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Technology as an Ally: Renewed Resilience and Spirituality Through the Impact of Augmented Reality (AR) in the Context of Dementia and Cognitive Impairment

Technologia jako sojusznik: odnowiona odporność i duchowość dzięki wpływowi rzeczywistości rozszerzonej (AR) w kontekście demencji i zaburzeń poznawczych

KEYWORDS
augmented reality (AR), dementia, cognitive impairment, resilience, autonomy

SŁOWA KLUCZOWE
rzeczywistość rozszerzona (AR), demencja, zaburzenia poznawcze, odporność, autonomia

ABSTRACT

Augmented reality (AR) is a resource that, when applied to people with dementia and cognitive impairment, reduces the latency of response to stimuli and facilitates the development of personal abilities, with greater autonomy and quality of life.

Broadening the range of an individual's functioning has an impact not only on an operational level, but also on a spiritual level. The autonomy provided by AR impacts the person's self-awareness and allows them to recognize themselves as an agent of change capable of actively and consciously triggering cognitive processes. In other words,

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it strengthens their internal control center, which is referred to in the scientific literature as a pillar of resilience. At the same time, identity empowerment benefits the spiritual health of the person, linked to resilience and referred to as a factor in health and emotional well-being.

ABSTRAKT

Rzeczywistość rozszerzona (AR) to narzędzie, które zastosowane u osób z demencją i zaburzeniami poznawczymi zmniejsza opóźnienie reakcji na bodźce, umożliwiając rozwój zdolności osobistych przy zachowaniu większej autonomii i jakości życia.

Poszerzenie zakresu tych funkcji ma wpływ nie tylko na poziomie operacyjnym, ale także na poziomie duchowym. Autonomia, jaką zapewnia AR, wpływa na samoświadomość człowieka i pozwala mu uznać siebie samego za sprawcę zmian w swoim życiu, który jest w stanie aktywnie i świadomie uruchamiać procesy poznawcze. Inaczej mówiąc, AR wzmacnia wewnętrzny ośrodek kontroli tychże procesów, który w literaturze naukowej określany jest jako podstawa odporności.

Jednocześnie wzmocnienie tożsamości osoby przynosi korzyści w aspekcie duchowym, co jest powiązane z odpornością i określane jako czynnik zdrowia i dobrego samopoczucia emocjonalnego.

Introduction

In the challenging context of the treatment and care of dementia and cognitive impairment, augmented reality (AR) emerges as a promising technological advance with the capacity to transcend traditional barriers and address not only functional needs, but also critical psychosocial aspects such as resilience and spirituality. This theoretical study seeks to explore how AR, by promoting autonomy and providing enriching experiences, acts as a catalyst for positive change in dementia care. By going beyond cognitive rehabilitation in its analysis of the application of AR to include fostering deep connections with the environment and others, this study aims to elucidate how technological developments can be effectively implemented in clinical practice. Through this analysis, we seek to comprehensively understand how technological advances in AR can be effectively applied not only to support the recovery of lost abilities,

but also to enrich the life experience of those facing the challenges of dementia and cognitive impairment, thus marking a step forward in the search for more holistic, humanized therapies.

Methodology

The complexity and multidisciplinarity inherent in the study of the impact of augmented reality on resilience and spirituality in the context of dementia and cognitive impairment require a methodological approach that allows for the exploration of interrelated concepts and established theories. The present study adopts a theoretical procedure to deepen this theoretical approach to research, drawing on psychological and neuroscientific theories that link autonomy and personal control with well-being and resilience. The premise that spirituality, conceptualized as the capacity to transcend the individual self toward the formation of meaningful relationships with others and the environment, plays a crucial role in the attribution of meaning to life. Such capacity for transcendence is closely linked to the perception of control over one's being and, by extension, over one's life, thus constituting the core of resilience.

In this theoretical framework, AR emerges as a tool that enables individuals affected by dementia to interact intentionally with their environment. Through literature review and conceptual analysis, we assess how these AR-facilitated improvements in autonomy and resilience contribute to greater spirituality and thus to a better quality of life for patients and their caregivers.

Examining AR from a holistic approach broadens the current perspective in empirical research and clinical practice, suggesting a paradigm shift toward treatments that embrace human complexity and thereby supporting resilience and spirituality. This approach underscores the need for a humanistic and multidimensional approach to technology in dementia care, thus promoting a significant improvement in the quality of life of patients and caregivers.

Strength in the Face of Adversity

Resilience as a key factor in the well-being of both people with dementia or cognitive impairment and their caregivers

The dictionary of the Real Academia Española defines resilience as deriving from the Latin *resiliens*, *-entis*, part. pres. act. of *resilīre*, meaning "to jump backwards, to bounce back," or "to withdraw," with the following meanings:

1. the adaptive capacity of a living being in the face of a disturbing agent or adverse state or situation
2. the ability of a material, mechanism, or system to recover its initial state when the disturbance to which it was subjected has ceased.

Over the past few decades, we have frequently used the concept of resilience to understand how certain people manage to overcome difficult situations and develop the ability to adapt and recover from adversity. Resilience has become a relevant research topic in the case of those suffering from dementia or cognitive impairment, as these people constantly face challenges and changes in their daily lives.

Resilience is defined as "a dynamic process that involves the ability to recover from adversity and to maintain or recover a satisfactory level of psychological and functional well-being" (Fletcher, Sarkar 2013: 98). It is important to note that resilience is not a static quality of a person, but a process influenced by various factors, such as social setting, cognitive capacity, emotional support, and personality. Rutter (1985) describes it as an individual's ability to adapt and recover from challenging or stressful situations. According to Vanistendael (1997), resilience encompasses five dimensions: (1) informal social networks, (2) sense of life and transcendence, (3) positive self-esteem, (4) skills and competencies, and (5) sense of humor. Resilience involves cognitive, emotional, and behavioral processes that enable a person to adapt to and recover from adverse situations (Luthar, Cicchetti, Becker 2000). These processes include the ability to regulate emotions, find meaning and purpose in life, establish positive social relationships, and use internal and external resources to cope with stressful situations (Richardson 2002).

Research has shown that resilience is influenced by both innate and learned factors. The innate component refers to an individual trait or personal characteristic, known as innate resilience, which drives a person to deal with adversity positively. On the other hand, the aspect of resilience that is learned is defined as a set of variables that provide protection against stressful or dangerous situations, promoting adaptation and being amenable to development and learning (Jiménez 2011).

In the context of people with dementia or cognitive impairment, resilience has been associated with the ability to maintain a good quality of life despite the symptoms and difficulties encountered throughout the disease. According to Brodaty and Arasaratnam (2012), resilience in such individuals can be expressed through the ability to adapt to change, maintain autonomy, find new meaning in life, and have satisfying relationships with others.

In this situation, a clearly defined correlation is established that also includes caregivers as a fundamental part. According to a study by Fernández-Lansac et al. (2012), caregivers who showed higher levels of resilience also had a better emotional and physical state. Furthermore, resilience was associated more with the personal characteristics of the caregiver (such as how they perceive and manage the caregiving situation) than with situational variables (such as the severity of the patient's illness). The authors conclude that strengthening caregivers' resilience may be an effective way to improve their health and the psychological well-being of the patient.

Importance of cognitive resilience in people with dementia or cognitive impairment

Cognitive resilience refers to a person's ability to maintain optimal cognitive functioning despite the presence of risk factors for cognitive decline such as aging, illness, and stress (Abellaneda-Pérez et al. 2023). Cognitive resilience has been linked to improved quality of life and reduced risk of dementia and cognitive decline in older adults (Kivipelto et al. 2018). Casaletto et al. (2020) reported that physical and cognitive activities in older age independently contribute to cognitive resilience and may reduce the risk of cognitive decline in older adults. Another study found that meditation and yoga may

improve cognitive resilience and reduce the risk of cognitive decline in older adults (Chételat et al. 2017). In addition, other factors such as a Mediterranean diet, a sense of coherence, and the ability to cope with stress and psychological well-being are also linked to cognitive resilience in older people (Charisis et al. 2021; Cattaneo et al. 2022; Arenaza-Urquijo et al. 2020; Ryff et al. 1995; Friedman et al. 2007; Boylan et al. 2017).

A sense of coherence, which refers to a person's ability to find meaning and understanding in their life, may also be related to cognitive resilience. A study by Cattaneo et al. (2022) found that sense of coherence mediated the relationship between cognitive reserve and cognitive performance in middle-aged adults. It may therefore influence the cognitive resilience of people with dementia or cognitive impairment. On the one hand, intelligibility makes it possible to adapt to cognitive changes and to understand the necessary strategies and supports. On the other hand, belief in one's own ability to cope with cognitive challenges increases resilience, encouraging active pursuit of strategies and support in order to maintain adequate functioning. In addition, the perception of purpose and meaning in life helps individuals to face cognitive challenges with a more positive attitude, motivating them to stay cognitively active and to seek alternatives and dynamics that improve their quality of life.

Recent research has revealed an interesting connection between the ability to handle stress and cognitive resilience. A study conducted by Arenaza-Urquijo et al. (2020) found that a better ability to cope with stress was associated with lower levels of tau, a protein associated with Alzheimer's disease, in cognitively healthy older adults with elevated levels of amyloid.

The connection between psychological well-being and cognitive resilience is a relevant research topic. Several studies have found that good psychological well-being is associated with a lower risk of dementia and cognitive decline in older adults (Ryff et al. 2006; Friedman et al. 2007; Boylan et al. 2017). These findings suggest that maintaining emotional balance and good mental health may have positive effects on cognitive health as we age.

The importance of education in cognitive resilience and the prevention of cognitive decline has been supported by recent studies. For example, a study conducted by the University of California over

20 years found that more education is associated with greater cognitive resilience and a reduced risk of dementia (Valenzuela, Sachdev 2006). These findings emphasize the relevance of cognitive stimulation and lifelong learning to maintain and strengthen our cognitive abilities, even in the presence of risk factors associated with cognitive decline. In more recent research conducted by Columbia University in New York, the cognitive functioning of nearly 3,000 people was analyzed to examine mild cognitive impairment (Angevaare et al. 2021). Several determinants affecting the chances of minimizing the development of such deterioration were identified, one of which was education (Angevaare et al. 2021). The results showed that time spent in education was associated with a lower risk of mild cognitive impairment (Angevaare et al. 2021). These findings further support the idea that education plays a crucial role in protecting our cognitive health. Investing in lifelong learning may be an effective strategy to keep our minds sharp and reduce the risk of cognitive decline.

In conclusion, cognitive resilience is an important capacity for maintaining optimal cognitive functioning and reducing the risk of dementia and cognitive decline in older adults.

Inner center of control as a key pillar of resilience in people with dementia or cognitive impairment

A person's belief in their ability to control life events is related to an internal center of control (Rotter 1966). This belief can be internal or external, meaning that a person may believe that they have control over their life or that events are controlled by external factors, such as luck or fate. The relationship between an internal center of control and resilience has been extensively studied. According to Ionescu et al. (2013), people with an inner center of control tend to be more resilient in the face of social pressure and have a more positive evaluation of themselves. They are also more creative and flexible in finding solutions to problems.

In people with dementia and cognitive impairment, an internal center of control may be particularly important because of its link to resilience. According to a study by Chang and Etnier (2009), physical exercise is particularly beneficial in positively influencing the level of self-esteem, general disposition, and certain cognitive

functions. Furthermore, according to Reich, Zautra, and Hall (2010), social support and observation of resilience models may be especially important for people with dementia and cognitive impairment.

The concept of an internal center of control has been explored in different assessment instruments, such as the Personal Behavior Inventory from Collins et al. (1973), which proposes different dimensions relevant to how we see the world. The first dimension is "orientation toward others"; people with high scores in it feel pressure to conform to the expectations of others and have low self-esteem, which makes them feel powerless to control the direction of their lives. The second dimension is "internal orientation," in which people have an internal plan or "psychological gyroscope" that guides their behavior and a clear idea of the direction they want their lives to take. The third dimension is "unconstraint," in which people are creative and free-spirited, allowing them to be spontaneous and adaptive to changes in their environment (Collins et al. 1973). On the other hand, a lack of constraints can be seen as a positive dimension of the internal center of control, as people who are less constrained in their behavior may be more creative and flexible in finding solutions to problems.

Troy and Mauss (2011) noted that resilience is a multidimensional characteristic that varies by context, age, gender, culture, and individual life. The ability to dissociate from negative stimuli, including one's own negative feelings, is an important protective factor against long-term negative outcomes. Rotter's Social Learning Theory argues that human behavior is influenced by constant interaction between cognitive, behavioral, and environmental factors. Consequently, the way in which a person perceives their own control or lack thereof over events around them is relevant to the direction their life takes. According to Rojas Marcos (2010), "a fundamental element of resilience is locating and maintaining the center of control within oneself" (p. 74).

Perception of control can affect resilience, which is people's ability to cope with and overcome difficult situations. According to Smith, Dobbins, and Wallston (1991), a high perception of control can help people adapt better to chronic illness and can be especially helpful when the threat is moderate or severe. This is because perceived control can effectively influence the coping process and can have a beneficial effect on coping with adverse situations.

As previous studies have shown, there is a relationship between the locus of control and resilience: it has been found that people with an internal locus tend to be more resilient and less dependent than those with an external locus. A person's belief in their ability to control the events in their life can be internal or external and has been linked to resilience, creativity, and flexibility in problem-solving. In addition, it has been found that an internal locus of control may be especially important in people with dementia and cognitive impairment and that physical exercise and social support may increase resilience in these people.

The ability to dissociate from negative stimuli has been identified as an important protective factor against long-term negative outcomes, further highlighting the importance of an internal locus of control as a key variable in building and enhancing resilience (Wallston B.D., Wallston K.A. 1978; Troy, Mauss 2011).

Impact of resilience on physical and mental health in people with dementia or cognitive impairment

Resilience has been identified as an important factor in the physical and mental health of people with dementia or cognitive impairment according to Clare et al. (2011). Challenges and changes in their daily lives may be diverse, but resilience can help them cope and maintain good physical and mental health. In relation to mental health, Rickenbach et al. (2015) found that people with cognitive impairment who had higher levels of resilience also had lower levels of depression and a better overall quality of life. Resilience can also help people maintain social relationships and emotional support, which can have a positive impact on their mental health, according to Cohen (2004).

In a recent study, Meléndez et al. (2018) compared resilience, coping, and psychological well-being in healthy older adults, patients with mild cognitive impairment, and patients with Alzheimer's disease (AD). The results showed that resilience decreases as the disease progresses, with AD patients having significantly lower levels of resilience than healthy older adults and mild cognitive impairment patients. In addition, significant differences in psychological

well-being were found between the groups, with AD patients showing a significant decrease in the dimension of positive relationships.

Resilience has been linked to an improved ability to cope with stressful and traumatic situations, which may be beneficial for mental health, according to Campbell-Sills et al. (2006), Fumaz et al. (2015), and Hildon et al. (2010). Furthermore, resilient individuals tend to have stronger social relationships and perceive greater social support, as noted by Hildon et al. (2010) and Pidgeon et al. (2014). In general, enhancing resilience factors and resilience capacity could help both in preventing and coping with various pathologies and personal situations at any point in the developmental process, as suggested by Pidgeon et al. (2014).

Transcending Boundaries

Spirituality as a driver of resilience in people with dementia or cognitive impairment

In 1998, the World Health Organization (WHO) amended its definition of health in its constitution to include the spiritual aspect alongside the physical, mental, and social aspects. Since then, it has been widely recognized that spirituality plays a fundamental role in adapting to difficult or stressful situations, as it contributes to the development of human skills and competencies for care and preservation of life.

In general, spirituality can be understood as a complex concept that can be influenced by culture, religion, upbringing, family, and personal experiences—factors that certainly are not alien to any of us. Furthermore, spirituality can be a source of resilience and faith can be an important component of it. Spirituality can become an important and valuable source of strength, associated with improved quality of life and adaptation and resilience in the face of illness (Navas, Villegas 2006). The assessment of spirituality and its role are highly relevant elements in the comprehensive care of patients facing serious health problems or life-threatening illnesses (Radbruch, Payne 2009). Martínez, Méndez, and Ballesteros (2004) highlight the importance of spiritual well-being in reducing stress and symptoms.

Resilience is related to spirituality insofar as the latter can become a way of managing ailments, as an anchor in the midst of difficulty and illness (Martinez, Mendez, Ballesteros 2004).

Spiritual care is both a personal responsibility and the responsibility of health professionals, who have the task of attending to the spiritual dimension of the patient (Torralba 2004).

A broader definition of spirituality should encompass feelings of connectedness to self, community, and nature, as well as a sense of purpose in life (Mytko, Knight 1999: 439–450). Thoresen (1998) points out that the term *religious* refers to a person's adherence to the beliefs, values, and practices put forward by a community, which establishes ways of perceiving and experiencing life. It is also related to the ability to find satisfactory answers about life, illness, and death (Brady et al. 1999: 417–428). In this sense, spirituality can inspire people to seek connection and understanding of others, as it enables them to transcend the boundaries that separate individuals and helps them to seek a common purpose. By being aware that we are all connected and that our actions can have an impact on ourselves and others, people who have a sense of spirituality can seek ways to live and act in a more considerate and empathetic way toward others. Certainly, this is particularly relevant in people with dementia or cognitive impairment, as we can develop a greater sense of connection and purpose in life, which can help us to overcome adversity and challenges more effectively.

Innovation for Reconnection

Augmented reality: Key features

Knowing the importance of factors such as cognitive resilience and spirituality and their impact on quality of life, we can find in technology an ally capable of providing new means to enhance these concepts and adapt them to the requirements and needs of people with dementia or cognitive impairment.

Augmented reality (AR) is a burgeoning technology that has gained popularity in recent years. Unlike virtual reality technology, where the user is immersed in a software-generated virtual

environment and interacts with it through peripheral devices, AR extends the individual's interactive capabilities by establishing a connection between the real world and software-generated digital objects. These digital objects are overlaid or combined with elements of the real world, providing the user with an enriched and extended experience. AR offers a new level of immersion by allowing users to interact with the physical environment in a more dynamic and engaging way.

Basogain et al. (2007) state that AR is not intended to replace the real world with a virtual one, but rather to maintain the tangible reality that the user experiences by complementing it with virtual information. In this way, the user never loses contact with the real, physical environment in front of their eyes, while being able to interact with the digital information presented to them.

According to Azuma (1994), AR is an environment that includes elements of virtual reality and aspects of the real world. There is a combination of different stimuli from the real context and the virtual context that impact on the user, thus modifying and amplifying the possibilities for assimilation and learning. Having this continuous presence of the real world can provide people with dementia or cognitive impairment with reinforcement that facilitates this cognitive reconnection.

In order to be able to establish a connection between the real world and virtual objects or environments, AR can be applied using different methods. The pattern recognition method in AR consists of adding specific shapes or markers to the objects the user interacts with, which allows the AR system to recognize these markers and accurately overlay digital objects and their functionalities on top of the real objects, as mentioned by Kato and Billinghurst (1999).

The contour recognition method in AR involves identifying the outline of an object or part of an object and combining it with digital objects to create a more integrated AR experience between the real world and virtual elements. This approach allows for a more seamless integration between the real world and virtual elements.

The surface recognition method involves using touch screens or projections on flat surfaces, such as walls or floors, to interact with projected digital objects in real time. The application uses image recognition to allow for a more immersive, realistic interaction with the

virtual environment. This method allows the user to interact with digital objects in a more natural and fluid way, providing a more immersive and engaging AR experience.

The location recognition method is based on identifying the user's location using geolocation systems such as GPS. From this information, a virtual environment is generated that is able to relate to the user's real environment, allowing the superimposition of digital objects in the physical space in a precise and contextualized manner. This method allows for a more integrated AR experience with the real world and may present a viable alternative in the context of dementia or cognitive impairment with orientation problems.

The implementation of these recognition methods plays a key role in creating immersive, accurate AR experiences. Thanks to them, a seamless interaction between the physical environment and the digital elements is achieved, providing a seamless integration between the real and virtual worlds.

In addition to these methods, different authors categorize different levels of AR according to their complexity and the technologies involved (Estebanell et al. 2012; Lens-Fitzgerald 2009; Rice 2009):

- Level 0 uses the technique of hyperlinking the physical world. This is achieved through the use of barcodes, QR codes, or other image recognition methods. At this level, the codes act as links to other content without any 3D registration or marker tracking. It is similar to an HTML hyperlink, but without the need for manual typing.
- In AR Level 1, the marker technique is used as a basis. This involves 2D and 3D pattern recognition. According to Estebanell et al. (2012), markers are mainly square black-and-white images with simple, asymmetric designs. This type of marker can clearly be useful in patients with dementia or cognitive impairment, as they allow us to parameterize specific triggers associated with different cognitive stimuli and to generate work patterns and sequences adapted to each patient.
- Level 2, markerless AR, uses the GPS coordinates of electronic devices to geolocate and superimpose points of interest on real-world images. Lens-Fitzgerald (2009) defines it as GPS-compass-based AR.

- Level 3 is augmented vision. Rice (2009) argues that it is necessary to transcend the monitor or display in order to adapt to different formats of wearable displays (such as glasses). Once AR becomes AV (augmented vision), it becomes immersive. The overall experience becomes more relevant and impactful on a contextual and personal level.

Consequently, this mixed reality—in which coherent integration is achieved between the elements of the physical world and a layer of digital information—is integrated in real time with the physical environment, allowing a richer and more enriching interaction with the reality in which the user finds themselves. In short, an alteration and/or enrichment of the information of the physical reality is achieved through the integration of the digital layer in the AR experience.

Therapeutic potential of augmented reality in dementia care and cognitive impairment

Augmented reality has been explored as a therapeutic tool in dementia care and cognitive impairment. According to Corregidor-Sánchez et al. (2020), AR can improve activities of daily living in older people, including those with dementia. Furthermore, Lee et al. (2019) suggest that AR has the potential to promote well-being in older adults by providing immersive and enriching experiences. In a systematic review study, Zheng et al. (2020) found that AR video games can improve the emotional well-being of older adults. Furthermore, in a meta-analysis by Ng et al. (2019), AR was found to improve physical performance and psychological outcomes in older adults.

Regarding cognitive therapy, Irazoki et al. (2020) found that cognitive training technologies, including AR, can improve cognitive function in people with mild cognitive impairment and dementia. It has also been shown that AR can improve memory in older adults (Cao 2019). According to Quintana and Favela (2012), AR applications can provide real-time visual annotations to help dementia patients perform everyday tasks, such as identifying objects and remembering names. In addition, AR can also help improve spatial orientation and memory, as demonstrated in a study by Corrêa et al. (2007) that used the GenVirtual application for cognitive and motor

rehabilitation. In another study, Chapoulie et al. (2014) used reminiscence therapy in AR to improve the quality of life of patients with dementia. The therapy consisted of presenting patients with images of familiar places and objects, which allowed them to recall past events and stimulate memory. In addition, AR can also be used for the assessment and diagnosis of dementia, as discussed in an article by García-Betances et al. (2015) which reviews the use of VR and AR in the assessment and treatment of Alzheimer's disease.

According to Dishman (2004), AR can be used to create welfare systems that allow people with this type of impairment to delay their hospitalization. Undoubtedly, prolonging as much as possible the autonomy and independence of people with dementia or cognitive impairment brings about an improvement in their quality of life. We can even consider the use of this technology from a preventive point of view, as it can be used for activities that mentally stimulate the patient, such as reading the newspaper and playing computer games, which can reduce the risk of Alzheimer's disease (Papastefanakis et al. 2011).

It is difficult to dissociate one profile of dementia or cognitive impairment from another, such as that of a caregiver, whether a professional or family member. A profound relationship is established in which AR can be an important tool to reduce the efforts and stress associated with caring for patients with Alzheimer's disease (Al-Khafaji et al. 2013). In the same vein, AR is also effective as a communication tool between patients and caregivers, as demonstrated by the CIRCA software used in research in Scotland (Dishman, Carrillo 2007).

We can affirm that AR offers a broad therapeutic potential in care for dementia and cognitive impairment patients. By enabling mental stimulation, improving communication, strengthening memory, and reducing caregiver stress, AR is positioned as an effective tool in improving activities of daily living, emotional well-being, cognitive function, and memory in older adults. Moreover, its usefulness ranges from rehabilitation and reminiscence therapy to assessment and diagnosis. However, more research is needed to fully exploit its potential in this field and to develop more effective, personalized applications tailored to the specific needs of patients with dementia or cognitive impairment.

Personalization of augmented reality for patients with different cognitive needs

The personalization of augmented reality is especially important in the context of interaction with patients with dementia or cognitive impairment. The use of colors and high contrast that are more visible and easier for the patient to distinguish, or the use of gamification tools that more actively and playfully involve the patient in the AR experience, can be considered. It is also recommended to adapt the quantity and complexity of the digital elements to the patient's cognitive abilities and attention span, in order to avoid mental and information overload that may hinder interaction and planned stimulation.

According to Pensosi and Villamía (2012), AR makes it possible to create different scenarios that personalize a suitable environment for the patient and, depending on their changes, increase the difficulties of this reality and thus allow the medical team to make different evaluations according to the results.

We can conclude that the capabilities and functionalities of AR can be customized for patients with different cognitive needs. It can be adapted to different scenarios and levels of cognitive impairment and it can provide a learning experience more tailored to the individual patient's needs. This demonstrates the potential of AR in the treatment of cognitive impairment and dementia.

Evaluation of the effectiveness of augmented reality in the treatment of patients with dementia or cognitive impairment

One of the great challenges may be evaluating the effectiveness of augmented reality in the treatment of patients with dementia or cognitive impairment, which is undoubtedly a highly complex issue due to the different situations that may arise. We must focus on quality of life as a referent outcome variable to study the effectiveness of possible interventions in people with dementia or cognitive impairment without ignoring the difficulty involved in evaluating it, which stems from the fact that it is a complex construct for which there is no single theoretical or conceptual approach.

To assess the effectiveness of AR in the treatment of patients with dementia or cognitive impairment, self-report measures and scales

can be used to collect the direct assessment of the subject, as well as proxy information provided by caregivers through interviews. In addition, systematic observations through tools such as Dementia Care Mapping (DCM) can be used to assess the observed behavior of patients during treatment. Specific instruments such as the Quality of Life in Alzheimer's Disease (QOL-AD) can also be used to assess the quality of life of patients.

We can therefore consider that the evaluation of the effectiveness of augmented reality in the treatment of patients with dementia or cognitive impairment is a complex issue that requires specific measurement instruments adapted to the needs of each patient.

Conclusions

Spirituality is achieved through transcendence, understood as the ability to transcend the self and turn toward others, thus establishing personal and material relationships that give meaning to life. Fundamental to achieving this is the perception of having some control over oneself and thus over one's own life. This self-perception is closely linked to our inner center of control, which acts as a fundamental pillar of resilience.

In this context, augmented reality technology plays a relevant role in enabling people with dementia or cognitive impairment to experience the feeling of intentionally interacting with their environment. This not only promotes improved autonomy, but also has a positive impact on the quality of life of both the person with dementia or cognitive impairment and their caregivers.

When people with dementia or cognitive impairment are able to have more control over their lives through augmented reality, it opens a path toward regaining their lost autonomy. This translates into an improvement in their quality of life, as they can actively participate in daily activities, interact with their environment, and establish meaningful connections with others. In turn, this improved autonomy also has a positive impact on the lives of caregivers, who experience lower stress levels as they see their loved ones regain some independence and well-being.

In short, not only does the perception that they are linked to the internal center of control revitalize their resilience, which—together

with the improved autonomy facilitated by augmented reality—contributes to transcendence toward others, but it is precisely this transcendence that we can associate with spirituality, generating a positive impact on the quality of life of both people with dementia or cognitive impairment and their caregivers.

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