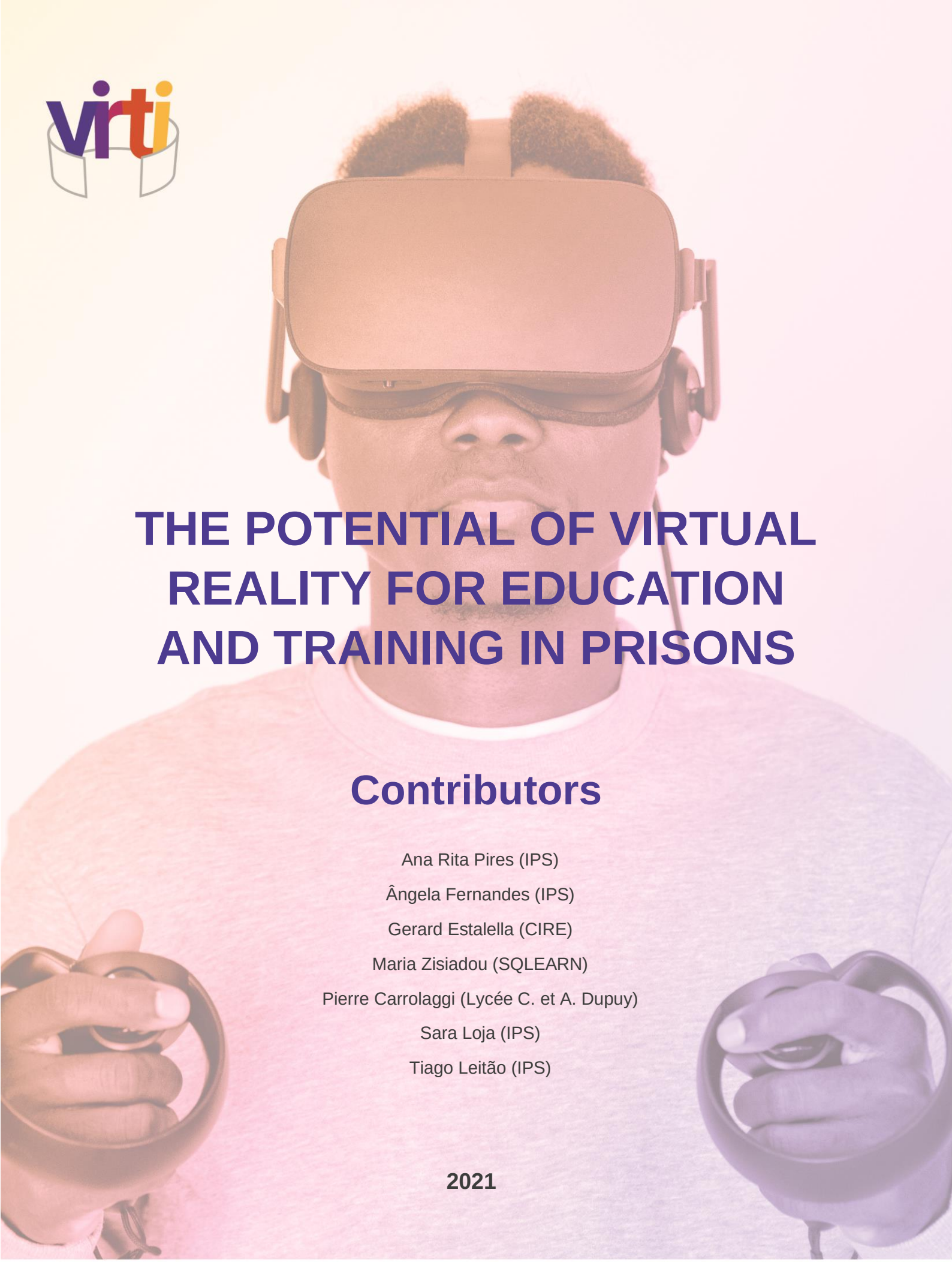

THE POTENTIAL OF VIRTUAL REALITY FOR EDUCATION AND TRAINING IN PRISONS

Contributors

Ana Rita Pires (IPS)

Ângela Fernandes (IPS)

Gerard Estalella (CIRE)

Maria Zisiadou (SQLEARN)

Pierre Carrolaggi (Lycée C. et A. Dupuy)

Sara Loja (IPS)

Tiago Leitão (IPS)

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Introduction

For inmates, the advantages of participating in education and training activities are multiple. Usually low educated and without qualifications, inmates achieve confidence by acquiring basic competencies and developing transversal and vocational skills. These gains will contribute to their chances of employment once leaving prison. For a successful rehabilitation, access to employment is a crucial aspect as it increases autonomy and reduces the risk of recidivism. However, training opportunities may be limited because not all prisons have the technical tools and resources required to provide vocational courses. Also, when faced with the opportunity to take part in vocational courses, inmates may be reluctant to participate, and even if they express their willingness to participate, the dropout rates are high.

Virtual Reality for Training Inmates (ViRTI)[1] arises from the need to improve the educational environment and expand the training offer for inmates, who generally have limited access to technical facilities because they are in a closed and restricted environment. Thus, ViRTI aims to use **Virtual Reality (VR)** technologies by creating virtual environments, compensating for the scarcity of resources (such as laboratories, materials and tools) in prison facilities. In addition, by introducing interactive and gamification features in the learning contents provided to inmates, it will be possible to attract more participants and maintain their motivation, thus reducing drop-out rates. With this project, it will be possible to increasingly encourage the application of content based on VR in prisons, which will collaborate with education and training providers for this purpose. In this way, more inmates will benefit from this added value, as they will develop skills and competencies and acquire knowledge about sectors of the economy where there is a scarce workforce, hence increasing their employability.

ViRTI gathers four partners from France, Spain, Greece, and Portugal: one expert in prison systems, two education and training centres with a long experience in training inmates and one developer of interactive learning content experienced in VR. Together, the Consortium will:

1. Analyse the potential of VR for education and training in prisons and specify some use cases;

2. Develop an interactive gamified training path in the construction sector, using VR based on 360° videos;

3. Pilot it in three different prison contexts: short term convicts, juvenile justice centre and detention centres welcoming inmates sentenced to more than one year with positive perspectives for rehabilitation;

[1] https://virtual.reality.for.inmates.training

4. Provide guidelines to a) Penitentiary administrations, b) Funding bodies, c) Educators and trainers, d) Learning content and technology providers so that they can introduce VR tools for training inmates.

After the project timeframe implementation, it is expected that more VR-based content can be used in prisons, more prisons will introduce it in collaboration with education and training providers, and more inmates will benefit from its added value. It is expected that inmates will develop skills and competencies and acquire knowledge of economic sectors lacking a workforce, increasing their employment chances. This project will apply to the participating countries, as all results will be available in French, Spanish, Catalan, Greek, and Portuguese. The disseminated English versions will allow transferring the acquired knowledge to the remaining countries interested in this project's development and results.

1. Concepts and Indicators

Over the last several years, there has been increased technology incorporation within the correctional context due to its benefits in rehabilitation, reintegration and education (Cornet & Van Gelder, 2020). VR is one of the latest digital tools, usually defined as “an artificial or computer-generated, three-dimensional representation of reality, which is experienced through the senses, and which is interactive” (Van Gelder, Otte & Luciano, 2014). The purpose of VR is to provide a real-life interactive simulation through virtual scenarios, which the user can visualise with HDM (a device placed on the head/helmet with a built-in display and lenses that provides a virtual wide viewing angle) and take control with hand movements (using a hand-controlled device, Kamińska et al., 2019). With these characteristics, VR offers the users high transportation, immersive, present, and engaged real-life virtual experience. Also, VR technology has advanced considerably in recent years due to reducing hardware expenses and technology progress, translating into an improvement in the quality of graphics and its interactivity.

Since VR is becoming more widely available and known to be used in a secure, controlled, and predictable environment, this tool has been incorporated in several varieties of settings, such as the construction industry, gaming, surgical training, urban planning, sports, engineering, the military, physical rehabilitation, mental healthcare, and education (Cornet & Van Gelder, 2020; Martirosov & Kopecek, 2017). For example, in the psychology field, researchers use VR specifically for assessments, therapies and treatments (Ticknor, 2019a), such as Exposure Therapy (ET) and Cognitive Behavioural Therapy (CBT). From a therapy point of view, stress, social anxiety, and panic disorders faced by VR have been commonly used (Ticknor, 2019b). Treatment results were positive in several studies, indicating that VR considerably reduces anxiety and stress levels and, consequently, can be considered a valuable improvement tool (Grillon et al., 2006; Krisch et al., 2016; Powers & Emmelkamp, 2008). It has also been effective in treating sexual disorders (Botella et al., 2004), arachnophobia, aerophobia, agoraphobia, acrophobia, binge eating disorder, body dysmorphic disorder and glossophobia (Riva, 2003). In this Virtual Reality Therapy (VRET), people suffering from these problems are confronted with their fears in the form of an object or situation in virtual representations. Although people are aware that they are in an immersive virtual scenario, VR can still trigger the same emotions, responses, and reactions to the fears as if standing in a real-life situation (Bowman & McMahan, 2007).

VR has also been used in sensitive medical procedures by creating pain management strategies, such as in dental work (Furman et al., 2009), chemotherapy (Schneider & Workman, 2000), and burn wound care (Hoffman et al., 2000), redirecting patients’ attention from the pain to different virtual scenarios. There are also encouraging findings with VR application in substance abuse treatment, namely smoking and alcohol addiction. Compared to traditional methods, virtual situations exposure revealed more indicators of craving (Lee et al., 2004); another study showed positive results with a reduction in the nicotine dependence

levels (Girard et al., 2009), strongly supporting the idea of using VR as a tool for health professionals, such as social workers and clinicians (Bordnick et al., 2013). VR can also be useful in the framework of alcohol addiction since it has been found to increase the Cue Exposure Treatment (CET) validity and reduce alcohol dependence (Lee et al., 2007). From an educational perspective, VR can be an effective method to raise awareness of the various dangers associated with alcohol and alcoholic driving (Montgomery et al., 2006).

Given the complexity of some problems and disorders, VR technology offers researchers the opportunity to design and create personalised virtual environments and conditions that would probably be difficult to practice in real life, with no invasive risks associated (Tal & Wansink, 2011). Essentially, environments can be created to simulate real-life scenarios (such as a living room, a street, a courtroom, a crime scene), as well as scenarios that do not exist (such as science fiction or fantasy worlds) (Riva & Gaggioli, 2008). Furthermore, VR also creates a virtual embodiment with users embodying avatars (Cornet & Van Gelder, 2020). The substitution of a user's physical body for a virtual one is referred to as virtual embodiment (Slater & Sanchez-Vives, 2016), which can give the illusion that the virtual body belongs to the user (Bombari et al., 2015; Mol, 2019; Slater et al., 2010). Seinfeld and colleagues (2018) developed a study relevant to Criminal Justice practice. They documented that the emotional recognition of male perpetrators of domestic violence significantly increased after they experienced a domestic violence occurrence from a female victim's point of view (and body). Using VR, this type of research enables a whole new world of discoveries and possibilities for corrective interventions. It is also now possible to have numerous users in the same VR environment at the same time, which opens new opportunities for social interaction research (e.g., co-offending) as well as new ways of interventions and applicability in Criminal Justice practice (e.g., the offender and the trainer both in the same virtual scenario). Additionally, VR can be applied simultaneously with other types of technologies, such as eye-tracking, to detect users' attention and where they direct their eyes to (this can give researchers a better understanding of the offender's or victim's cognitive processes, focus, and attentional conditions) (Cornet & Van Gelder, 2020; Jacques, Lasky & Fisher, 2015). Another interesting feature of VR is that users may perceive the virtual world as real in a matter of minutes (Pan & Hamilton, 2018; Slater, 2009; Slater & Sanchez-Vives, 2016).

VR technology has been proven to be a tool with great potential within the educational context, facilitating the teaching and learning process. Kamińska and colleagues (2019) revealed that "most students remembered what they saw in VR and concluded that VR is a more memorable environment than laboratory-based demonstrations" (an idea also sustained by Cochrane, 2016; Nadan et al., 2011; Slavova & Mu, 2018). Furthermore, multi-sensory interaction scenarios and real-world visual representations are some of the characteristics that facilitate students' learning processes (Mikropoulos & Natsis, 2011). VR allows access to essential learning resources that in daily practices would be difficult or not even possible to achieve due to its expenses (e.g., electronic mechanisms, robotics, chemical components, medical materials, etc.) (Kamińska et al., 2019). Teachers/educators/trainers also have access to a tool that facilitates learning activities considered challenging for them to implement during regular practical lessons (Petkovska et al., 2018). Thus, this VR gamification feature enables

real-world learning and seems to keep users motivated to continue engaging in a VR experience (Ticknor & Tillinghast, 2011).

Research shows that the inmates' population, in general, are undereducated and lack educational skills (Davis et al., 2014). Some even mention being expelled from school, having a history of academic failure (Coates, 2016). According to Crabbe (2016), two-thirds of inmates have numeracy abilities at or below compared to an 11-year-old; in addition, almost a third self-reported suffering from a learning difficulty or disability (OLASS, 2015). Reports also indicate that most correctional facilities are unaware of inmates with learning disabilities and difficulties (Office of the United Nations High Commissioner for Human Rights, 2009). Thus, inmates with these problems can also present difficulties in speech and communication that may indicate undiagnosed disorders (such as dyslexia or autism). Both undereducation skills and learning disabilities represent a significant obstacle for inmates having a chance of being employed after their release, which, in turn, may lead to a deficient social reintegration and increased recidivism (Clarke, 2010). Despite the general adverse scenario of prison education, there has been an increased effort in Europe (particularly in the Nordic countries) to provide prison education, which seemed to produce positive results (Nordic Council of Ministers, 2005). Prison education offers a purpose for inmates serving time: it allows for further study and provides the opportunity of attaining more profitable employment after the end of the sentence (Duwe, 2017). This is an important measure since it has been proven that prison education reduces the likelihood of recidivism, representing a promising path on crime prevention (Davis et al., 2013; Sokoloff, Jay & Fontaine, 2013; Runell, 2017).

Even though delivering vocational education in prison is recognised as a contributor to post-release employment and, consequently, a decrease in inmates' probabilities of reoffending (Bhuller et al., 2019), there are still inmates who feel apprehensive about joining educational programmes. Not only because of the undiagnosed learning problems (Skues et al., 2019), but inmates also often feel reluctant to engage in a learning environment for fear of exposing their fragilities and educational limitations to other peers (Ricciardelli, Maier & Hannah-Moffatt, 2015). For these reasons, it can be challenging for inmates to enrol in educational activities without any withdrawals during the process. VR technologies allow a personalised recreation and experience of multiple life scenarios without leaving the correctional facility. Given the nature of the incarcerated environment, sometimes it can be challenging to give inmates' access to scenarios in prison that will represent real-life vocational education, such as mechanics, forestry, and carpentry (McLauchlan & Farley, 2019). Also, the VR gaming element contributes to the inmate's motivation to increase and, thus, become more willing to be involved in educational learning activities (Ticknor & Tillinghast, 2011).

In this sense, VR holds a great potential to improve the education of formerly incarcerated people, specifically those who suffer from numeracy/literacy difficulties (McLauchlan & Farley, 2019). Dolven and Fidel (2017) created a programme with VR use for inmates in which they developed computer skills and learned how to manage money. This technology also offered the ability to show inmates who had long sentences (some of them with 20 years) how different the world was and what exactly changed since their detention (e.g., how to self-checkout at a

supermarket). A literacy and numeracy programme developed in New Zealand (McLauchlan & Farley, 2019) using VR setups in a classroom to represent a mechanic's workshop revealed that participants did not take long to learn its functionalities (e.g., identify car parts, manipulate instruments, follow instructions): "Had it all down by the first session though. Real easy once you know what you're doing." (p. 7). Moreover, researchers observed a high-level activity engagement compared to conventional learning, with inmates' feeling more motivated to attend classes and less prone to withdraw. Several inmates expressed their willingness to continue their VR educational progress after release, developing self-confidence within the learning context. Finally, researchers documented increased literacy/numeracy scores of all inmates who participated in the project, expressing positive feedback: "Real good. Have definitely brushed up on a few skills and learned some new ones. Mostly literacy though." (p. 7). VR technology contributed to inmates' personal development and empowered them with new opportunities of being educated and partakers of content that will possibly help their acquisition of market skills and social reintegration.

VR use in correctional facilities has numerous advantages from the vocational education point of view. Without leaving their cells, inmates can participate in an immersive experience with access to tools and role-plays and familiarise themselves with different knowledge that, in another way, they would not be able to experience inside a prison. They can visit a virtual construction site or a commercial kitchen (Zoukis, 2016), role-play as a mechanic, carpenter, chef or shop assistant in an engaging and safe environment, apt even for participants who have reduced digital literacies (these types of skills are the same that employers have increasingly valued over time) (Herold, 2018).

2. Panorama of the existing use of Virtual Reality in prisons

The following content concerns VR educational use evidence in the European prisons, specifically in France, Greece, Portugal, and Spain. Because the VR application in prisons is innovative and recent, there is still the need to develop investigation further. As such, few examples exist of VR use in the prison context for educational purposes.

2.1. Virtual Reality use in prison contexts

2.1.1. France

Discovering jobs

On April 2021, around twenty inmates (under 25 years old) from the detention centre of Oermingen in Alsace used VR to learn about jobs lacking a workforce. They were accompanied by the *Mission Locale* of Saverne (in charge of social and labour integration of under 25). They have used the commercial device *Métiers 360* activated in several Mission locales and job centres in France. It works through monthly subscriptions, including the activation or renting of three VR headsets, use of a WebApp or a website to discover the professional environments.

Short 360° videos present one hundred and ten jobs in more than 30 professional environments: during 3 to 5 minutes, a worker speaks in his/her professional environment where he/she can show the tools and equipment used. The user needs to sit on a rotating chair. He/she moves within the offer of professional environments - jobs with remote control.

In the detention centre, working with the job adviser, the inmates had selected previously three jobs they wanted to enquire so that the day of the experiment, they would not wander from one job to another without organisation. They were placed then by groups of four, each one with a headset. The time needed was around 30 minutes to familiarise with the tool and browse four jobs (the three preselected + one open choice).

If this experimentation has not been formally evaluated, general satisfaction from the inmates and the job adviser has been expressed.

Living a theatre experience

Les falaises de V. is a VR play created by Laurent Bazin and performed in different theatres. The 40-minute performance is based on a ten-minute sequence-shot film. The spectator lives a 360° story, as the main character and not as a simple spectator, with a headset. The action takes place in a prison hospital, as the main character will undergo an eye removal in exchange for his/her freedom.

The other characters interact with the main character by talking and looking. With this experience, he/she feels into a state halfway between the real and the virtual. The point of view can be changed because of the 360° view of the scenes.

There are still few theatrical experiences in VR, but it allows to open this art to a new audience that cannot necessarily go to the theatre; the VR headset is enough to view the play without needing a stage or other spectators. This is, of course, the case for inmates.

As part of digital education, culture and artistic fields, the school of the Penitentiary Center of Toulon-La Farlède proposed to 18 inmates in 2017 the view of this film on VR headsets. The viewing of the film was prepared in class and was followed by an exchange with the teachers and the film team about VR. Discussion tools are placed on the following topics: their relationship to the real, the commodification of the body, and the price of freedom. Some of the inmates also addressed technical questions about the treatment of the image, about the cameras used, sound recordings, or the choice of writing to capture the viewer's attention in space and encourage him to look in a given direction.

Here, apart from the fact that the cultural item accessed is based on VR, VR has also been used to facilitate the expression of inmates about reality, freedom and other philosophical issues

As far as we know, this experience has not been renewed, although if it had been positive. We do not know if it is because of a lack of interest from other Centers, because they are not aware of it, or because part of the pedagogical value resides in the exchange with the film team, whose availability is probably limited by other engagements.

Using Virtual Reality to try to prevent recidivism

FRED is a virtual environment where the subject materialises and shares a representation with the professional that articulates his/her current experience, future projections, and evolving support plan. It was built to accompany the subject in developing a life plan that satisfies his/her identified personal needs, in thinking about his/her social identity and stimulating his/her disposition and commitment towards change.

By defining himself/herself in such a way and environment, the subject gives substance to his/her fundamental values and needs. Although these elements have not occurred, they contribute to the current definition of the self and create a positive memory anchor. This

anchoring makes it possible to observe strong positive manifestations impacting current attitudes and behaviours. The subject projects himself/herself into the future based on his/her values and, thus, build a life coherent with his/her identity and not a life where it must adapt to external constraints. The future projection allows the subject to compose without the stressors or triggers currently blocking his/her capacity to perceive or envisage life without the transgression. The therapist's absence in the person's visual environment favours the free production of a discourse on oneself by oneself. Speech is released more quickly than in a face-to-face visual context.

FRED is based on the Life Plan method suggested by the Good Lives Model coupled with the temporal projection of the TIM-E model (Dieu, 2016) and aims at optimising its accompaniments:

- The Good Lives Model assumes that a subject with a satisfying life would no longer have a reason to act out. Therefore, the primary objective of the intervention is no longer the strict prevention of recidivism but the development of the subject as a guarantee against the occurrence of subsequent acts.

- The TIM-E model of Temporal Identity (Dieu, 2016) makes time a central dimension of support as a variable underpinning identity definition.

"FRED is divided into two virtual spaces: a beach with a pontoon, dedicated to relaxation exercises, and a house, a work area for interviews and exercises on temporal identity and life plan. In these spaces, several virtual objects are available: avatars and spheres of life.
The avatars represent the subject in a non-gendered humanoid form. Commanded by the subject, the avatar is used either to materialise him in his life plan or for exercises involving a decentration of people or time (self in the past or future).
The spheres of life, transparent bubbles, represent the domains (categories of people and activities. Each represented by a symbol) concretely invested by the subject in his daily life. These spheres are used to represent the elements of the subject's life plan in the different temporalities.
The placement and the appearance of the spheres can be modified by the subject only and according to coding, which allows representing: the time devoted to this sphere of life in daily life; the quality of the subject's feeling in connection with the sphere, on a continuum going from unpleasant to pleasant; the qualitative importance of the sphere in the eyes of the subject (the intensity of the need or the value in terms of identity which is associated to it). Still, concerning the appearance of the spheres, a modality makes it possible to specify the temporality to which they belong: present, past or future - allowing exercises of time decentration and the construction of the future life plan. Links can be created by the subject, connecting spheres to each other, an avatar and a sphere, avatars to each other and any other combinations, symbolising their relationships." (Dieu, 2020).

2.1.2. Greece

Serious efforts and various projects and initiatives took place in Greece, in recent years, aiming to provide education to vulnerable social groups, such as inmates. However, VR technology, despite the multiple benefits it could offer, is not a common mean to be used for educational purposes let alone to be used for the training of inmates.

There are two projects implemented with support from European funds that have used VR for inmates or for professionals working in the prison system at a national level. These projects, having Greek partners in the consortium, proceeded with actions that were both implemented in Greece. More information on these projects is presented below.

STEPs, "Supporting Ties in the Education of Prisoners" Project

STEPs, "Supporting Ties in the Education of Prisoners" [2], is an innovative project under the Erasmus+ programme for Cooperation and Innovation and the exchange of best practices, promoted and funded by the EU. The project started in November 2018 and was completed in October 2021. It was implemented by four stakeholders in the fields of education and reintegration, deriving from four European countries. The project was coordinated by EEPEK of Larissa, Greece, involving schools in prisons in Greece (at Larissa) and in Italy (at the CPIA1 Rome), as well as non-formal education organizations, such as Kerigma in Barcelos (Portugal) and C.I.P. Citizens in Power in Nicosia (Cyprus).

"STEPs" aimed to promote effective actions for re-education, social inclusion and prevention of relapses. The "STEPs" project's partners worked together to create an innovative training material to be used in prison schools, rehabilitation centres and other related structures. In the framework of the project, a VR Unit with six digital VR stories was developed. Each VR Unit was provide a framework where each inmate or ex-inmate moved to a virtual room through VR devices. In this virtual room, users saw a number of items that were somehow related to their profile and story. Usually, these items were related to the cause of an inmate's imprisonment.

The users wore the VR glasses and headphones and interacted with the unit through handheld sensors and dedicated user interfaces. They could pick a particular item and hear, watch or read it. They could move inside the physical room (where the installation was hosted) and by their movement to interact with the Virtual Room and all the items that appeared in the Virtual Room. The user was able to move around in a set of ten different Virtual Rooms simulating rooms in prison, the place where the crime was committed, internal or external places, etc. The users had the impression of being in the virtual world while having the ability to navigate

[2] http://steps.eepek.gr/

and interact with elements, where they both became witnesses and protagonists in stories perhaps similar to their own.

The goal was to emotionally identify with another inmate's mental state of mind, to understand his/her behavior and motivations, and through this to understand their own behavior, motivations and ultimately their self-esteem.

The whole concept of the project was based on the fact that research has shown that the free exchange of stories of different individuals supports their psychological state, help them to reassess their actions, to redefine their priorities and values, to gain self-respect and can lead them to take decisions which will ultimately lead to their reintegration into society.

In the framework of the project, six digital VR stories were developed. According to the statements of the Greek project stakeholder, trainees of the Second Chance School (SCSs) of Larissa, shared or wrote together with other inmates and inmates of Europe the story of their lives and with the use of VR technology these stories became a "film" of VR.

The Greek stakeholders pointed that through the VR stories, the user realises that the mistakes, the stereotypical perceptions and the experiences of an inmate know no boarders. Moreover, anyone who wishes to partake in this experience has the chance to contact their trainer, share their feelings and impressions and even narrate or write down their own story. What is more important, however, is the chance for empathy and self-reflection of their own choices and decisions through this heavily emotional experience.

The director of the 2nd SCS of Larissa Prison, George Trantas, stressed that *"the STEPs program is not intended to show what virtual reality is, it is not a virtual reality documentary. Its purpose is to help inmates see a story of another inmate and to be able to improve and change themselves by making better decisions in their lives".*

J-SAFE Project

This is another innovative project entitled "Judicial Strategy against all forms of Violent Extremism (J-SAFE)" [3] funded by the European Justice Programme (JUST-AG-2016-03) and implemented during January 2018 – January 2021. This project aimed to analyze the current situation of prosecution and detection measures of extremism in all phases of the criminal procedure in the participating countries (a Greek partner was among the consortium members).

This project aimed to generate tools, protocols, and risk assessment guides in accordance with European regulations for its use by judges and prison staff. During this project, training was provided for judiciary personnel and prison staff professionals while the impact of the tools created was evaluated in each country.

[3] http://jsafeproject.info

In the framework of this project, various training activities were carried out including a new approach to train LEAs in understanding the processes of radicalization in prisons, forensics operations for prevention and investigation as well as activities related to data surveillance within the prison environments. To this end, and in order to exploit the potential of the risks as well as to train counter-terrorism officers and prison administrative staff, several scenarios were created within virtual environments. The scenarios aimed to enhance their decision-making capabilities, situational awareness and emotional resilience during dangerous, threat-to-life scenarios.

In this framework, the Center for Security Studies (KEMEA), the Greek project partner, held a workshop in Athens entitled "VR (Virtual Reality) Simulation Prison Search" [4]. Seven prison officers of Korydallos Prison System (Greece) took part in this training activity. The executives that participated as trainers-experts were officers of the Hellenic Penitentiary Service and KEMEA.

The training activities were delivered using an innovative methodology, called VR Blended Solution. This highly immersive solution allowed its users to simulate and experience the process of searching and investigating in a prison cell firsthand. Thus, the usage of VR equipment allowed the Law and Enforcement officer to look around the environment in a full 360° degrees to search for indicators of possible terrorist activity and radicalization signs and to learn how to approach digital forensics operations in prison. Another scope of this training was also the evaluation of the benefits of blended VR for Security and Justice Trainings.

2.1.3. Portugal

Besides the STEPs project described above, in Portugal, two more VR projects are being implemented.

TRAIVR Project

The use of VR in prison contexts is a recent topic in Portugal. At the end of 2020, a new Erasmus+ programme was approved – TRAIVR: Training of Refugee Offenders by Virtual Reality (2020-2023)[5]. The TRAIVR project aims to close the language barrier gap and provide rehabilitation for substance user refugee probationers by developing a VR programme to improve their coping skills (problem-solving and emotion regulation skills). The main focus of TRAIVR is teaching coping skills rather than working on substance use behaviour. The VR system provides a better adult learning opportunity by eliminating the language barrier, and

[4] http://www.kemea.gr/en/news/latest-news/1139-press-release-j-safe-training-course-on-vr-simulation-prison-search
[5] https://prisonsystems.eu/traivr

confidentiality will be assured. In addition to these advantages, the same VR scenario can be adapted to different languages; therefore, it is cost-effective. The technique could be used in a wide range of skills, thus open to progress. VR technology has the ability to be repurposed, as the same scenario can be used in normal settings.

The main objectives that TRAIVR aims to accomplish are:

1. Conduct a study targeting the refugees' rehabilitation problems resulting from language barriers - using a needs analysis questionnaire;

2. To define and compile the literature on using VR technology for training stress management on rehabilitation;

3. The creation of a VR programme software for refugee offenders, developing VR technology methodology in skill teaching and adapting the newly structured system into probation fields as a new methodology. The new methodology using VR technology to rehabilitate refugee offenders showing deficiency in coping skills will be structured. Since the language barrier is the main difficulty in teaching the group coping skills, VR will be an effective solution. VR will provide an alternative way to handle the refugee offender cases (in teaching them skills that will help them manage the stress in their lives without committing a crime).

TRAIVR Project will end in 2023, and if the new technology turns out to be effective, it has the power to be generalised to all refugee probationers (including the foreign-speaking) and even to refugees without conflict with the law.

VRforDrugRehabilitation Project

Given the extensive use of drugs among juvenile offenders, prison and probation settings are essential for providing responses addressing drug use. Research has been shown the effectiveness of treatment through new technologies, such as VR, augmented reality, and video games. The project assumes that users are repeatedly exposed to cues and encouraged to ignore the craving response using realistic scenarios in virtual environments.

The VRforDrugRehabilitation (Developing and Using Virtual Reality Technology for Rehabilitation of Drug Users in Probation Service)[6] project aims to support youth workers by promoting quality VR technology for drug addiction rehabilitation in the probation system for young adult offenders and promote empowerment of changing their lives. The main goals of the project are to:

1. Decrease drug use among young probationers through a VR drug treatment programme;

[6] https://www.vr4drugrehab.org

2. Develop an assessment tool for testing VR sessions' effects;

3. Enhance awareness and capacity on probation service to create a methodology of rehabilitation by using VR;

4. Increase young adult people's motivation to change their lives;

5. Reduce stereotypes in the community that drug addicted people cannot change;

6. Disseminate the project's outputs to other prison and probation services.

The VRforDrugRehabilitation project started in February 2019, and it is foreseen to end in December 2021. The project consortium includes partners from Portugal, Romania and Turkey.

VISION Project

The VISION project aims to mitigate one of the most felt difficulties of inmates' post-release, which is obtaining rewarding employment. For this purpose, the VISION project seeks to develop inmates' competencies through VET programmes, supported by the application of Virtual Reality (VR) technology. This rehabilitation intervention predicts the achievement of positive outcomes by developing an adequate training programme for educators/trainers, which, therefore, will provide the necessary training inmates need. Consequently, by achieving the proposed goals of the project, we will support inmates in being better prepared to find and retain a job, leading to successful social reintegration and the avoidance of reincarceration.

The main goals of the project are to:

1. Increase adherence to VET programmes (through the development of different virtual scenarios related to course enrolment and motivation);

2. Increase commitment of inmates in VET programmes (inmates' education and vocational skills development);

3. Increase success (inmates' preparation for labour market integration, employment post-release, reintegration, and avoidance of reincarceration);

4. Improve trainers/educations skills to train inmates.

The VISION project forecasts the engagement of 320 inmates/professionals/stakeholders in the implementation of the project activities and events. The project result includes several activities in which they will be enrolled to provide inputs to its development and pursue project aims.

The project started in November 2021 and is scheduled to end in May 2024. The partner countries involved in the project are Portugal, Greece, Romania, France, Spain, and Italy.

2.1.4. Spain

Relatively new VR technology has gained importance in recent years. In addition to being a motivator for gamification, this method is increasingly used for therapeutic purposes. What is particular and characteristic of VR technology is presenting an artificial environment that can be experienced as real.

However, the fundamentals of VR do not necessarily consist of the realism of the presented objects; more important is that the perception of the virtual world is the closest thing to the perception we have of things in our daily lives. In this way, the first steps taken in Spain prisons have been very useful: both for training in occupations and prevention of occupational hazards and creating a new reality that helps inmates remember everyday landscapes they had not walked through a long time.

Three examples may illustrate what has been achieved in the last few years:

Quatre Camins Penitentiary Centre – Catalonia

This project was launched in December 2018 with the support of the penitentiary management and the collaboration of all the staff. For the project's development, an INSTA360 ONE camera was used, supported with a tripod in the middle of each unit and activated remotely via Bluetooth with an iPhone 8. The purpose was that only the image of the space would appear without the presence of people (although this has not always been successfully achieved). The photographs were taken, and then a route was organised using the online resource ROUND ME.[7]

When inmates enter prison, they spend time at the reception area until their jail cell is decided and in which residential unit they will be assigned. During this time, inmates are usually very distressed (especially in the case of those who enter prison for the first time). They do not know where they are, nor can they imagine what their daily life will be like during their stay in prison.

Through this virtual visit, from the first moment, in the reception interview (which a pedagogue of the centre carries typically out), inmates establish the first contact with the centre, placing themselves in the space where they will spend some time of their life. If inmates are offered the opportunity to visualise the different spaces where they will live during the fulfilment of their sentence, it may help them calm down, dispelling doubts and uncertain expectations. The virtual visit may dispel the uncertainty of joining an unknown reality and mediate between the professional who performs the reception and the inmate in the first orientation. Likewise, this

[7] https://roundme.com/tour/326808/view/1119525/

virtual visit will allow the family to know where the inmate lives. As such, the space knowledge will contribute to a better understanding of the reality in prison.

Thus, with this project, we want to achieve the following objectives:

1. Prison open doors to society;

2. With a single click on the browser, we offer the possibility for everyone to take a walk inside the prison. The 360° photographs give the chance to see each one of the interior spaces in detail, entertaining oneself by contemplating what may attract our attention;

3. Likewise, by knowing what the centre physically looks like, its distribution and the meaning attributed to each space is very interesting for those who have to carry out some activity, such as substitutes, academic practices, volunteering, etc.;

4. It is also an opportunity for society, in general, to get closer to the penitentiary world, therefore an element of transparency and a knowledge of the institution.

Lledoners Penitentiary Centre - Catalonia

Within the area of drug addiction (located in modules 7 and 8 of CP Lledoners), it is proposed to work the programmes "Development of Pro-social Thinking", specifically the subprogrammes of "Social Skills", "Cognitive Restructuring", "Problem Solving", "Emotional Self-control", "Values and Self-esteem". These subprogrammes are to be worked from a more experimental format, developing a project in a global way that can address the objectives of each subprogramme. This way, it can be put into practice in a controlled environment with a standard and participatory purpose to achieve knowledge.

It will take place in different phases:

- The starting point will be the generation of a story that follows the style of the book "CHOOSE YOUR ADVENTURE", where a story begins, and as it progresses, options are given so that the story can evolve in one way or another.

- Once the framework story has been generated by consensus, they will choose the scenarios and the necessary images to convert it to a digital and 3D format.

At this point, 3D ROUND ME and other programmes will be introduced to participants so that the book can be digitised:

a. Inmates who can enjoy scheduled outings will take photographs of the scenarios through which the story takes place, using resources to apply 3D software;

b. In parallel, the audio will be recorded and the story written;

c. It will group all the material to create a 3D story of consultation open to all.

Conceptually, it is intended to use real-life stories and scenarios that may be their own or known to them to use their experiences to give alternative answers.

From the soft skill point of view, the project offers the possibility of integrating and consolidating the objectives that are split in the framework programme of curricular organisation for each subprogramme. In this way, those objectives that give a theoretical perspective of the different competencies were treated more superficially, seeking that the experiences within the project address the objectives more practically:

- It will be necessary to use a classroom in module 7 or 8 and also access the ICT point, therefore, the ROUND ME programme and related programmes to support the generation of the story;
- 360° degree camera or, in the absence of it, a mobile phone without a SIM that has a camera with good definition;
- It will be necessary to use basic office supplies (paper, pens, etc.);
- Three or four computers with access to 3D software[8].

Acebuche Penitentiary Centre - University of Almería

The University of Almería, together with the El Acebuche Penitentiary Center, has created a specific re-education and social reintegration programme group of 25 inmates from the so-called "Therapeutic Unit" who have participated in a VR workshop taught by the professor José L. Rodríguez from the Department of Mathematics, along with a student of Computer Engineering. The professor expressed that *"the activity has been classified as* '*a great success, because the inmates felt free for a while, like on the street,'* which has explained the peculiarities of this module in prison: "*It is a special unit in what are special rules of personal commitment, not with drugs, not with violence, to try to change habits and life... it is a special unit with lots of pampering".*

After a brief introduction on VR, augmented and mixed reality, the professors explained to the inmates some of the applications that these new emerging technologies have in different areas of society and presented their educational software "Neotrie VR"[9]. We must say that this was the first time that inmates of this unit have tried fully immersive VR, so *"the initial impact has been impressive".* The virtual stage designed in '*Neotrie'* is a Greek temple, surrounded by a small forest and sea, where the inmates have been able to create and manipulate some geometric objects and 3D models using the controls of the VR equipment. *"The 'immersive' feeling is amazing"*. Unlike other standard software, *"'Neotrie VR' allows viewing and also editing 3D objects directly in virtual reality, both for study and subsequent implementation in*

[8] The result can be seen in: https://espaitic.wordpress.com/tag/realitat-virtual/
[9] http://www2.ual.es/neotrie/
http://www2.ual.es/neotrie/project-neotrie/

other software or environments, 3D printing or augmented reality", he explained to some very attentive students. In this way, they can enter the figures or fly over them and the entire virtual scene, showing great emotion.

These actions precisely mean that the prison routine has changed for healthy habits or acts that are interesting for inmates' release since their freedom is restricted here. However, training, social, or recreational activities are not limited so that inmates get used to doing things that can be done generally in the outside world.

Virtual Reality as a treatment in the rehabilitation of aggressors in gender-based violence - research in the Catalan Justice Department

One crucial point about VR is that our brain reacts the same or almost the same way as an authentic experience. As such, it can be useful as a therapy. The three-dimensional stereoscopic vision generates physiological and behavioural responses. It is used in medical and psychological treatments.

After 25 years of experience, VR is being used more frequently, although more experimentation remains needed.

European project on VR in gender violence

The use of VR can aid in the prevention of violence and the intervention, both with victims and offenders.

Considering the prevention stage, VR can be used to modify attitudes and behaviours using the “embodiment” methodology. The concept of embodiment describes the “incarnation” in a body/avatar in a virtual scenario- that can be a victim and/or an offender - and when the person's body moves, the avatar will also move in the same direction. This technique allows an offender to be embodied in the avatar of a victim and experience an episode of violence as a victim and not as an offender. The immersive technique allied to the embodiment allows the participants to process stimuli and feelings that will change/modify their perspective regarding violence and violence perpetrations.

Participants react as if they were real situations instead of imagining; it allows them to experience the situation from another perspective, enabling, for example, an offender to recognise the victim’s feelings of fear.

Criminological needs and treatment goals

- Accountability;
- System of beliefs and values;

- Emotional self-control;
- Empathy;
- Conflict resolution and social skills;
- Relapse prevention.

As described above, VR improves empathy (both cognitive and emotional), mirroring another person's emotion). IRI Experiment Interpersonal Reactivity Index provides a multidimensional measure of empathy and is a useful tool to assess the results.

Some critical points of the project

- The sample needs to be expanded;
- Some doubts about whether the IRI is adequate to measure empathy;
- The prison environment probably does not favour the results, as it is highly stressful;
- It is necessary to analyse at which point in the treatment the VR is more appropriate.

New scenes are being developed for School Youth to prevent parent-child problems as well.

The scenes in VR help in the recognition of the crime.

In Lledoners, they have applied the VR to aggressors, and the reaction is in a few minutes.

This research evaluates a pilot project carried out in two prisons to improve the results of specialized treatment programmes in gender violence. Through immersive VR, the person participating in the treatment experiences a situation of psychological violence in the first person, which is believed to affect their level of empathy and thus better deal with the understanding of the crime committed and lead to a change in behaviour after performing the programme.

Objectives

The main objective is to assess whether the introduction of VR sessions improves the behaviours of those convicted of gender-based violence crimes in areas such as empathy and improving social behaviour. At the same time, with the introduction of new technologies in rehabilitation programmes, the aim is to enhance their efficiency in the conduct of the inmate and, therefore, on recidivism rates.

Gender-based violence is a complex social and cultural phenomenon to eradicate, and it requires multidisciplinary treatment. Therefore, there is a need to innovate in the face of current radicalization.
Differentiation between being and doing. This is where the VR can mediate.

2.2. Non-EU Countries

2.2.1. Chile

Virtual Reality as a family link

In 2017, twelve inmates of the women's prison in San Joaquin, Chile, benefited from audio-visual workshops that included VR experiences. Previously, a Chilean filmmaker spent two weeks touring the homes and neighbourhoods of six inmates, with a 360° camera given to a family member in the house, who would go around the space and tell the inmate whatever he/she wanted to tell them about everyday things. The objective was to allow them to "go home", remaining inside the prison.

The VR would strengthen the link between the inmates and their families and improve the reintegration of those who benefit from it.

2.2.2. USA

Offenders with Anxiety Disorders

The National Commission on Correctional Health Care (2002) has shown that over 14% of federal inmates and over 22% of state prison inmates have presented anxiety disorders. If not adequately addressed, anxiety can contribute to the recidivism rates, as these individuals tend to have a more challenging time adjusting to the prison environment and following resocialisation programmes (Listwan-Johnson et al., 2004). Therefore, VR helps to address this issue – on the Oregon Department of Corrections, a mediation programme named “Provata VR” is used to tackle inmate and staff anxiety and depression (Peters, 2018).

Substance Abuse

Being substance abuse a recidivism predictor (Andrews & Bonta, 2010), it came to no shock when a 2002 national study (Karberg & James, 2005) showed that around 70% of the incarcerated individuals met the criteria for substance abuse, evaluated under the Diagnostic

and Statistical Manual of Mental Disorders 5 (DSM-V) (American Psychiatric Association, 2013). In 2015, the Substance Abuse and Mental Health Services Administration (2015) estimated that around 17 million adults abuse or are dependent on alcohol, and 7 million people (12 years or older) use illicit drugs. One of the most common treatments for substance abuse involves cue-based exposure (Cho et al., 2008), which exposes the individuals to the triggering generated by the substances and teaches how to deal with the urges to consume/drink (Bordnick et al., 2009). These studies have proven efficient, as it aims to develop coping mechanisms by visually stimulating individuals and to use VR to introduce high-risk situations that induce alcohol and/or drug cravings (Hone-Blanchet, Wensing & Fecteau, 2014).

Enhancement of traditional Cognitive Behavioural Therapy for juvenile offenders

In 2013, the pilot Virtual Environment for the Treatment of Offenders (VETO) took place at a juvenile facility in Ohio (Ticknor, 2018). This pilot aimed to assess the feasibility of using VR to enhance traditional CBT for juvenile offenders. This pilot was developed in multiple sessions, being that each session focused on different skill sets, such as effective communication and active listening, using VR.

Bringing Virtual Reality technology into prisons

Under the direction of a great entrepreneur, Dr Raji Wahidy, a startup was created in New York that sought to combine VR technologies into prisons to educate and rehabilitate inmates (Bindi, 2016). Dr Wahidy believes that VR technology can teach and guide former inmates to live a better life outside of prison, preventing recidivists and reducing taxpayers' contributions to these problems.

Helping inmates reintegrate into society

In 2020, the state of Colorado started a programme for people who were convicted in their youth and have already served 20 years of their sentence. In order to be ready to live their life outside the penitentiary, the inmates prepare for their rehabilitation through VR. For three years, they are immersed in everyday scenes (which were utterly unknown to them). Some systems and rules did not exist when they were teenagers at the time of their conviction. Many are afraid of life outside of prison. For example, they fear not knowing how to behave as an adult.

2.2.3. Canada

Sexual offenders

VR has recently gained footing as a promising technique in forensic psychiatry. Since 2006, VR has been used to assess sexual offenders at the Philippe-Pinel Institute of Montréal in Canada, a psychiatric hospital specialising in forensic psychiatry. This is the first laboratory with high technologies (such as a Cave-type immersive vault) devoted explicitly to forensic psychiatry and equipped to receive forensic patients representing different levels of a security risk (Benbouriche et al., 2014). The same authors stated that investments are needed to create new tools that will give decision-makers a better knowledge of violent behaviour and, eventually, enhance treatment choices for violent offenders to reduce recidivism and safeguard society. VR, among other things, provides for a methodological and conceptual renewal.

The prevalence of deviant sexual desires is the cornerstone of decision-making regarding diagnosis, treatment, and supervision recommendations in therapeutic settings (American Psychiatric Association, 2013). One of the most important diagnostic categories is any acute and sustained sexual attraction other than genital stimulation or anticipatory fondling with phenotypically consenting human partners. Furthermore, a large body of evidence suggests that having deviant sexual preferences is one of the most critical risk factors for sexual recidivism. However, the Risk-Need Responsivity Intervention Approach, an empirically established treatment model for offenders, emphasises the necessity of explicitly targeting risk factors linked to offending (Fernandes, 2011).

VR's capacity to create customised surroundings, virtual characters and provide great experimental control is likely to overcome some difficulties in assessing deviant sexual inclinations (Fromberger, Jordan & Müller, 2018). VR creates evaluating conditions that closely resemble the ecological characteristics of real-world situations. This is critical because certain contextual circumstances must be present for individual risk factors to be activated and for sexually deviant behaviour to occur (Rizzo & Bouchard, 2019). The same author mentioned that VR appears to be a valuable tool for grasping and comprehending the fundamental processes of sexual offending. In conclusion, VR and eye-tracking appear viable for resolving some difficulties and better understanding the interacting elements contributing to sexual aggressiveness in natural situations.

2.3. Expected results on inmates

One of the most commonly used technologies in public education is VR (Borovanska et al., 2020). Bridging the gaps between theoretical and practical approaches, VR has shown great potential to support education, even when logistical and ethical challenges occur (Codd & Choudhury, 2011). However, there is a lack of studies directly related to its results on inmates, as the developed studies have been conducted on a task-based virtual lessons basis (e.g., doing laundry, driving a car, etc.). Still, VR helps to understand better and retrieve the information (Freina & Ott, 2015), increasing the user's engagement in activities and motivating them by inducing and increasing a sense of emotion (Riva et al., 2007). Huang and colleagues (2016) add that some features, such as immersion and imagination, when used on and with VR, are directly connected to the users' learning outcomes, namely its benefits.

3. How to elaborate and use learning/awareness material based on Virtual Reality[10]

3.1. Different Virtual Reality possibilities[11]

VR is a technology that rises day today, and new software and hardware features are constantly added to the current VR hardware and software status quo. The reason why VR technology is developing so rapidly, playing an important role in the digital world and economy, is the real experience that can provide the end user's capability to simulate every possible situation and environment. This impressive characteristic has made VR technology a vital part of entertainment and a very promising tool for education and training.

The three main types of VR are the following:

- **Fully – immersive**

A fully – immersive VR is commonly used for gaming and other entertainment purposes. This VR type gives users the most realistic experience possible, complete with sight and sound while the VR headsets provide high-resolution content with a wide field of view. This type of VR technology gives the sense of physical presence in that virtual world and that everything is happening to you for real.

Despite its many advantages, fully immersive VR is costly and not so widely created yet.

[10] https://heizenrader.com/the-3-types-of-virtual-reality/; https://learn.g2.com/virtual-reality; https://unity.com/how-to/what-is-xr-glossary#360-video; https://www.marxentlabs.com/what-is-virtual-reality/; https://www.pcmag.com/picks/the-best-vr-headsets; https://www.oculus.com/quest-2/; https://www.cnet.com/tech/gaming/best-vr-headsets/; https://www.pcgamer.com/best-vr-headset/

[11] VR is different than Mixed Reality (MR) and Augmented Reality (AR). MR is a combination of real-world objects and virtual objects. The term encompasses a wide range of technologies from AR to Augmented Virtuality (AV). AR is essentially adding digital content to a real environment, while AV is adding physical content to a virtual environment. As it encompasses a wide range of technologies, it can be displayed via headsets, smartphones, glasses, etc.

- **Semi - immersive**

Semi–immersive VR type provides users with a partially virtual environment to interact with. This type of VR is mainly used for educational and training purposes. Semi-immersive VR simulations still give users the perception of being in a different reality. This can be in the form of a 3D space or virtual environment where you can move about on your own through a computer screen or a VR box/headset. However, you have no real physical movements other than your visual experience.

Often in this type of VR, physical environments are created to supplement the VR. Some semi-immersive reality experiences are actually considered mixed reality, where digital objects interact with physical objects.

This type of VR is the most cost-effective and the most commonly used among all types of VR after non-immersive VR.

- **Non - immersive**

Non – immersive VR refers to a virtual experience through a computer where the environment is not directly interacting with you, but you can control some characters or activities within the software. The average video game is technically considered an non-immersive VR experience as you are sitting in a physical space interacting with a virtual one. These types of experiences have become more advanced in recent years where the system detects your motion and translates it on screen.

When used for training purposes, VR allows students and trainees to experience, through immersion, any possible situation and training content resulting in education in sectors that no one could imagine some years ago. As a result of the many advantages that this technology offers, many companies in the technology industry have launched their VR equipment.

Oculus[12] has launched Oculus Quest 2[13] (replacing Oculus Quest and Oculus Go that was discontinued), a stand-alone VR headset to promote portability and independence since it can be used without the need of a personal computer.

HTC launched the second most popular device. HTC has launched Vive, Vive Pro and Vive Pro Eye as its main devices, which require a computer to use them. HTC has also launched Vive Focus and Vive Cosmos as its stand-alone devices.

Other companies that have launched their VR equipment are Valve, with Valve Index, Sony with PSVR for the PlayStation Console, Lenovo with Mirage and Samsung with Gear VR in collaboration with Oculus.

[12] https://www.oculus.com/
[13] https://www.oculus.com/quest-2/

3.1.1. Elaboration Requirements

Equipment selected

Taking into consideration Oculus' products popularity and our VR Experts advice for standalone VR equipment (no PC needed) to lower entry costs for organisations, we have decided to use in the ViRTI project:

• **Oculus Quest 2**

Oculus Quest 2 is a new Oculus' family VR headset launched in October 2020. The main advantage of this new device is that it is a standalone headset, meaning that it lets you experience VR apps without the need for a powerful PC or mobile phone. This device is an effective tool for all types of training in VR and an ideal choice for the purposes and requirements of the ViRTI project. In comparison with other devices, Oculus Quest 2 offers the best overall balance of hardware, features, and price.

Main Advantages

The Oculus Quest 2 has crystal clear optics and state-of-the-art 3D graphics that make the users' headsets feel more like a personal theatre. Also, portability - that means no PC, phone, wires or hassles. Finally, the Oculus Quest 2 has easy navigation in the VR environment using the device's intuitive hand controllers.

3.1.2. Functioning Requirements

In order to be able to view the VR scenarios to be developed in the framework of the project, an initial set-up procedure will be needed.

Initial set up

• **Requirements:**

- 02.11 b/g/n wireless Internet access;
- A Facebook account;
- An iPhone (iOS 10 or higher) or Android™ (5.0 Lollipop or higher) smartphone to run the Oculus app (free download) to set up the device;

- Among other steps, the initial setup of the Oculus Quest 2 device requires that the user has a mobile phone with internet connectivity. The user must download the Oculus mobile app and sign into Oculus via his/her Facebook account.

Upon completing the initial headset setup and pre-downloaded the VR scenarios, the Oculus Quest 2 device will work offline without an internet connection. Thus, the users will be able to view the 6 VR scenarios to be developed in the framework of the project offline.

Pricing and where to buy the device

• Pricing:

The Oculus Quest 2 starts at 350€ for the 64GB model. If the user wants more onboard storage, he/she can spring for the 450€ version with 256GB of space. For the purposes of this project, SQLearn's team of VR Experts proposed the option with the 64GB.

• Where to buy:

The user can buy the Oculus Quest 2 VR headset from the Oculus' website[14], as well as from major retailers' websites such as Amazon, Best Buy and GameStop.

3.2. Evolution and Trends[15]

• The headset provides a more real experience

The generation of headsets that appeared in 2016 is the first consumer product to offer a tolerable experience. In five years, models from HTC, Oculus, Sony and Valve have progressed, but they are only a small part of the way to what may one day be a near-reality feel.

The first challenge is to widen the field of view. Existing models give the impression that you are looking at the image with blinders because their narrow field of view is between 90 and 110 degrees. To reproduce a natural vision field, it should be increased to 240 degrees. The intensity of the screens' luminosity is still 100 times less than natural light in the middle of summer (120,000 lux).

[14] https://www.oculus.com/
[15] https://www.lemonde.fr/pixels/article/2021/03/27/realite-virtuelle-les-casques-gardent-une-enorme-marge-de-progression_6074665_4408996.html

The other major challenge is to display perfectly sharp images. If televisions and smartphones are already capable of this, headsets are still a long way off at a distance we look at them. Even though the resolution of their small screens (one in front of each eye) has doubled in five years, to around four million pixels, it is still very inadequate, and we can still see the grid of the small luminous cubes. Images look blurry, and the text is not very legible. A 16K resolution per eye would be needed, meaning that a seven centimetres widescreen should include 132 million pixels. This would increase the needed capacity considerably to calculate images. To reduce the need for computing power, there are two possibilities:

- Headsets could adopt foveated rendering that started to be used in 2019. Headsets using this technology track the eye's movements to detect the area they are looking at and display maximum graphics quality while degrading the quality at the sides, where we see less accurately.
- To compute the images on powerful remote computers and transfer them, either by fibre or by 5G.

• Providing natural controls

The controllers track hand movements quite well and allow to grasp an object in a relatively natural way by tightening fingers on their grip. But the precise movements of each finger are only just beginning to be tracked, notably by the Valve Index, as are the joints (wrists, elbows, shoulders, knees, pelvis) of the human body. Several avenues are being explored to achieve whole-body movement tracking: the first, which is restrictive, is to put on a suit fitted with sensors; the second is to use cameras that monitor limb movements in real-time. *"We'll probably need several external cameras to work together. The ones we have built into the helmet can't see every part of the body at the same time,"* says Wheeler.[16]

To provide a perfectly natural interaction, touch must also be taken into account. The hand must encounter varying resistance from one object to another - it is not the same when holding a knife or a foam ball. On the other hand, the body is able to perceive all kinds of contact and feels resistance when an obstacle prevents it from moving freely. *"This is the problem we have the hardest time imagining solving"*. The leads we have allow us to start thinking about ultrasound stimulation of touch, to give a sense of click. But that is just a very small beginning to this very complex problem.

[16] https://www.lemonde.fr/pixels/article/2021/03/27/realite-virtuelle-les-casques-gardent-une-enorme-marge-de-progression_6074665_4408996.html

• **Freeing up movement**

Autonomous headsets such as the Oculus Quest offer the possibility of moving freely, without a cable restricting movements. In order to avoid bumping into furniture or walls, some headsets now offer the possibility of defining a safe movement zone. When you walk outside this zone, VR pauses, and the headset broadcasts an image of the surrounding environment as if it were becoming transparent. While convenient, this feature does not fix the basic problem of walking for a few meters without being interrupted. Even though many applications are used sitting down, the feeling of a natural move is, for the moment, unattainable. For the time being, there are only cumbersome and rudimentary solutions to this problem, such as the carpet from “Omni On” on which one can move by sliding one's feet, or very expensive solutions, such as the omnidirectional electric treadmills imagined by NASA or by Infinadeck.

• **Avoiding nausea**

To avoid feeling nausea, the image needs to follow the movement immediately, and the movements displayed in the headset must correspond perfectly to those of the body. Otherwise, the inner ear will be confused. For the moment, the main solution is to limit the movements.

• **Paying attention to comfort**

Many headsets as the Oculus Quest 2, weigh half a kilo. To increase the comfort of VR sessions, they will have to become considerably lighter. It means that the room for improvement is huge and that we are only in the prehistory of VR. Furthermore, most so-called “VR” headsets will likely evolve into mixed reality headsets mixing VR and augmented reality in the coming years.[17]

[17] https://www.informatiquenews.fr/la-realite-virtuelle-en-berne-en-2020-mais-en-acceleration-en-2021-73090

4. Analysis of the Virtual Reality use

4.1. Impact and added value

It can be challenging to leave prison and reintegrate into society, especially for individuals who have served long sentences. VR makes it possible for inmates to be successfully transported to the outside world without leaving the prison walls, getting to practice situations considered challenging and developing relevant competencies for their social return. Also, activities such as supermarket' self-checkout, housekeeping responsibilities, and social interactions require practice to develop daily basic skills. Since employment post-release is a critical factor for reducing recidivism, practising job interviews with specific virtual scenarios makes VR application inside the prison a tool with great potential. Although currently in a testing phase, the Virtual Interactive Training Agent (VITA), developed by the Institute for Creative Technologies at the University of Southern California (USC), is a VR job interview with several scenarios that allows a personalised practice with different characters and difficulty levels (Burke et al., 2018). Although applied to young adults with autism or other developmental disabilities, this programme has produced positive preliminary results for employment interviews (Bresnahan et al., 2016). VITA's added value is currently being studied among incarcerated juveniles practising job interviewing skills to anticipate their release[18].

Another illustration of VR potential for offender reintegration is the project called "Back Home"[19], developed by the Chilean filmmaker Catalina Alarcón. This project aims to offer inmates a chance to visit their homes through virtual scenarios by providing inmates' family members with 360°-degree cameras so that this artistic organisation can record their regular life routine. Thus, inmates can visit their homes in detail without leaving their cells and feel more socially connected and reintegrated.

VR rehabilitation tool effectiveness is also demonstrated in inmates who suffer from drug abuse problems, such as alcohol abuse. As there is a large number of inmates serving their time who struggle with this addiction (Belenko & Peugh, 2005), and after release, there are several social encounters they can be confronted and challenged with (such as drinks at a party, peer pressure, among others), inmates need to be prepared and develop self-regulation to avoid any eventual relapses. As such, the VR-based Cue Exposure Therapy (CET) uses VR by exposing people to their triggers' addictions to help them develop coping skills and be better equipped to deal with situations that can trigger their addictions. The VR-CET allows inmates to prepare for their social return and reintegration within the prison settings, with similar and possibly higher effectiveness than traditional CET therapies (Giovancarli et al., 2016; Lee et al., 2004; Park et al., 2014).

[18] https://www.youtube.com/watch?v=upxzVJpANQo
[19] https://volveracasavr.org

4.1.1. Advantages of using Virtual Reality

As new generations are born and nurtured in a digital world with significant technical developments, they will undoubtedly embrace technology and oppose conventional learning methods. As a result, VR technology can improve the education of future generations (Harrington et al., 2018).

The benefits of using VR training can be described in the following aspects (Ticknor, 2019a; 2019b):

- Little or even no risk associated;
- It is safe to use and can be used in a controlled area;
- Provides realistic scenarios;
- Can be used/done remotely (thus saving time and money);
- Improves retention and recall of information;
- Simplifies complex problems or situations;
- It is suitable for different learning styles and learning contexts;
- It is innovative and enjoyable.

Last but not least, there is an essential point to be made. It is simpler to train if the experience is pleasant or pleasurable, resulting in a better degree of involvement and comprehension.

4.1.1.1. Visualises in a way that is not possible in a traditional classroom

VR is incredible because it allows exploring new worlds and experiences. A VR headset exposes high-quality visuals that can positively impact life. Traditional teaching techniques will never attain high effectiveness in stressing concepts through visuals (Van Gelder, Otte & Luciano, 2014).

4.1.1.2. Creates interest in the student/learner

Regardless of the age, the student will always choose to sit and watch something rather than read it. VR technology is intriguing because it can generate incredible experiences that could never be "experienced" in real life. With the usage of this technology, students will be more motivated to learn (Harrington et al., 2018).

4.1.1.3. Engages the learner/student increases

Teachers nowadays have a difficult time creating constructive interaction. With the introduction of VR technology into school, this element will go permanently since most students would be enticed to talk about their VR experiences (Cornet & Van Gelder, 2020). VR training aids in capturing and maintaining learners' attention, resulting in improved information retention (Martirosov & Kopecek, 2017).

4.1.1.4. Improves the quality of education in different fields

VR is an exciting and novel method to learn about any subject. Textbooks, movies, and even the internet are all out of date. Students/learners may experience history, science, and other disciplines as if they were there. Students/learners can engage in hands-on virtual activities using additional devices (Pan & Hamilton, 2018; Slater, 2009; Slater & Sanchez-Vives, 2016). This technology can educate professionals such as doctors, surgeons, dentists, teachers, and others. As we stated previously, VR enhances creativity, engagement and participation, improving knowledge retention and thus improving the quality of education (Cornet & Van Gelder, 2020; Jacques, Lasky & Fisher, 2015).

4.1.1.5. Eliminates the language barrier

When it comes to education, the language barrier is frequently a significant issue. VR allows for the incorporation of any language into the software. As a result, language will no longer be a barrier to learners/students' educational goals (Krisch et al., 2016).

4.1.1.6. Creates a safe learning environment

Learners may engage with virtual sceneries and risks in a safe environment, which is one of the primary advantages of VR teaching. VR is a fantastic tool for experiencing learning in complicated areas that would otherwise be too hazardous, costly, or harmful to study otherwise (Grillon et al., 2006; Krisch et al., 2016; Powers & Emmelkamp, 2008). Learners can make decisions that do not impact the organization's equipment, workers, or consumers.

4.1.1.7. Realistic technical skills practice

Learners can gain hands-on experience with technical activities such as product assembly and complex operating machinery. Learners may physically move about in their VR environment and utilize hand-held VR controllers to pick up, push, and explore virtual items. When it comes to technical instruction, VR offers several advantages, including scalability, the avoidance of real-world machinery, and the opportunity for learners to perform real-world activities again (Cornet & Van Gelder, 2020; Martirosov & Kopecek, 2017). For example, VR may place supply chain personnel on a virtual manufacturing line to practice stacking items correctly. The VR software can identify and rectify errors, ensuring that trainees complete the activity correctly in the actual world.

4.1.1.8. Collection of information/data of the training

A distinguishing feature of VR training is the collection of solid metrics that would not be available in the in-person training. For example, basic technical information such as who is using the training, how frequently they use it, and how long it takes them to complete a job (Cornet & Van Gelder, 2020; Jacques, Lasky & Fisher, 2015). How are the learners' progress (quantitative indicators if the learner is on track or not) and performance indicators (decisions, timing, bodily motions, and retinal eye-tracking are all numerical markers of productivity and engagement)? These pieces of information are important because they assess the efficacy of the training programme, detect and correct faults, and ensure that the learners are learning. This information can also provide real-time feedback to the learners (Pan & Hamilton, 2018; Slater, 2009; Slater & Sanchez-Vives, 2016).

4.1.1.9. Cognitive benefits

Because our motor and visual processes are inextricably linked, embodied cognition theories claim physiological signals and interactions in a virtual world might boost a higher level of cognitive processing. Emotions can also significantly impact decision-making and problem-solving, especially in dangerous situations (Ticknor, 2019a; 2019b).

4.2. Disadvantages and limitations of Virtual Reality

4.2.1. Nausea

The most widespread effect is probably a feeling of nausea after a few minutes of VR use, with more risk to occur as the amount of time spent increases. Nausea is mainly caused by motion sickness in the most turbulent experiences. It can also be caused by sim sickness, which occurs when vision and hearing perceive elements that the other senses cannot detect. After some time, this sensory desynchronisation can cause nausea.

Technological advances over the past few years have mitigated this phenomenon. It is more a weakness than a real risk as the feeling disappears by taking a break.

4.2.2. Loss of orientation in space

After thirty minutes or even less, VR headset users lose their sense of orientation in the physical space around them. If they move in a room, they may bump obstacles and get hurt.

4.2.3. Dry eyes and vision problems

Prolonged use of VR can cause dry eyes and other vision problems. For example, when removing a VR headset after an extended period, it is possible to see blurry for a few moments. A VR headset with a poor-quality screen with a standard definition is more likely to cause eye strain or migraine. The solution to avoid this inconvenience is to take regular breaks. It is also important to adjust the focus when possible. Some experts believe that intensive use of VR could have long-term effects and impact the ability of the eyes to change their focus between near and far objects.

4.2.4. Less effective learning

VR users often report a high degree of engagement with immersive content (Harrington et al., 2018). However, this increase in engagement does not guarantee an improvement in memorisation and subsequent performance. It could even lead to an increase in learning time (Smith & Salmon, 2017). Indeed, VR's interaction in training scenarios is so appreciated and incentivised that the user spends more time on it than other training methods. If increasing engagement is relevant to recreate motivation, it is also at the risk of losing learning efficiency.

4.2.5. Balance problems

VR usage has been proven to be able to cause balance issues (Im et al., 2019), especially among older adults (Borger et al., 1999) and the elderly (Chiarovano et al., 2017), increasing the risk of falling due to the sensory mismatch. Even though VR can cause balance issues, this tool is used for vestibular rehabilitation of Menière's disease (disorder on the inner ear that usually leads to dizziness – vertigo – and hearing loss) (Garcia et al., 2013; Matsumura & Murofushi, 2021; Miziara et al., 2019).

4.2.6. Photosensitive Epilepsy

Similarly to television and mobile devices, VR technology can cause seizure attacks. However, a recent study performed on children has proven that even though VR headsets are worn close to the eyes and a flashing sequence is able to affect the visual cortex (South & Borkin, 2020), medical literature does not support that VR headsets use might pose a risk for photosensitive seizure evoked episodes to be triggered (Tychsen & Thio, 2020).

4.2.7. Cyber Sickness or Virtual Reality Induced Sickness Effects (VRISE)

Cyber sickness can significantly impair the efficiency of VR learning techniques due to the sensory mismatch. This mismatch, caused by the contradictory messages the brain receives from the visual system, informs the brain that the body is moving, while the vestibular system contradicts this information by reporting that the body is stationary (Howarth & Costello, 1997). It is reported to produce similar effects as motion sickness (Gavgani et al., 2018), and its effects can last for hours.

The cybersickness is characterised by feelings of nausea, disorientation, headaches, fatigue, discomfort, difficulty concentrating, vision problems, among other symptoms (Rebenitsch & Owen, 2016). In a study conducted by Mosadeghi and colleagues (2016), 40% of the participants experienced general discomfort and dizziness, around 33% reported experiencing blurred vision and difficulties on concentrating, and 21% experienced double vision (prevalence of VR side effect symptoms when compared with augmented reality and tablet use).

4.2.8. Failure to Reflect IRL situations

The performance developed under simulation cannot always reflect how the individual reacts in the actual world, no matter how realistic the simulation is or how likely it matches the real world (Moroney & Lilienthal, 2009). This can happen due to the stress levels remaining stable (as the situation virtually presented is not regarded as a potential threat), the participants being expectant of unscheduled events or emergencies to deal with while on the simulator, and to

be evaluated in these circumstances (being hypervigilant), or even the inability to simulate the daily emotions one experiences (boredom, fatigue, excited, among others).

Even though simulators allow us to manipulate reality, this piece of technology is still regarded as not realistic. However, the lack of realism in these simulations contributes to effectiveness (Moroney & Lilienthal, 2009).

4.2.9. Costs

VR still requires high-end equipment, such as a powerful computer with a strong graphics card and a head-mounted display (HMD), even though it costs a fraction of what it did ten years ago (HMD). When used intensively and on-site, VR equipment is also susceptible to damage, increasing the chances of needing repair (Cornet & Van Gelder, 2020). The VR use can also involve additional costs when managing the equipment, the levels of presence, the graphics quality, etc., so it requires specialised knowledge when used (otherwise, it can cause users to experience headaches, physical discomfort, eyestrain, and cybersickness (Cornet & Van Gelder, 2020).

4.2.10. Ethical considerations

One challenge to using VR within the Criminal Justice setting is that private companies may create the equipment requiring data collection for commercial purposes (Madary & Metzinger, 2016). This data collection comes into conflict with ethics on the users' data privacy guarantees, being important to be aware of how data protection and data assessment is provided and communicated to its users (especially when the Internet is needed for the VR equipment to function, since there are online channels that may not be safe in terms of data access and collection, and given the criminal justice data policy) (Fromberger, Jordan & Müller, 2018).

4.2.11. Limited in time

VR technology offers users an intense and fascinating experience; however, wearing a VR headset for too long could be uncomfortable and cause some negative health consequences. This innovative tool is not meant to be used for hours, especially if users utilise this technology for the first time.

Several research findings state that exposure to VR for more than 10 minutes can be associated with sickness symptoms and that the degree of this symptom increases with longer VR exposure time (Liu & Uang, 2012; Lo & So, 2001; Stanney et al., 2003; So & Lo, 1999; So, Lo et al., 2001). Relative studies also stress that *"longer immersion in VR environments will surely induce more severe postural instability and more symptoms of motion sickness"* and *"induce more severe postural instability (body sway) than the shorter immersion condition".* Moreover, research also supports those longer immersions can stimulate greater levels of cybersickness (Murata, 2004). Therefore, as in our case used for training purposes, VR should be designed as a short activity.

When designing a VR activity, we should take into consideration the duration recommendations most VR headset manufacturers suggest so as for users to avoid disorientation and possible simulator sickness. The most popular VR makers recommend users take short breaks between their immersions in VR even if they do not think they need it. Oculus, the VR headset manufacturer of the device selected, has issued a health and safety manual with warnings related to the use of its devices. Some of these warnings are related to the time the user should spend using the device, especially if it uses this kind of equipment for the first time. These warnings stress out a time limitation that needs to be taken into consideration during the development phase. Due to this limitation, SQLearn's VR developers have decided that the duration of the VR capsules will be no longer than 10 minutes each to avoid negative health side effects to our users.

Time-related limitations from the Oculus Quest 2 Health and Safety Warnings Manual[20]:

- Start by using your headset for only a few minutes at a time, and only increase the amount of time using the headset gradually as you grow accustomed to the experience;
- Take a break at least every 30 minutes while becoming accustomed to your headset or new content. Take brakes more frequently than every 30 minutes if you feel discomfort;
- Always take a break if you feel discomfort and don't start again until you are no longer feeling discomfort;
- Extended use without adequate breaks may increase the risk of injury, other adverse effects, or property damage.

[20] https://www.oculus.com/safety-center/quest-2/

5. Methodology

The chosen methodologies for the IO1 development were desk research and data analysis. The focus of the research was the potential of VR application in the prison context, the added value for inmates' personal development, educational and vocational skills, their confidence and motivation, post-release employment, reduced recidivism and successful social reintegration.

For this purpose, the articles, books, chapters, handbooks, news and reports selection were based on this output goal, which is related to the use of VR in the prison context. The research was gathered through different scientific research channels (e.g., medical, psychology), taking into account the successful results on therapy/treatments using VR, personal and skills development, increased confidence and motivation, learning progress more facilitated, the connection to the economic sector, employment and evidence on inmates' social rehabilitation. The articles selection was also based on VR's disadvantages, namely at the physical level (such as nausea symptoms, vision and balance problems, users' potential sickness and low realism, the availability of technical solutions and the costs).

The collection of experiences regarding the existing use of VR with inmates has also been done through direct contacts, either with detention centres or with their administration at the local or regional level or with the organisations in charge of education or training activities. This has been limited to the four partner countries and has been done through email or phone calls to locate the experiments and ensure that the whole territory was covered. These direct contacts were all the more necessary as most of the experiments do not generate scientific literature and because prison administration does not communicate much, particularly on the internet.

5.1. Identifying Sources

We conducted a literature review based on different academic databases (Web of Science, ERIC, and Scopus) and some "Grey Literature" (newsletters, magazines, technical and annual reports).

"'Grey Literature' is defined as a literature that has not been traditionally published. Extensive databases and other popular sources frequently ignore it. Grey literature may also refer to works that are difficult to locate or have inconsistencies or gaps in bibliographic information. We aimed to eliminate prejudice, look for grey Literature, and ensure the review was as detailed as feasible. We also aimed to uncover additional evidence or sources for

unfavourable outcomes, find additional published literature references that academic database search may have missed". (Higgins et al., 2021).

The inclusion criteria for the initial theme study (into the applications and motivations of VR in education) stipulated would only be considered for further research if it had implemented a VR-based solution in a criminal pedagogical setting. Due to the lack of information on the matter, the research was expanded to cover all different applications of VR and different settings.

5.2. Inclusion criteria

To search for information, we develop the following search string:

- ("VR"); ("virtual reality") and ("school education");
- ("VR education");
- ("virtual reality applications");
- ("virtual reality treatment");
- ("virtual reality") and ("Justice system");
- ("virtual reality") and ("motivation");
- ("Virtual reality") and ("learning skills");
- ("virtual reality") and ("treatment");
- ("virtual reality") and ("rehabilitation");
- ("VR in prison rehabilitation");
- ("virtual reality") and ("offenders");
- ("virtual reality") and ("offenders reintegration");
- ("VR") and ("recidivism").

The gathered data was selected according to the development date of the paper, books and articles: it ought to have been released within the last six years or less. However, information collected beyond that threshold was included when deemed relevant and/or innovative.

5.3. Data collected

The information gathered featured several fields of study: engineering, science (general medicine, surgery, physical rehabilitation, and nursing education), health-related (mental health, treatments), general education (basic, professional and university education), among others (aviation, architecture, robotics, Criminal Justice System).

6. Conclusion

The application of VR involves learning processes and education. VR has been used for training in various fields, whether in the classroom, military training, or health treatments (both mental health and educating young health professionals). VR has been shown to be effective in enhancing how learners acquire new skills; however, this has been less explored for the issues that criminal justice faces daily.

Based on the literature review, both the Criminal Justice domain and other relevant fields have the considerable applied potential for Criminal Justice Practice. VR technology can expand the existing toolbox of risk assessment, correctional rehabilitation, and reintegration programmes (Cornet & Van Gelder, 2020). It can also allow creating safe training environments or scenarios to practice certain skills. This will allow everyone to understand the pains of imprisonment and rehabilitation. The successful application and the diversified potential of VR technology in other domains (from mental health treatment to medical education and complex procedures) can be sources of information to apply this technology and its capacities for criminal justice practice.

The fact that VR applications in Criminal Justice have been comparatively late to emerge, compared to other disciplines with more established VR traditions, suggests that the future of VR applied to Criminal Justice practice is bright.

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