Chapter 8
Gamification Applied to Autism Spectrum Disorder

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ABSTRACT

Gamification is a recent technique in software development that allows the application of game principles to non-game contexts and environments. In an increasingly technological world, gamification has now higher popularity, and it is currently used in several technologies. One of the health conditions where gamification can bring great benefits is in autism spectrum disorder (ASD), which is a persistent neurodevelopmental disorder that can be characterized briefly by deficits in verbal and non-verbal communication, difficulties in interaction, and manifestation of stereotyped movements or interests. In the case of ASD, the programs, software, or the mobile applications should focus on the development of intrapersonal (such as motivation) and interpersonal (social skills) skills. Therefore, gamification can be useful in cases of ASD, but it is necessary to increase the analysis of the potentialities and needs for improvement of technologies and applications available on the market.

INTRODUCTION

Medicine and health treatments are usually associated with live sessions as a traditional in-person approach. However, with the rapid development of digital technologies, such as the internet or communication devices, it was possible to expand the health services to other approaches, namely telehealth (Weinstein et al., 2018).

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According to World Health Organization (2010), telehealth can be defined as *"the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies, for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, in all the interests of advancing the health of individuals and their communities"*. In addition, telehealth is a term used to encompass a broader application of technologies for the application of evaluative, consultative, preventive, and therapeutic services delivered through information and communication technologies that support health care services, such as video conferencing, mobile apps and secure messaging (Brown-Jackson, 2019; Kruse et al., 2017). After some research, it is clear that sometimes the terms "telehealth" and "telemedicine" are defined differently, however throughout this paper, following the WHO line, no distinction will be made between telehealth and telemedicine, so the term 'telehealth' will be used for both (Kruse et al., 2017).

Telehealth has shown enormous potential to improve the reach and availability of treatment since it covers a variety of modalities that can be used for different conditions and populations to increase the affordability of treatment. This may be due to the lower cost usually associated with technologically based treatments and the increase the sense of confidentiality, because in nowadays some people prefer not to be seen in a healthcare setting (Granja et al., 2018; Marsch et al., 2014; Shigekawa et al., 2018). In addition to these advantages, the technology allows us to measure what the individual is experiencing in an objective, non-reactive way. Also, it allows the person applying the intervention to provide personalized feedback in real-time (Marsch et al., 2014). These advantages are due to the possibilities of communicating with a doctor or therapist, monitoring symptoms and providing therapeutic education. Literature also presents the efficiency of these technologies in the screening and treatment of several mental health pathologies (Shigekawa et al., 2018).

Even though there are many advantages of telehealth in the literature, it is necessary to highlight some disadvantages about telehealth, such as the difficulties in the palpation or use of touching on patients, which in a different point of view could be considered beneficial for the patient, since that, in some instances, this lack of proximity may increase openness to specific issues, such as sexuality and family problems (Weinstein et al., 2018). Beyond these, the literature indicates that there may be a breakdown in the relationship between health professional and patient. The risk of bad network connection, device breakdown or even lack of skills for using the digital tool may also be a disadvantage for the users (Daragó et al., 2013; Hjelm, 2005). In addition to this, the adherence rates to the use of health technologies are not as expected, so it was necessary to develop some strategies that can enrich this type of interventions (Cheng, 2020).

Telehealth also shows some difficulties to be implemented due to bureaucratic and ethical issues, such as problems with existing policies, rules or laws for remote health care delivery, problems to ensure the quality of the care provided, problems with malpractice liability and, finally, problems with data protection and confidentiality, due to the increased risk of unauthorized access to patient's personal and medical information (Daragó et al., 2013; Hjelm, 2005).

GAMIFICATION'S STATE OF THE ART

Today, there is no doubt that technology can facilitate the creation of various interventions, whereby this chapter will focus on Gamification and its applications (Marsch et al., 2014).

Currently, there are already several technology-based interventions such as computer-assisted modules and exposure-based interventions where virtual reality is used to simulate certain situations that may be difficult to experience in real life (Bickel et al., 2008; Bordnick et al., 2008; Carroll et al., 2008; Marsch et al., 2014; Rothbaum et al., 2012). Furthermore, there are applications and/or games that seem very attractive to make interventions in certain age groups, such as children and adolescents (Arzone et al., 2020; Bickel et al., 2008; Carroll et al., 2008; Dennison et al., 2013; Marsch et al., 2014; Sheehan et al., 2012).

In the middle of the 21st century, the generations are highly dependent of technologies. They have grown up with the influence of technology, which has had a significant impact on how they communicate and socialize and engage with each other. The gamification technique arises to respond to the changes imposed by new generations in several contexts (Gupta & Gomathi, 2017).

Gamification consists of "*the use of game design elements in non-game contexts*.", which popularity has been increasing over the years (Cheng, 2020; Deterding et al., 2011). But there are many definitions in the literature of gamification, like the one defended by Huotari and Hamari (2012), *"a process of enhancing a service with affordances for gameful experiences in order to support [a] user's overall value creation".* The essence of gamification is not found in technology but the environment; it promotes the diversity of learning paths and individuals' decision and reward systems (Busarello, 2016).

The term "gamification" is often used associated with a serious game; nevertheless, Deterding et al. (2011) go further on this association and defends that gamification is a concept that is included in serious games, which consists in the *"use of games, but with a serious background*". The primary purpose of this type of game is more than entertainment, and they aim to promote learning and behavioral change (Sardi et al., 2017; Tolks et al., 2020; Wouters et al., 2009). Often the serious games approach conveys serious and relevant content/information, such as health and/or education issues. This approach is attractive as it is fun, immersive, and engaging (Arzone et al., 2020; Sardi et al., 2017; Tolks et al., 2020; Wouters et al., 2009). They are widely used to promote learning, especially in health and education; however, they are designed to solve various problems more engagingly (Lau et al., 2017; Sardi et al., 2017; Tolks et al., 2020; Wouters et al., 2009). The main aim of serious games is to generalize the learning achieved through play and that this improves a person's wellbeing and quality of life in everyday life. In comparison with games built for entertainment it is possible to observe differences, since it is not expected that with those games skills are acquired or knowledge is generalized beyond that context. In entertainment games the motivational strategy used is points as a form of reward, in the case of serious games the strategy used is based on intrinsic motivation so that learning is acquired in a more sustainable way. Serious games can only achieve these goals if they include in their construction basic concepts of video games, which allow the creation of immersive and comfortable environments. It should be noted that this type of game is always based on theories of learning and development theories (Whyte et al., 2015).

Usually, gaming is considered a leisure activity for people to engage in during their free time, leading people to understand it as just a hobby (Gupta & Gomathi, 2017). Initially, gamification emerged to use people's interest in engaging in gaming activities and combining it with painstaking work to apply the results in education, marketing, employee engagement, and other business and management activities. Overall, what has been attempted to do is to merge the concept of work and play (Gupta & Gomathi, 2017).

In order to promote or increase certain skills during serious games, it is necessary that the goals set are challenging, i.e. not too complex, but achievable in a safe and supportive environment. As already mentioned, the game should not be expected to be so difficult that it frustrates the participant or makes them want to give up (Whyte et al., 2015).

When this kind of element is used in games, it is always based on some theoretical model, i.e. models that relate challenge to learning (Whyte et al., 2015). These theoretical models that relate to providing achievable challenges in learning can be Vygotsky's Zone of Proximal Development (Barab et al., 2005; Vygotsky, 1980) and the concept of 'flow' theory in task involvement (Shernoff et al., 2014). In the case of 'flow' theory, this suggests that engagement in learning increases when the challenges proposed and the skills to be acquired are balanced. Importantly, both models indicate that a mismatch between the difficulty of the game and the level of skills to be increased may result in decreased motivation, engagement and therefore learning (Whyte et al., 2015).

It should be noted that each person has different levels of what they find challenging, so in the case of serious games there needs to be individualised moments, so that the difficulty increases in a gradual and personalised way. In this way, the game slowly increases in difficulty in a way that is consistent with each player's individual ability (Whyte et al., 2015).

Serious games use game elements and structures based on gamification, such as badges, medals, leader boards, goals points, missions and records, as well as storylines and narratives, feedback and rewards, progressive challenges, avatars, collections, goals directed learning around targeted skills, increasing levels of difficulty, individualization and provision of choice (Cheng, 2020; Gobbo et al., 2018; Lee et al., 2017; Miller et al., 2016; Sardi et al., 2017; Valencia et al., 2019; Whyte et al., 2015).

In fact, badges are used when a task is completed as it motivates the individual by increasing a sense of pleasure, accomplishment and a feeling of control (Gobbo et al., 2018; Lee et al., 2017). In addition, medals usually come in three colors, namely bronze, silver and gold, which is helpful for easy visualization of the result (Gobbo et al., 2018; Lee et al., 2017). Beyond these, the questions present in the game should be simple and very objective as a way to facilitate its understanding, and the use of avatars shows great advantages, since literature finds the improvement in skills related to nonverbal social behaviours when it shows facial expressions (Barajas et al., 2017; Ern, 2014). Thus, creating a storyline or narrative that incorporates and contextualises the skills and/or objectives that need to be learned, is one of the most effective elements for increasing motivation for learning. This type of element in the construction of serious games increases enthusiasm, immersion in the context and thus learning. In general, creating an in-game storyline allows people to be willing to learn content in a context that is meaningful to them. As already mentioned, in serious games the story narrative is always constructed with a focus on learning deficit skills. (Lu et al. 2012). The use of story lines that include carefully thought out characters allows for the improvement of social skills, such as empathy, and also increases intrinsic motivation to learn skills, as participants relate to the characters, creating emotional connections, often participants identify with the characters creating empathy for them. Of note, to create an even more immersive environment, character development should be high and the creation of dialogue may be beneficial (Dickey, 2005, 2006). The use of feedback and the provision of progressive rewards throughout learning are crucial for shaping behaviour as participants try to achieve the planned goal of that serious game. In the construction or design of the serious game, rewards and feedback, try to include both intrinsic and extrinsic motivation needs. Compared to entertainment games, it can be seen that entertainment games focus mainly on extrinsic and immediate rewards, i.e. there is usually an immediate visual or auditory reward, an increase in game points or a level-up on the leaderboards, which include the points of the other players. In serious games, as the focus is on both types of motivation, what occurs is feedback, not immediate, but with the completion of long-term goals in order to reinforce the intrinsic motivation for learning, throughout the progress is given feedback with the information of the evolution. It is emphasised that serious games are designed so that there is an involvement of the player in the game and in learning the skills that are

difficult to acquire, it is never expected that there is frustration on the part of the participant. Negative feedback can trigger a decrease in motivation to continue playing. It is therefore easy to understand that the continuous provision of feedback and rewards for progress towards the long-term goal is essential (Whyte et al., 2015).

According to Cheng et al. (2019), the average number of game elements included in mental health apps or programs used is five. These tools exploit the inherent interest in competition, status, achievement, self-expression and altruism. The primary strategy of this technique relies on providing rewards to players who achieve the goal of the proposed task (Gupta & Gomathi, 2017).

The playable elements allow what Huotari and Hamari (2012) defines as "*gameful experience*", which is possible with factors identified by Eppmann et al. (2018) and Högberg et al. (2019), such as enjoyment, absorption, creative thinking, activation, absence of negative effect, dominance, accomplishment, challenge, competition, guided[ness], immersion, playfulness, and social experience.

Gamification can be used in various contexts, but when relating it with the provision of health services, it is possible to mention that some of the tasks proposed by professionals are boring, repetitive, frustrating and sometimes painful (Martins & Dores, 2021). Associating this type of task with a fun game may have many benefits since people associate this type of activity with pure entertainment (Martins & Dores, 2021).

The most used technologies for gamification are associated with mobile applications, internet-based resources or immersive environments (associated with virtual, augmented or mixed reality) (Carmona-Serrano et al., 2020).

Five variables define the concept of gamification, namely learning (getting out of the routine, encouraging behaviour, adapting content and piquing curiosity), game mechanics (mechanics guide actions, dynamics are interaction with mechanics and aesthetics are emotions in interaction), narrative (living history, mastery of history and interactive elements and stories are engaging and moving media), motivation and engagement (challenge, fantasy and curiosity) and finally thinking as in games (goal, rules, feedback and participation) (Busarello, 2016).

For these reasons, gamification is experiencing an increase in its usability. It is essential to stand other factors seen as potentialities, such as current accessibility to technology, facility to increase the intrinsic motivation attractiveness and applicability, cost-benefit efficiency and ease of insertion into the daily routine (Arzone et al., 2020; Johnson et al., 2016). Through these, it is easily understood that this approach is applied to healthcare settings, such as inpatient monitoring, physical or cognitive intervention or in modifying risk behaviours that may interfere with the patient's wellbeing and health (Christie et al., 2019; Johnson et al., 2016; Lee et al., 2018). For the healthcare provider to achieve the patient's complete state of wellbeing, it is relevant to keep the patient motivated throughout the process. Currently, it is already known that the use of game elements can provide an increase in intrinsic motivation, the expressed commitment and higher performance, both in qualitative and quantitative terms, which suggests the potentialities of gamification and its beneficial impact on health (Arzone et al., 2020; Johnson et al., 2016).

It is essential to highlight the creation of a model that regulates the interventions on the Internet (named Internet Interventions Model), which reveals the characteristics of users that influence the interaction with the intervention, such as disease type and severity; demographics; psychological traits; cognition; attitudes and beliefs; physiological factors; and skills (Cheng, 2020; Ritterband et al., 2009). As these characteristics differ from person to person, it is essential to adapt each app or serious game to the individual to enhance the potential of self-satisfaction and clinical improvements (Arzone et al.,

2020). That can be possible with simple customization and adaptation according to interests and/or individual needs (Cheng, 2020).

However, gamification tools should be used with care as their implementation can damage the intention to contribute to the community and the quality of the members' experiences (Leclercq et al., 2020). It is crucial to understand some aspects that need to be considered when clinicians suggest the use of gamification in therapy, such as suitability, the use of technology as a coherent system, acceptability, impact and comprehensive documentation and description of the game (Cheng, 2020).

Hereupon, the knowledge about gamification's advantages and potentialities in the health field allows the expansion of its use in multiple pathologies and clinical presentations (Lokhorst, 2014). One of these is Autism Spectrum Disorder (ASD), which benefits from the use of digital technologies in several ways (Carmona-Serrano et al., 2020).

AUTISM SPECTRUM DISORDERS (ASD)

The ASD are persistent behavioural disorders that deficits can briefly characterize in terms of verbal and non-verbal communication and interaction, being observed stereotyped movements, without an obligatory intellectual commitment (Brewer et al., 2017; Geretsegger et al., 2014; National Collaborating Centre for Mental Health, 2013; Strunk et al., 2017; Weitlauf et al., 2014).

There is no consensus regarding data and statistics due to methodological issues and differences between the population of countries. However, according to Lyall et al. (2017), the prevalence of ASD is estimated at approximately 1.5% in developed countries worldwide.

Despite these data, it is well known that the prevalence of ASD has increased dramatically. (Martins & de Melo, 2020; Newschaffer et al., 2007; Thompson et al., 2018). Regarding the prevalence of the condition by gender, it is higher in males, corresponding to one woman for every four men (Maenner et al., 2020; Martins & de Melo, 2020; Murphy et al., 2016). The ASD occurs with no distinction between race, ethnicity and socioeconomic group (Maenner et al., 2020).

The term "spectrum" refers to the diversity of symptoms and clinical manifestations across individuals with ASD, which ranges from low to high-functioning Autism (Andreou & Skrimpa, 2020; Arzone et al., 2020; Carmassi et al., 2019; Davidson & Orsini, 2013; Hendricks, 2010). Besides Autism's disorder, the spectrum includes Asperger's disorder, Rett's disorder, pervasive developmental disorder not otherwise specified, and childhood disintegrative disorder (American Psychiatric Association, 2014).

ASD is a heterogeneous condition since its clinical presentations are varied both in terms of symptoms and severity (Andreou & Skrimpa, 2020). Therefore, the functional consequences associated with ASD can go from mild impairments to severe impairments in academic, social and personal life (Carmassi et al., 2019).

Individuals with ASD show deficits in socialization (sharing interests, for example) and in non-verbal communication (use of inappropriate gestures and facial expressions or even lack of its use, lack of eye contact); manifest lack of social and emotional reciprocity; present restricted and repetitive patterns of behaviour, including stereotypies (such as flapping and balancing, stereotyped speech and echolalia); show difficulties to maintaining appropriate relationships (creating friendships, adapting behaviour to the context and situation); express excessive adherence to routine and atypical sensory interests or responses (more than 40%); do not share their pleasure; react atypically in response to the display of anger, affection and other emotions, show lack of imitation games; show little cognitive flexibility and prefer

predictability, having difficulties in performing several tasks at the same time; may present cognitive impairments, which can vary across the spectrum (occasionally, the intellectual level ranges from superior intellect to profound intellectual disabilities, which is closely related to the concept of spectrum); and, as a core feature, social and communication deficits, with a language delay (American Psychiatric Association, 2014; Chojnicka & Wawer, 2020; Gyawali & Patra, 2019; Mahajan & Mostofsky, 2015; National Collaborating Centre for Mental Health, 2013; Navan & Khaleghi, 2020; Weitlauf et al., 2017). Statistics show that about 40% of children with ASD do not speak at all, 25% to 30% of children say just a few words between 12 and 18 months of age and then stop saying and other children can speak but not before childhood (Maenner et al., 2020). The above characteristics are the most obvious and evident in this condition and stand out specifically in social situations present in everyday life, compared to neurotypical children (Kinsell et al., 2015).

ASD is related to the concept of the Theory of Mind, which tries to explain the social interaction difficulties in individuals with this pathology. This concept is associated with mentalization deficit, which prevents them from inferring mental states, beliefs, and behaviours (Baron-Cohen, 1999). This deficit is observed at the brain level, since this affection can be seen in changes in the brain circuit responsible for empathy, involving structures such as the amygdala, cingulate gyrus, prefrontal cortex, among others. The connection between frontal and parietal lobes is also affected, which will condition the cognitive part - deficient development of the theory of mind, executive functions, subjectivity (National Collaborating Centre for Mental Health, 2013).

ASD is associated with other pathologies, which are not part of the diagnosis, but which contribute to the individual's functional impairment, wherein statistics show that about 70% of individuals meet the criteria necessary to be diagnosed with at least one comorbidity (Gotham et al., 2015; National Collaborating Centre for Mental Health, 2013). The most common comorbidity is intellectual disability, corresponding to approximately 30% of cases and historically estimated to be approximately 70% (Lewis, 2018; Lyall et al., 2017). In addition, there are others, such as anxiety, depression, oppositional defiant disorder, tics, epilepsy, gastrointestinal abnormalities, sleep disorders, immune deficits and attention deficits, which occur in about 30-40% of cases (Gyawali & Patra, 2019; Lyall et al., 2017; Mahajan & Mostofsky, 2015; Oliveira, 2009). Moreover, up to 15% of cases of ASD may be related to another clinical disorder or syndrome (Fragile X Syndrome, for example) (Lyall et al., 2017).

Even if ASD are frequently seen as childhood disorders, nowadays, it is well known the persistent character of the individual's symptoms (Evans, 2017). The symptoms are permanent and impact adulthood of those who have ASD. However, as the development occurs, it is common to experience the decline of symptomatology due to the normalization of brain size (Mahajan & Mostofsky, 2015; Shattuck et al., 2007). Furthermore, it is essential to highlight the fact that many adults manage to hide their symptoms, finding some compensation strategies to implement in their daily routine, both to social and non-social skills, which also justifies the lower than expected number of diagnoses in this age group (Lewis, 2018; Livingston et al., 2019).

The features in adulthood are similar to those observed in childhood. However, they are sometimes more conditioning since adults have more significant demands and needs for personal development, such as looking for professional and educational opportunities, community participation and in-home care activities. A substantial percentage of individuals with ASD need personal support in adulthood due to this condition (Enner et al., 2020; Tromans et al., 2018).

For a better understanding of this condition, it is essential to stand the origin of the characteristics associated with ASD (Lyall et al., 2017; Sandin et al., 2017). The etiology of the genetic contribution to

the disorder of the autism spectrum is strongly supported by studies of families and twins, contributing to some estimates of heritability varying between 50% and 95% (Lyall et al., 2017; Sandin et al., 2017).

Nowadays, knowing the relevance of epigenetics in gene expression allow us to accept that the child's experience may influence anatomical and physiological alterations in brain functions identified as possible markers and expected in this medical condition (Carmassi et al., 2019; Mahajan & Mostofsky, 2015). Therefore, in ASD, this relation between genetics and epigenetics is considered the most validated theory (Carmassi et al., 2019).

The brain anatomy in ASD starts to change in the early development (that is why ASD is considered an early-onset condition), during the peak synaptogenesis and the maturation of neural networks (Carmassi et al., 2019; Mahajan & Mostofsky, 2015). That means that changes in the neurotypical development in specific structures may influence other structures' development, which directly affects the neural circuits required for the typical development of the child (Mahajan & Mostofsky, 2015).

At the moment, there is no knowledge about specific biomarkers for the diagnosis, which is usually made after observing the individual's behaviour (Vargason et al., 2020; Yahata et al., 2016). However, it is possible to find abnormalities in susceptible genes so it is common to also find abnormalities in cerebral areas related to symptoms observed (Enner et al., 2020; Vargason et al., 2020).

Nonetheless, it is well known that the hemispheric asymmetries found in autism spectrum disorders, with impairments in the left hemisphere are associated with social communication, language, and motor-related skills (Peterson et al., 2015; Wilkinson et al., 2016). It is postulated in the literature that this can be due to the more considerable susceptibility of this hemisphere to suffer the influence of the environment during neurodevelopment (Floris et al., 2020; Geschwind et al., 2002; Peterson et al., 2015; Stroganova et al., 2020).

Even if the literature is not consistent and clear about all the mechanisms associated with the heterogeneous manifestations of autism, it is known, or at least considered, that the brain experiences a precocious development during the first year of life, however this development delays as the child gets older (Amaral et al., 2008; Tunç et al., 2019). In fact, the statistics show that up to 10% of children with autism evidence brain enlargement (Amaral et al., 2008).

Similar to what is observed in the cerebral cortex, other brain structures seem to be enlarged in Autism, such as the cerebellum, amygdala (which experience differences in the developmental process in Autism and is mainly associated with the deficits in social and communication skills), but also basal ganglia, thalamus, corpus callosum and caudate nucleus (which is associated with repetitive behaviours) (Amaral et al., 2008; Postema et al., 2019; Wilkinson et al., 2016).

With these being said, as structures affected in ASD, the literature highlights the frontal, temporal and cerebellar cortices, which are directly associated with alterations in the "social brain" and in structures associated with sensory processing and attention mechanisms, which are features impaired in ASD, as mentioned before (Carmassi et al., 2019; Mahajan & Mostofsky, 2015).

Even with all of this knowledge, it is not easy to stand out precisely the anatomical differences because of all the heterogeneity of characteristics, presence of diverse comorbid conditions, differences among studies and methodologies used, and reduced sample sizes (Amaral et al., 2008; Peterson et al., 2015; Postema et al., 2019; Wilkinson et al., 2016). Beyond that, some factors influence the generalization of the findings regarding neuroanatomy, such as age, sex and the taking of medication (Yahata et al., 2016).

It is essential to also stand environmental risk factors that, allied with the genetic and epigenetic factors mentioned above, play a role in determining the risk of Autism and appears to be transgenerational (Dietert et al., 2011; Modabbernia et al., 2017).

The most frequent risk factors identified so far fall into drugs, environmental chemicals, infectious agents, dietary factors and other physical or psychological stressors. (Dietert et al., 2011; Modabbernia et al., 2017). It is further highlighted some prenatal factors (threatened abortion, hypertension, drug abuse, mental health conditions and obesity); perinatal factors (pre-term birth, cesarean section, pregnancy complications) and postnatal factors (hypoxia, neonatal jaundice, pallor, routine vaccine, low birth weight) (El-Baz et al., 2011; Guisso et al., 2018; Hisle-Gorman et al., 2018; National Collaborating Centre for Mental Health, 2013). Beyond these, the increasing age of parents is also one of the most identified risk factors for disturbance of the autism spectrum. Higher ages can independently influence the risk of autism spectrum disorder (National Collaborating Centre for Mental Health, 2013; Oliveira, 2009).

The diagnosis of ASD is made according to the existing classification systems. In recent years, and after the publication of the Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition, children are diagnosed with ASD, rather than subclassifications of the spectrum, such as autistic disorder, Asperger's syndrome, or invasive developmental disorder - not otherwise specified, as already mentioned (American Psychiatric Association, 2014).

The evaluation process, as a rule, is based on several evaluation stages, among which the historical record where parental concerns, neonatal history, birth, family history and socioeconomic condition are ascertained; the examinations; the observation, where play is used to identify specific behaviors and check the interaction, speech and gestures of the individual; the indication of the developmental profile and finally the determination of the diagnosis through the DSM-V (Mukherjee, 2017). Sometimes the assessment also allows for an evaluation of comorbidities that may occur in Autism (Mukherjee, 2017). Thus, there is no marker or diagnostic test for Autism, so the diagnosis is based on behavioural attitudes. The manifestations are not all observed initially but are assumed over time (Garland et al., 2013; National Collaborating Centre for Mental Health, 2013).

In Autism spectrum disorder, similar to other medical conditions, it is crucial to have a team with training and experience in this disorder to provide the best service and follow-up (Martins Halpern et al., 2021). The multidisciplinary team may include professionals from the fields of paediatrics in the area of neurodevelopment, psychiatry, psychology, nursing, social work, speech therapy, occupational therapy, special education and rehabilitation, those that should be carried out individually in order to provide a specialized service and consequently improve the best outcomes (Dillenburger et al., 2014; Martins Halpern et al., 2021). It should also be noted that, as ASD intervention is also carried out with the adult population who have this condition, the multidisciplinary team remains with a similar composition and essentially aims not only to provide a transition to adulthood (in cases where the diagnosis is made in childhood) but also to guide and advise on the best path that the individual should follow, allowing for the best outcomes in terms of self-awareness, self-efficacy, self-advocacy and ultimately self-determination (Abbott, 2019; Dillenburger et al., 2014). That said, one of the common goals in multidisciplinary teams is the shared interest in improving the quality of life of individuals with ASD as well as their families, which response to the main intervention goals with this population (Dillenburger et al., 2014).

As mentioned above, deficits in social and emotional skills are the main characteristics of individuals with autism spectrum disorder (Carlier et al., 2020; Malinverni et al., 2017). Many of the studies focus on the deficit skills already mentioned, such as facial and emotion recognition, social attention bias, imitation, turn-taking, cooperation and vocalization (Carlier et al., 2020; Hillier et al., 2020; Lee, 2021; Mubin & Poh, 2019; Wendt et al., 2020). However, several studies associated with ASD comorbidities, namely anxiety, stress and sedentary lifestyles, are beginning to emerge (Carlier et al., 2020; Hillier et al., 2020; Lee, 2021; Mubin & Poh, 2019; Navan & Khaleghi, 2020; Wendt et al., 2020).

Currently, some methods and interventions to promote behavioural change in these cases have been identified and evidenced (Malinverni et al., 2017). Most of the traditional approaches are related to cognitive behavioural therapies, social skills learning programmes, natural teaching strategies, parent training and play-based interventions (Mairena et al., 2019; Malinverni et al., 2017). However, for there to be data on the effectiveness of this type of intervention, treatment needs to be fairly continuous and intensive (Mairena et al., 2019).

In fact, basic principles that support evidence-based interventions conducted with individuals with ASD stand out from those of the Applied Behaviour Analysis (ABA) method (Cadieux & Keenan, 2020; Hyman et al., 2020; Mukherjee, 2017). This methodology stands out for the importance of defining and measuring the individual's behaviour, then analyzing and presenting feedback to correct it, and in a dynamic process of adapting the individual's performance (Cadieux & Keenan, 2020).

Regarding the performance of individuals with ASD, it is imperative not only to pay attention to improving behaviour and social skills but also to generalize them to contexts other than those used in training, a skill that is also impaired in ASD (Cadieux & Keenan, 2020; Kinsell et al., 2015). In addition to this methodology, it should be noted that early intervention will be essential to develop the most affected behaviours before they worsen, so intervention during early childhood is the most effective way to decrease ASD symptoms and provide the best possible prognosis (National Collaborating Centre for Mental Health, 2013; Strunk et al., 2017; Weitlauf et al., 2014). Therefore, the intervention plan should be individualized and should address the strengths and weaknesses of the affected child; the learning situation and family environment should also be considered (Abbott, 2019; Strunk et al., 2017). However, the intervention's effectiveness is related to the age of the child at the beginning of the treatment and its intensity (regarding the duration of each session and treatment in general) (Mubin & Poh, 2019).

GAMIFICATION TO SUPPORT INDIVIDUALS WITH ASD

In recent years, with the growing interest in technology, the intervention has been evolving and developing through the potential of some computer systems (Malinverni et al., 2017). The use of technologies in people with ASD is used in several areas, such as education, communication, behaviour and sensory issues (Kim et al., 2020; Koumpouros & Kafazis, 2019; Lee, 2021; Liu et al., 2017; Valencia et al., 2019; Zakari et al., 2014). This approach is supported by the fact that children with autism as well as their typically developing peers enjoy playing computer games in their free time. In addition, computer games and the privacy that the gaming environment provides, makes it non-threatening for children who have deficits in both practice and acquisition of certain skills (Kapp, 2012; Whyte et al., 2015). Thus, since it is known that intervention in ASD can be facilitated with the use of new technologies, many of the studies based on technological interventions focus on the deficit skills already mentioned, such as facial and emotional recognition, social attention biases, imitation, turning, cooperation and vocalization, but also academic skills (Carlier et al., 2020; Gay et al., 2016; Hillier et al., 2020; Lee, 2021; Mubin & Poh, 2019; Vallefuoco et al., 2017; Wendt et al., 2020). Beyond these, there is also evident concern from the scientific community to create responses for ASD comorbidities, namely anxiety, stress and sedentary lifestyles - ABA principles are also applied in this type of intervention (Cadieux & Keenan, 2020; Lee et al., 2020).

In addition, the rapid development of technologies has increased the hope of making treatment more effective, consistent and cost-efficient, especially in social skills training (Gay et al., 2016; Liu et al.,

2017). Apart from the reduced cost, the main benefit of using technology to facilitate treatment is that the stimuli produced in each treatment session can be controlled, which not only ensures consistency across different sessions but also allows focusing on a single phenomenon, which is difficult even for a trained practitioner to execute and provide stimuli according to the treatment plan (Arzone et al., 2020; Liu et al., 2017; Valencia et al., 2019).

In general, technologies aim to improve the lives of children with ASD and their parents, providing a path to independence through strategies on how to deal with the condition (e.g. behavioral intervention), it also helps them to overcome challenges (e.g. health management support) and improve their health. their well-being and daily life functions (Kim et al., 2020). Moreover, technologies can be used in several ways, as a motivating teaching tool or strategy to increase independence or even for Alternative and Augmentative Communication (AAC), which focuses primarily on issues of communication and social interactions in clinical and educational practice, as it allows to establish functional communication to meet basic wants and needs and participate in activities of daily living (Koumpouros & Kafazis, 2019; Liu et al., 2017; Mukherjee, 2017; Stephanidis, 2020; Valencia et al., 2019). Regarding this alternative form of communication, AAC approaches range from low-tech paper-based communication boards to the most current and widely used high-tech strategies, including voice generating devices (SGDS) and tablets like the iPad with corresponding tablet apps (Stephanidis, 2020). The use of applications promotes increased communication and also ideally increases the natural speech production of minimally verbal children (Stephanidis, 2020).

Technology can also be helpful to support behavior management, creating regular schedules and routines to follow each day (Koumpouros & Kafazis, 2019). Besides these, it is possible to resourt to technologies to train daily activities, such as taking the bus, doing the first aids as well and working capacities and skills (Bernardes et al., 2015). For instance, Parsons et al. (2006) used café and bus environments to train the social skills of two adolescents with ASD, whose task was to find an appropriate place to sit within the environment. Along with this, Mitchell et al. (2007), similarly, used a café environment to teach social skills to six adolescents with ASD which, after two non-immersive virtual reality (VR) exposure sessions, were able to generalize the learned skills and apply them to another context (bus environment).

In these games, which focus relies on the social interactions, it is often used in two ways possible, passively observing the conversation between characters or, in a more participatory approach, actively chatting with characters (Barajas et al., 2017).

In fact, either in a traditional approach or in a technological one, the main focus of the intervention in children with Autism is the removal of barriers that can prevent the achievement of essential aspirations for this, such as a good quality of life, the achievement of independence and decision making (National Collaborating Centre for Mental Health, 2013; Weitlauf et al., 2014).

With this being said, the learning of emotional, cognitive and social skills by people with ASD mediated by digital technologies should involve much more than the computer and the Internet, as strategies that express personalization, intentionality and humanization should be used (Barroso & De Souza, 2018).

Hereupon, the use of games and gamification to educate children with ASD, particularly mild to moderate autism, has been able to have effects on the development and promotion of their abilities (Navan & Khaleghi, 2020). Actually, there are apps compatible with many mobile devices whose purpose is to facilitate the learning process for the children and the teachers, helping to gain vocabulary and aid in literacy (Gobbo et al., 2018; Vallefuoco et al., 2017). This is important since people with autism have deficits in language and communication, which influence their academic development, as speaking and listening are key components of literacy (Stephanidis, 2020).

In these cases, the adaptation of the apps includes levels with different goals for individuals with autism, such as distinguishing shapes, assisting in reading comprehension and increasing vocabulary, teaching alphabet letters and simple syllables, image association and written word (Gobbo et al., 2018). These apps also include some of the gamification elements mentioned above, such as medals, trophies and points, as well as give importance to use colors, images, interface and language (Gobbo et al., 2018).

Thus, combined with digital technology, gamification has several benefits when applied to autism intervention (Mairena et al., 2019). However, and since the spectrum and manifestations are so varied, clinicians need to assess what type of serious game or game elements are beneficial for each person, according to their needs (Collazos & Moreira, 2019). According to Wojciechowski and Al-Musawi (2017) and Lee (2021), the adherence to technology and gamification by individuals with ASD is associated with their structure and predictability, which are essential elements for this population and are assumed as beneficial for individuals with ASD (Collazos & Moreira, 2019). Many of the activities presented through traditional intervention methodologies are boring or repetitive, which compromises their execution. Thus gamification appears as a solution to this constraint, as it brings the principle that regular activity can be transformed into an exciting game, making it more dynamic (Oliva et al., 2019). Moreover, the devices used in the approach play an important role in the effectiveness of the app, since it is known that touchscreen presents more advantages in terms of interaction compared to keyboard and mouse (Zakari et al., 2014).

What has been developing and currently has been a trend is the gamification of traditional treatments. In addition, the simulation of social situations using virtual environments or robots has also been developed (Malinverni et al., 2017). Thus, playful strategies continue to be used in already frequently performed activities (Collazos & Moreira, 2019).

In general, gamification is associated with a number of benefits in emotional, cognitive and social skills (Gay et al., 2016; Sardi et al., 2017). The feeling of belonging and integration, as well as the development of positive social relationships stand out as the main benefits of this technique (Sardi et al., 2017). In fact, individuals tend to show good results through the gamification process because they are interested and inclined towards activities with a gamified purpose. In the case of children, since they show much interest in digital games, it is possible to increase motivation and produce behavioral changes (Gay et al., 2016; Lee et al., 2020). However, it is relevant that in this type of techniques (associated with gamification), certain elements are present, such as the therapeutic element, which helps children with ASD to adhere to the intervention process (Mubin & Poh, 2019). The game should have specific therapeutic goals, such as motivation, to achieve a change in behavior - motivation to be interested in the game and motivation to use gamification in therapeutic procedures (Mubin & Poh, 2019). In fact, as the interactivity increases in the game, the more motivation is observed (Barajas et al., 2017). This motivation may be enhanced with 3D and virtual reality environments, which stimulate interactivity and motivation in individuals with ASD, providing a sense of co-presence, social interaction and realism, minimizing the problems associated with learning transfer (Bozgeyikli et al., 2017; Laforcade & Vakhrina, 2016; Mesa-Gresa et al., 2018; Mubin & Poh, 2019; Parsons & Cobb, 2011). The great difficulty in turning the game into something fun and necessary since children never reject a game with fun (Mubin & Poh, 2019). Suppose the person likes the proposed activity, the more likely it is to be performed. In that case, if they do not like the activity, it is necessary to change it and mold it to their needs and expectations - for example, by turning simple activities designed for learning into games, educators get greater cooperation from children as they put more effort and attention into performing them (Mubin & Poh, 2019; Oliva et al., 2019). Furthermore, the fact that some of the gamification tactics involve competition, i.e., induce

the desire to achieve at a high level in the leadership framework provided by the game, promotes skills such as self-satisfaction, self-esteem, and pride (Sardi et al., 2017). In addition to evidence on social and emotional skills, gamification also promotes cognitive development. Moreover, there is good evidence that gamification helps cognitive development as it allows players to increase or develop strategic skills, promotes improved working memory, visual attention, and processing speed (Sardi et al., 2017).

Regarding the development of games, programs and/or applications, it is highly relevant and brings numerous advantages to the involvement of individuals with ASD in their construction, only in this way is it possible to take into account the user's perspective and thus facilitate their adaptation to what are the main characteristics of the medical condition, as already mentioned (Cadieux & Keenan, 2020; Politis et al., 2017). Moreover, the involvement of each individual provides the optimal level of stimulation and training, and also the opportunity to build applications/programs that are easy to understand and that allow progress in individual intervention, noting that it is important to try to adapt the intervention program to the individual therapeutic needs and goals, just as in traditional interventions (Lee et al., 2020; Navan & Khaleghi, 2020). Thus, it is intended to overcome two of the challenges posed to the use of gamification with individuals with ASD, namely play voluntarily and not obligatorily, and allow the individual to disconnect from their own world and focus only on the game (Gobbo et al., 2018).

As noted above, the beneficial role of digital tools in promoting the development of autonomy-related skills in individuals with ASD is well known (Gay et al., 2016). However, in the case of the ASD population, there is a lack of knowledge about intervention using technologies and/or non-pharmacological interventions in the adult age group, which can be explained by the fact that it is a relatively new topic in the literature (Howlin & Moss, 2012; Murphy et al., 2016; Tromans et al., 2018). Thus, it is more common to observe the use of pharmacological interventions in this age group, which include antipsychotics, antidepressants, and stimulants (Garland et al., 2013; Howlin & Moss, 2012).

CONCLUSION

Overall, there is little relevant research in this field as there are small sample sizes, the heterogeneous characteristics among individuals with ASD, lack of control groups needed to assess whether the intervention is due to practical effects or natural development and, most importantly, the failure to include tasks designed to measure the generalization of behaviours to real life contexts (Collazos & Moreira, 2019; Navan & Khaleghi, 2020; Weitlauf et al., 2017).

Nevertheless, the use of games among individuals with ASD seems promising, even if there is not enough scientific evidence to prove significant results of using gamification in ASD intervention (Cheng, 2020). However, there are already several studies in the area of gamification and serious games that show positive results in managing ASD symptoms and associated comorbidities (Collazos & Moreira, 2019; Floryan et al., 2020; Lokhorst, 2014). More research on the effectiveness of the interventions and the design of serious games is needed to understand if this type of intervention could be an integral part of an intervention program for ASD (Collazos & Moreira, 2019; Lokhorst, 2014).

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