the digital environment (Slater, 2003). This is achieved when the sensory information produced by virtual reality is combined with the individual's perception, creating a coherent environment in which it is possible to interact with people and objects (Schultze, 2010). According to this theoretical construct, presence is defined as: 1) the feeling of actually being in the virtual environment; 2) the extent to which users respond to the virtual environment and not to the real one; and 3) the extent to which individuals remember having visited a place in the digital environment compared to simply viewing images on a computer (Slater, 1999). In other words, the sense of presence is considered something objective and measurable in terms of sensory realism (Sanchez-Vives & Slater, 2005);

- *Localized attention to the virtual world*, this theory focuses on the user's attention in the virtual environment. Specifically, when the user shifts attention from the virtual world to the real one, a "break in presence" is created (Garau et al., 2008) which can occur when a simple task is proposed in the digital environment or when involvement decreases;

- *Possibility of action*, according to this theoretical perspective, the sense of presence is linked to the possibility of performing actions in virtual reality (Lee, 2004; Schubert et al., 2001). In particular, it is based on the ecological approach of visual perception and on the concept of affordances (Gibson, 1979) as an opportunity for actions offered by the environment;

- *Construction of the characteristics of the self*, considers the possibility of feeling present in the virtual world in the same way as in the real world. According to some scholars, the presence in virtual reality systems consists of levels, which refer to the three levels of the Self (Damasio, 1999) and the levels of consciousness (Riva, Waterworth & Waterworth, 2004): 1) *proto presence*, understood as presence unconscious that belongs to biological and neural schemes. This level of presence can be influenced by virtual reality which is able to make the user experience the sensation of really being with the body in a virtual space; 2) *nuclear presence*, that is the awareness of being in the present thanks to sensory stimuli that come from the outside world and that can extend to the virtual world to offer the user a presence experience; 3) *extended presence*, with reference to the virtual experiences that are significant for the individual in order to build her identity. When the three levels are integrated with each other, a high sense of experience is achieved in which it is possible to experience the so-called "flow experience" that is a sense of high participation in the activity and the consequent satisfaction (Csikszentmihalyi & Csikzentmihaly, 1990; Pallavicini, 2020)

The progressive evolution of technologies has led to an "incarnation" of technology in the human body, defined as embodied interaction (Kay, 1990) in order to make human-computer interaction natural (Biocca, 1997). This approach, known as direct manipulation, starts from the assumption that people can interact equally with both digital and physical objects by adapting their perceptual-motor patterns (Morganti & Riva, 2006). Virtual reality systems allow the user to experience this "incarnation" by replacing his real body with that of an avatar, also offering the possibility to manipulate the structure and color of the virtual body (Martini, Perez-Marcos & Sanchez-Vives, 2013). This sense of presence and incarnation, which is experienced in virtual reality, involves the senses of individuals in an intense way, offering immersive experiences and knowledge even to those who do not have the possibility to physically reach specific places, think of people with disabilities. physics. In fact, virtual reality systems can be considered as an aid for people with disabilities, as they can use it as an alternative tool to perform a task and compensate for the effects of disability (McComas, Pivik & Laflamme, 1998). In other words, virtual reality can offer opportunities for people with Special Educational Needs (BES) who otherwise would not be able to experience (Buzio, Chiesa & Toppan, 2017), as immersive environments can be customized to fit people's individual needs, in particular on their strengths, in order to encourage interaction and work on a specific task.

Inclusive Virtual Museum: a museum accessible to all

Some research (Kalyvioti & Mikropoulos, 2012; Kast et al., 2007) have shown how virtual reality can favor the development of specific skills in children with Special Educational Needs, through the use of a constructionist model aimed at supporting knowledge based on the exploration of the immersive environment (Cobb, 2007). These immersive environments are characterized by flexibility and controllability, in which it is possible to progressively increase the degree of complexity of the task and have a control over the learning process. In other words, virtual reality could be considered an effective tool for interactive learning, as it stimulates motivation and increases the degree of awareness of experiences, creating a favorable context for the development of particular skills that can be transferred to the real world. For this reason, it is possible to use virtual reality to break down cultural barriers, offering a new way of enjoying culture that allows people to be at the center of their learning process. Some studies (Di Tore, Todino & Sibilio, 2019; Zouboula et al., 2008) have focused on the use of immersive technologies in museums in order to create an effective learning environment for people with SEN and to promote active participation of all, rethinking communication in the museum and planning interventions based on the needs of visitors. In fact, these studies have shown an improvement in the visitor experience with the increase in multisensory involvement. Currently some museums offer visitors the opportunity to play through tourist apps or video games, just think of *Race against time*, *Foursquare* or *Geocaching*. Also, at the Archaeological Museum of Naples a video game called *Father and Son* has been created, which refers to the *gamification* experience that shows the work of *TuoMuseo*, in which the player can explore the rooms of the museum and walk around the city, following the journey of the protagonist who is in search of the story of his never known archaeologist father (Nesti, 2017).

The contemporary museum has become an inclusive place in which it is necessary to adapt to the needs of visitors, expanding their social function. In museums, the work of art must not only be contemplated passively by the visitor but must be transformed into an engaging experience, capable of arousing curiosity and providing clear information. Museum proposals must require the active participation of the visitor, offering the opportunity to interact with the works and the surrounding environment. In other words, designing a VR environment with real archaeological finds transformed into digital assets has the same value as the experience of a visitor immersed in a real museum, with the added value of facilitating the creation of specific mediators able to guarantee at the same time an inclusive experience. In fact, if we ask ourselves how a visitor with a disability (intellectual, motor, sensorial…) can experience the museum environment, respecting their own operational profiles and personal learning methods, we would find different answers in these devices (Giaconi et al.2021a). The cornerstone of this approach always remains the co-design of these environments with the community of people with disabilities which, in our opinion, is characterized as one of the most innovative frontiers of special pedagogy applied to cultural heritage (Giaconi, Rodrigues & Del Bianco 2019; Giaconi et al., 2021b). The following research project moves in this direction, which aims to create an inclusive virtual museum in order to promote knowledge of cultural heritage. The virtual museum was developed by the University of Salerno with *Unity 3D* software in which a room was created where the digital assets of the archaeological finds of the Campania museums were inserted. Through the *Unity* graphic engine it is possible to develop applications and videogames that can be used on desktop computers, mobile devices and videogames consoles. In the prototype of the virtual museum have been included the archaeological finds scanned at the National Archaeological Museum of Sannio Caudino in Benevento and the Archaeological Museum of Carife in Benevento province of Avellino. The aim is to design a virtual museum that allows everyone to access and explore the different rooms of the museum, especially people with special educational needs, in order to promote the learning of cultural heritage. The design of the virtual museum is inspired by the principles of *Universal Design for learning*, in order to create a flexible environment and maximize accessibility, favoring the learning process. From a didactic point of view, with particular reference to *simplex didactics*, the virtual environment takes into account the *principle of meaning* and the *principle of deviation*, using the immersive experience as a non-linear choice aimed at favoring significant learning in students (Sibilio, 2014; Aiello, Pace & Sibilio, 2020). The prototype features a museum room that can be used through *Oculus Quest 2*, or for those who don't have this device, you can use the mouse and keyboard. The virtual museum has been specially designed to be customized according to user needs, in fact, it is possible to remotely adjust the brightness of the environment and the intensity of the colors, change the fonts of the showcases and the height of the avatar, in particular, the avatar becomes a sort of *digital twin*. In addition, in the virtual museum it is possible to use the "vignette effect" which could be useful to reduce the sense of nausea, or, to adjust the height of the avatar to allow the user to explore the virtual environment both seated and both from standing.The other features, such as brightness and color intensity, can be adjusted to make it accessible to visually impaired people.

Figure 1 - Inclusive virtual museum created with Unity software

In museums, textual apparatuses do not play a privileged role but can help visitors understand the works. Therefore, in order to make the virtual museum accessible to everyone, including dyslexic children, the descriptions of the works have been reported using three different fonts, namely *Arial*, *Times New Roman* and *OpenDyslexic* (Figure 2). In this way, you can choose the font you prefer according to the individual needs of the users. To improve the accuracy and speed of reading in dyslexic subjects, it is possible to intervene on some parameters, such as the shape, spacing and size of the letters, using fonts that facilitate the decoding process (Reid, 2004; Di Tore, 2016). Taking

Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva / Italian Journal of Health Education, Sports and Inclusive Didactics - Anno 6 n. 4 - ISSN 2532-3296 ISBN 978-88-6022-456-9 - ottobre - dicembre 2022 - CC BY-NC-ND 3.0 IT-

these parameters into account, it is possible to maximize accessibility to texts by dyslexic subjects by using sans-serif fonts compared to serif-fonts. The British Dyslexia Association (2012), to facilitate the decoding process, recommends the use of Arial and Cominc Sans fonts, as fonts not properly designed for dyslexic subjects, such as Sylexiad (Hillier, 2008) and OpenDyslexic (the only open-source font). The fonts designed for dyslexic subjects have in common the high differentiation between the individual letters, for example the *OpenDyslexic* font is based on the Arial font but graphic differentiations have been added on the letters that are similar to each other while always maintaining a clean style. In order to use inclusive formatting of the text, both in physical and digital space, it is appropriate to take into account the following parameters, suggested in the literature, to create formatting accessible to all: 1) font size between 12 and 18 pt; 2) effective spacing by expanding the extension of the "space" character; 3) kerning to reduce the space between pairs of characters and facilitate the recognition of the single glyphs, in particular with line spacing from 1 to 2.5 cm and left alignment; 4) Recommended font and background color is yellow on blue or white on black (Di Tore, 2016).

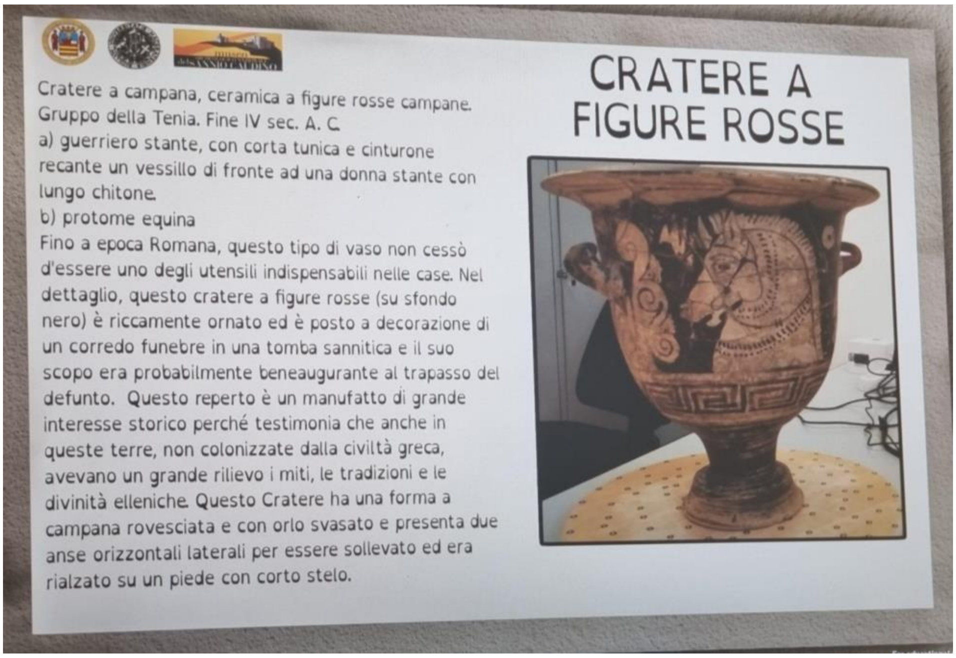

Figure 2– Description of the red-figure crater with the font OpenDyslexic

Various factors come into play in the museum, such as the lighting or the layout of the space, which can communicate unclear information to visitors, so it is necessary to take into account these peculiarities that can influence the experience of visitors inside the museum. Rethinking communication in museums and developing interventions based on the needs of individual visitors can guarantee education for all and develop the sense of being there even if in a virtual reality (Pace, 2021).

3d scans of archaeological finds in museums

As previously described, for the realization of the inclusive virtual museum some works were scanned at the National Archaeological Museum of Sannio Caudino in Benevento and the Archaeological Museum of Carife in the province of Avellino. The National Archaeological Museum of Sannio Caudino in Benevento is known for the conservation of the Vase of Assteas of the "Rape of Europe", while the Archaeological Museum of Carife preserves a rare collection of Samnite finds. The 3D scans of the works were carried out using Shining 3D's EinScan Pro HD structured light 3D scanner. Specifically, a “Guttus” was scanned in the Archaeological Museum of Carife, the shape of which was used to embellish the container reserved for perfumed oils. The word Guttus means “vessel from which the liquid flowed drop by drop” and was used for multiple purposes, including as a women's toilet ritual. In particular, this Guttus (Figure 3) accompanied a Samnite fair on its journey to the afterlife for more than two millennia. Furthermore, a terracotta “perfumer” from the Samnite era was scanned in the Archaeological Museum of Carife. In the past, perfume was considered an expensive commodity, in fact this artifact was found inside the tomb of a high-ranking person.

Figure 3 – Digital asset of the Guttus and the Perfumer

As far as the National Archaeological Museum of Sannio Caudino di Montesarchio is concerned, a *Red Figure Crater* was scanned (Figure 4). The crater is a large vase found in a necropolis of the Valla Caudina, in Greek culture it was used to mix wine with water to reduce the alcohol content and was served at banquets, especially in the symposium. Another archaeological find scanned at the Montesarchio Museum is the so-called *Bell Crater* (Figure 4) considered a necessary tool until Roman times. The vase originates in the "red figure period" towards the end of the 4th century B.C. and confirms how in these lands great importance was attached to Hellenic myths and divinities.

Figure 4- Scanning of the red-figure crater and the bell crater

Figure 5- Scanning of the works at the De Chiara De Maio foundation

The scans of the works carried out at these museums are open-source, so it is possible to 3D print digital assets or add them within a three-dimensional navigation space, such as Serious games or Edugame. In addition, other works have been scanned at the De Chiara De Maio foundation, currently they are in the cleaning phase, which will be added to the site ScanItaly (Figure 5). Specifically, on the website of the Lab-H of the University of Salerno it is possible to know the evolution of the project and download the virtual museum file. The project file allows anyone, equipped with a virtual reality helmet, to immerse themselves in this virtual environment or, for those who do not have this technology, to move around the room using the keyboard of their computer.

Conclusion

Virtual reality is a new form of Human-Machine Interaction linked to a new way of communicating and gaining experience. Virtual reality systems can be used to enhance the experiential learning process through realistic simulations of real situations, allowing people to practice in a controlled and safe environment (Riva & Gaggioli, 2019). To understand the applicative potential of virtual reality, it is also necessary to keep in mind the psychological implications related to its use, since technology alone is not enough, but it should be at the service of the person and considered for the advantage it can offer, without being seen as an alternative to real life. In fact, it is not possible to imagine, in the slightest, that technology can invade our lives and replace social interactions but rather offer greater flexibility to communication. It is useless to deny that a possible risk could be linked to the addiction that this immersive world could generate in some individuals, and which is no different from that which could develop for a classic video game (De Giorgis, 2021). However, virtual reality has advantages in favoring learning processes as it is possible to make an abstract concept tangible and create an immersive experience for the participants. The user plays an active role in this immersive technology when the "sense of presence" occurs which is the result of a simulation process where one feels inside the virtual environment as if it were real. In recent years, immersive technologies have also been used in museum education to increase multisensory involvement and improve the visitor experience. In fact, the following project aims to create an inclusive virtual museum paying particular attention to accessibility by people with Special Educational Needs. In fact, a virtual environment makes it possible to make one's avatar walk while sitting, modify the perception of the virtual environment, in terms of colours, lines, details, physical laws, etc., in a personalized way. The design of new forms of Human-Machine Interaction thus becomes the viaticum for the design of new bodies and opens up, among other things, the possibility of developing unexplored forms of didactic interaction (Sibilio, 2020). The implications in terms of benefits and risks related to the concept of inclusion and accessibility are virtually endless. In this sense, this study presented here has the dual purpose of digitizing, through 3D scanning, works of art and historical museum exhibits from southern Italy, to develop prototypes of inclusive educational open-source digital assets with the technological thrust described above. The creation of these assets will be oriented towards the development of a virtual museum, usable with and without a VR viewer and the creation of print-ready 3D models. The digitization of historical artifacts and their virtualized or physical reproducibility through 3D printing will also allow for an in-depth study of the most effective forms of inclusive interaction that can be used in teaching.

References

Aiello, P., Pace, E. M., & Sibilio, M. (2021). A simplex approach in Italian teacher education programmes to promote inclusive practices. International Journal of Inclusive Education, 1-14.

Biocca, F. (1997). The cyborg's dilemma: Progressive embodiment in virtual environments. Journal of computer-mediated communication, 3(2), JCMC324.

Bohil, C. J., Alicea, B., & Biocca, F. A. (2011). Virtual reality in neuroscience research and therapy. Nature reviews neuroscience, 12(12), 752-762.

Bowman, D. A., & McMahan, R. P. (2007). Virtual reality: how much immersion is enough?. Computer, 40(7), 36-43.

British Dyslexia Association. (2012). Dyslexia style guide. British Dyslexia Association. Bt Press.

Bricken, M. (1994). Virtual worlds: No interface to design. Cambridge: MIT Press.

Buzio, A., Chiesa, M., & Toppan, R. (2017, March). Virtual reality for special educational needs. In Proceedings of the 2017 ACM Workshop on Intelligent Interfaces for Ubiquitous and Smart Learning (pp. 7-10).

Cobb, S. V. (2007). Virtual environments supporting learning and communication in special needs education. Topics in Language Disorders, 27(3), 211-225.

Csikszentmihalyi, M., & Csikzentmihaly, M. (1990). Flow: The psychology of optimal experience (Vol. 1990). New York: Harper & Row.

Damasio, A. R. (1999). The feeling of what happens: Body and emotion in the making of consciousness. Boston: Houghton Mifflin Harcourt.

De Giorgis, G. (2021). Unity. Guida pratica per sviluppare applicazioni di realtà virtuale e aumentata, Milano: Apogeo.

Di Tore, S. (2016). La tecnologia della parola. Didattica inclusiva e lettura. Milano: FrancoAngeli.

Di Tore, S., Todino, M. D., & Sibilio, M. (2019). L' apprendimento in ambienti di mixed reality Mixed Reality Learning Environment. Le Società per la società: ricerca, scenari, emergenze, 26, 151.

Ellis, S. R. (1994). What are virtual environments?. IEEE Computer Graphics and Applications, 14(1), 17-22.

Garau, M., Friedman, D., Widenfeld, H. R., Antley, A., Brogni, A., & Slater, M. (2008). Temporal and spatial variations in presence: Qualitative analysis of interviews from an experiment on breaks in presence. Presence: Teleoperators and Virtual Environments, 17(3), 293-309.

Giaconi, C., Rodrigues, M. B., Del Bianco, N., (2019). Gettare lo sguardo in avanti. La co-progettazione nella pedagogia speciale 1; Edizioni Accademiche Italiane, Germania

Giaconi, Catia, DEL BIANCO, Noemi, D'Angelo, Ilaria, Halwany, Samah, Aparecida Capellini, Simone, (2021a). Cultural accessibility of people with Intellectual disabilities: A pilot study in Italy in JESET; 7/1; Free Port, Famagusta, Birlesik Dunya Yenilik Arastirma ve Yayincilik Merkezi; pp. 17 - 26

Giaconi, C., Ascenzi, A., DEL BIANCO, N., D'Angelo, I., APARECIDA CAPELLINI, S., (2021b). Virtual and Augmented Reality for the Cultural Accessibility of People with Autism Spectrum Disorders. A Pilot Study in THE INTERNATIONAL JOURNAL OF THE INCLUSIVE MUSEUM; 14/1; Canberra, Amareswar Galla, International Institute for the Inclusive Museum, Australia and India.

Gibson, J. J. (2014). The ecological approach to visual perception: classic edition. Hove: Psychology press.

Greenbaum, P. (1992). The lawnmower man. Film and video, 9(3), 58-62.

Heim, M. (2000). Virtual realism. Oxford: Oxford University Press.

Hillier, R. (2008). Sylexiad. A typeface for the adult dyslexic reader. Journal of Writing in Creative Practice, 1(3), 275-291.

Kalyvioti, K., & Mikropoulos, T. A. (2012). Memory performance of dyslexic adults in virtual environments. Procedia Computer Science, 14, 410-418.

Kast, M., Meyer, M., Vögeli, C., Gross, M., & Jäncke, L. (2007). Computer-based multisensory learning in children with developmental dyslexia. Restorative Neurology and Neuroscience, 25(3-4), 355-369.

Kay, A. (1990). User interface: A personal view. The art of human-computer interface design, 191-207.

Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. Journal of computer-mediated communication, 3(2), JCMC325.

Lee, K. M. (2004). Presence, explicated. Communication theory, 14(1), 27-50.

Martini, M., Perez-Marcos, D., & Sanchez-Vives, M. V. (2013). What color is my arm? Changes in skin color of an embodied virtual arm modulates pain threshold. Frontiers in human neuroscience, 7, 438.

McComas, J., Pivik, J., & Laflamme, M. (1998). Current uses of virtual reality for children with disabilities. Studies in health technology and informatics, 161-169.

Morganti, F., & Riva, G. (2006). Conoscenza, comunicazione e tecnologia: aspetti cognitivi della realtà virtuale. LED Edizioni Universitarie.

Nesti, R. (2017). Game-Based Learning: gioco e progettazione ludica in educazione. Pisa: ETS.

Pace, E. M. (2021). Physically dispersed but virtually reunited: stories of inclusion during lockdown. Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva, 5(1).

Pallavicini, F. (2020). Psicologia della realtà virtuale. Aspetti tecnologici, teorie e applicazioni per il benessere mentale, Firenze: Mondadori.

Reid, L. D., Reid, M. L., & Bennett, A. (2004). Towards a Reader Friendly Font. Visible Language, Rhode Island School of Design, Providence, Rhode Island, USA.

Rello, L., & Baeza-Yates, R. (2013, October). Good fonts for dyslexia. In Proceedings of the 15th international ACM SIGACCESS conference on computers and accessibility (pp. 1-8).

Riva, G., & Gaggioli, A. (2019). Realtà virtuali: gli aspetti psicologici delle tecnologie simulative e il loro impatto sull'esperienza umana. Firenze: Giunti Psychometrics.

Riva, G., Waterworth, J. A., & Waterworth, E. L. (2004). The layers of presence: a bio-cultural approach to understanding presence in natural and mediated environments. CyberPsychology & Behavior, 7(4), 402-416.

Sanchez-Vives, M. V., & Slater, M. (2005). From presence to consciousness through virtual reality. Nature Reviews Neuroscience, 6(4), 332-339.

Schubert, T., Friedmann, F., & Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. Presence: Teleoperators & Virtual Environments, 10(3), 266-281.

Schuemie, M. J., Van Der Straaten, P., Krijn, M., & Van Der Mast, C. A. (2001). Research on presence in virtual reality: A survey. CyberPsychology & Behavior, 4(2), 183-201.

Schultze, U. (2010). Embodiment and presence in virtual worlds: a review. Journal of Information Technology, 25(4), 434-449.

Seth, A. K., Suzuki, K., & Critchley, H. D. (2012). An interoceptive predictive coding model of conscious presence. Frontiers in psychology, 2, 395.

Sibilio, M. (2014). La didattica semplessa. Napoli: Liguori.

Sibilio M. (2020), L'integrazione didattica. Scholè: Brescia.

Slater, M. (1999). Measuring presence: A response to the Witmer and Singer presence questionnaire. Presence: teleoperators and virtual environments, 8(5), 560-565.

Slater, M. (2003). A note on presence terminology. Presence connect, 3(3), 1-5.

Slater, M., Linakis, V., Usoh, M., & Kooper, R. (1996, July). Immersion, presence and performance in virtual environments: An experiment with tri-dimensional chess. In Proceedings of the ACM symposium on virtual reality software and technology (pp. 163-172).

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. Presence: Teleoperators & Virtual Environments, 6(6), 603-616.

Todino, M. D., Campitiello, L., & Di Tore, S. (2022). From presence to distance in museum education: the use of archaeological finds to create digital assets through 3D scanning. Journal of Inclusive Methodology and Technology in Learning and Teaching, 2(1).

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. Presence, 7(3), 225-240.

Zouboula, N., Fokides, E., Tsolakidis, C., & Vratsalis, C. (2008). Virtual reality and museum: an educational application for museum education. International Journal of Emerging Technologies in Learning (iJET), 3.