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Gamification in Rehabilitation: The Role of Subjective Experience in a Multisensory Learning Context – A Narrative Review

Introduction

Gamification is defined as the use of game design principles to modify people's thinking and behavior. This could be a promising approach in the field of rehabilitation. While many educators understand that fun and engagement can enhance learning, not all of them are aware of the underlying mechanisms and how to intentionally apply them to create meaningful learning experiences. In the realm of education, the Neuroscience-Based Learning Technique (Dorantes-González, 2022) incorporates neurophysiological processes related to emotional arousal and cognitive learning to facilitate lasting learning outcomes. The present review aims to explore whether a similar approach can be effective in rehabilitation, by activating brain functions such as perception, memory, motivation, the reward pathway, and the sympathetic and parasympathetic nervous systems to promote implicit and explicit learning and achieve optimal functional recovery.

In recent years, we have observed a rise in gamification strategies in e-health and wellness (see for examples Sardi et al., 2017), which involve utilizing smartphone applications to provide a narrative sense of goal completion. These tactics illustrate how storytelling and challenge can enhance individuals' engagement levels and modify their behavioral habits.

Gamification is now also being used to teach specialized skills, such as those needed by surgeons, as well as on a social level in order to influence people's behavior. Also, in the realm of environmental concerns, game designers have created eco-friendly games or incorporated green features into non-game settings to encourage pro-environmental behavior (Willoughby & Smith, 2016). The introduction of gamification in behavioral change dates back to 2016, when Mazur-Stommen and Farley (see Mazur-Stommen and Farley, 2016) identified the gamification as the process through which positive motivation can be added to everyday actions. So, gamification, similar to nudging, uses design techniques to influence people. However, nudging differs from gamification in that it focuses on modifying behavior by manipulating the environment (Wang et al., 2022),

without the characteristic game elements such as points, rankings, badges, and rewards.

All these examples demonstrate that gamification in the educational realm is closely linked to external rewards; however, the goal of rehabilitation is to activate the patient's internal resources and encourage them to take ownership of their own process of re-learning in a pathological condition.

Parallel to all learning processes, the recovery process following a musculoskeletal/motor system injury can also be seen as a process of re-learning under new conditions. While healing and medical-surgical interventions play a fundamental role in recovery, individuals who experience movement impairments due to a pathology may require adaptation to a new way of moving post-injury. After an initial phase of recovery focused on regaining movement, which can occur rapidly, patients often experience a plateau as they need to transform movement into functional actions that could be adapted to various environmental contexts and situations.

Various complex factors come into play during this transformation, beyond just muscle strength and articulation. The individual who desires to return to their pre-injury activities may experience different and unfamiliar sensations and emotions (Claydon et al., 2017), which may impede the conclusion of the therapeutic process. This may include fear of movement or reinjury, as well as the challenge of controlling the affected area while processing information from both the internal and external environment (dual task). Furthermore, the individual's motivation, defined as their need to perform a specific task in a particular way, and emotions must also be taken into account when executing the movement (Siegert and Taylor, 2004).

All these factors often result in the conclusion of an "incomplete" treatment cycle or the continuation of physiotherapy sessions beyond the patient's sole rehabilitative goals.

Rehabilitation is attempting to evolve towards the resolution of these problems. One area of research is the problem-based approach known as Cognitive Therapeutic Exercise (De Patre et al., 2017) – (also knowns as Cognitive Sensory Motor Training (Chanubol et al., 2012) or Perfetti method (Albiol-Pérez et al., 2014). These exercises require the subject to correctly plan movement to solve the sensory-motor recognition exercise presented. According to this study group, however, the limitation of rehabilitation is the difficulty in promoting emotional involvement. To address this, Cognitive Multisensory Rehabilitation (Van de Winckel et al., 2020) includes exercises that encourage comparison between pre-injury actions and current abilities.

Other rehabilitation approaches in the final stages of recovery solely rely on motivational and training theories. This involves placing the patient in various contexts and implementing exercises of increasing complexity, potentially incorporating more advanced technologies such as feedback. However, these approaches are analytical, focusing on relearning motor gestures without considering the emotional aspect of the relearned movement.

To date, gamification can be seen as a rehabilitative approach that incorporates cognitive and implicit learning. Similar to other learning scenarios, gamification can promote patient engagement by presenting escalating levels of exercises with increasing complexity, with the aim of adapting relearned movements to varying contexts. (Steiner et al., 2020).

The role of neuroplasticity in physiotherapy is considered in the treatment of patients with conditions affecting the nervous system (see for examples Joshua, 2022). However, there are also changes in the central nervous system in patients with conditions affecting the musculoskeletal system (Snodgrass et al., 2014). Studies on neuroplasticity demonstrate that both physical and psychological traumas have a direct impact on long-term memory (Alberini et al. 2010), bypassing short-term memory and establishing strong connections with the amygdala and other structures involved in conscious and unconscious experiences. The amygdala plays a significant role in memory formation, depending on the intensity and emotionality of the information being processed. These circuits, already utilized in other areas of research, must not be underestimated when it comes to recovery following injury. Neuroplasticity is the focus of rehabilitation when attempting to overcome patients' compensatory strategies developed during the recovery process.

Several studies (see Sailer et al., 2013; Richter et al., 2015) report the positive effects of the reward mechanism activated by gamification. It leads to the production of more dopamine by the basal ganglia, which is essential for learning new skills. Other neurotransmitters (Nabar et al., 2018) may also reinforce motivation and its effect on mood, linked to the desire to improve gaming performance and the endorphin released during physical activity. Additionally, the deep connections of the amygdala and hippocampus play a crucial role in structuring positive memories. Therefore, a patient who discovers that they are capable of making new movements within the context of play may achieve greater functional outcomes.

Studies mentioned in the literature primarily focus on the utilization of gamification in physiotherapy for neurological and pediatric patients, based on dopamine mechanisms for long-term potentiation. Nevertheless, evidence also exists for studies with patients experiencing musculoskeletal injuries, emphasizing the

possibility of implementing rehabilitation through this game-based learning technique. Several studies (for review see Tuah et al., 2021) direct their findings towards supporting the increase in patient motivation and engagement through the application of gamification. However, this outcome remains a "virtual" outcome that is either marginally or not at all investigated with real outcome measures, in comparison to others of functional or medical nature.

Given the inherent complexities of using gamification in rehabilitation, this narrative review aims to provide a snapshot of the current understanding of the potential of this tool in rehabilitation. The study will analyze subjective measures in the researches, with less emphasis on physiological data linked to movement and more focus on the phenomenological experience of the individual undergoing rehabilitation.

Methods

Search strategy

A literature review was carried out on gamification and rehabilitation through a search of the primary electronic databases (Scopus, Pubmed, Google Scholar). The search was conducted using the following MeSH terms: "gamification," "exergaming," "rehabilitation," and "physiotherapy." Only articles that had been published or were in press were included, and review and conference proceedings were excluded.

Study selection

Articles were excluded from the original search for the following reasons: on the basis of title and duplicates, publication languages, and specific clinical fields (such as psychiatric conditions, cardio-respiratory rehabilitation, amputees, etc.).

The considered articles had to be in English and report data on other aspects (such as motivation, engagement, self-efficacy, emotions) in addition to joint, functional, and pain recovery. Experimental studies were included only if they obtained self-report data on the patients' experience or demonstrated better resource management and impact on healthcare costs.

Additionally, several works from other research fields were considered to aid in understanding the topic of the review.

The authors also included studies they found to be significant. After this selection process, a total of 17 studies were included and considered for this narrative review.

Results

Key Topic 1: Methods

The first part of the results discusses the methodological aspects of the analyzed studies, such as the study design, the ways in which gamification was implemented, and the choices made by researchers with regards to the therapeutic setting.

Type of studies

The studies included in our analysis focused on the selection and use of gamification in rehabilitation, spanning from 2016 to 2022. Seven studies focused on patients with neurological pathologies, while six explored gamification for rehabilitation following elective orthopedic surgery or fractures. Two studies targeted the elderly population, one focused on diabetic foot patients, and two trials were conducted with healthy populations.

Four articles conducted feasibility tests with both healthy individuals and rehabilitation professionals before presenting the software to patients. In one article, the real possibilities of patients to perceive all necessary information to interact with the software both visually and auditorily were considered. Many studies focused on the challenge of producing the most suitable movements to be detected by the software, particularly when a controller (e.g. Kinect) was not required.

Gamification device

The ways in which the game context was created varied significantly among the studios and were categorized into three areas for the purpose of classification. Seven studies utilized a device that was specifically designed for the research, while five studies employed programs connected to Kinect-motion sensors. In six studies, the activities were available on a common smartphone or tablet device.

Out of the six studies that utilized an application that could be used with any smartphone or tablet equipped with a camera, four were conducted on outpatients, who were able to access the platform to practice at home at any time in the absence of a physiotherapist. The use of the application in Metha et al.(2020), which was configured as an RCT with 242 participants, began at hospital discharge, and participants were monitored through SMS.

In two instances (Fotopoulos et al., 2022; LaPiana et al., 2020), the platform was employed in the presence of the physiotherapist during the rehabilitation session or learned under supervision and then continued independently at home.

The presence of the physiotherapist

In the study of Fotopoulos et al. (2022), five stroke patients were instructed by the physiotherapist and followed a customized exercise program independently

after leaving the hospital, while in study of Epalte et al. (2020), stroke patients performed the exercises at home without the supervision of the physiotherapist. In all other cases, patients with neurological conditions performed the exercises under the guidance of the physiotherapist. The other studies, which did not require the presence of the physiotherapist, focused on patients with orthopedic issues or healthy individuals.

Whether a physiotherapist was present during rehabilitation was also determined by the types of technology used. Studies that required the use of specifically designed devices almost always required the presence of a physiotherapist, as this took up part of the allotted rehabilitation time. Studies in which participants could use their smartphones to perform exercises independently did not require the presence of the physiotherapist. In all cases, the possibility of interaction between users and researchers was maintained, and assistance and remote control were provided through activity logging software.

In the majority of the analyzed studies (10 studies), the rehabilitation program was carried out under the supervision of a physiotherapist, allowing for possible assistance in managing the device and executing the necessary gestures to interact with the software. In three studies, the testing situation still required the presence of the therapist, even though it was not a rehabilitation program, and in two cases, the participants had no medical condition.

Treatment frequency

The studies vary in terms of the timing and methods proposed for treatment, with no established standard for timing and frequency. This is determined based on the individual possibilities of the sample being observed, or on the possibilities of using the device, whether at home or in the clinic. Some studies included patients who used the device independently several times a day, while others used it only a few times during the study (i.e. Aartolahti et al., 2022).

Among studies with inpatients, treatment occurred up to 5 times a week, either in combination with or as a replacement for normal physiotherapy sessions during hospitalization. Among studies with outpatients, a further distinction must be made between protocols that involved performing the session in the clinic with a physiotherapist and those that provided software or a device to allow participants to self-determine the frequency of treatments. In the former case, sessions were approximately 2-3 times per week, while in the latter case, patients could choose the frequency and duration of the exercises.

Treatment duration

Due to the variability in the nature of the studies selected, it is not possible to establish a standard timeframe for evaluating the effectiveness of treatments.

In pilot studies, sessions ranged from 1 to 6 weeks, while in randomized controlled trials with remote monitoring by researchers, treatment lasted up to 4 weeks.

Beginning of phisiotherapy with gamification

Regarding the moment when it is preferable to incorporate gamification in the rehabilitation process some studies coincide the beginning with hospitalization and therefore with physiotherapy during hospitalization, while others start treatment from the moment of discharge or, in case of chronic patients, when the study requires it.

In two studies (Aartolahti et al., 2022; Fotopoulos et al., 2022), gamification was initiated during hospitalization and was subsequently customized and implemented by the physiotherapist. The patient then continued using gamification independently at home.

Key Topic 2 – Subjective Experience

The second key topic, which is the main focus of this review, was to understand which section of the literature focused on the experiences of patients who were offered rehabilitation through the assistance of new technology. In this respect, the research objective and how this information was evaluated, were taken into account.

The game experience

All of the studies selected for this narrative review included an investigation into the gaming experience of the patients.

The term "motivation," which is very prominent in the gamification literature, is rarely used in the studies considered. Rather than directly evaluating motivation, most of these studies evaluated other motivation-related psychological constructs such as such as feelings, satisfaction, experience, enjoyment, and self-efficacy. The researchers wanted to capture the participants' emotions during the game, during different phases of the game, and how these emotions could persist over time (van dei Kooij et al., 2019) to represent a real stimulus to continue physiotherapy at home. In one case (Erdogan et al., 2018), a more refined analysis was added to investigate the modes of interaction with the device or application that could increase the engagement score.

In 11 studies (see Bell, Ringgenberg, Aartolahti, Fotopoulos, Hashim, Montoya, LaPiana, Epalte, Segura, van dei Kooij, Elor), the researchers recorded the participants' emotions, while in 5 studies (Aartolahti, Hashim, Montoya, Metha, Ferreira), they focused on satisfaction. The value of engagement was considered in 5 studies (Bell, Fotopoulos, LaPiana, Then, Erdogan), and only 3 studies

(Bell, Montoya, Erdogan) investigated the perception of challenging. Furthermore, several studies investigated acceptance (Bell, Ringgenberg, Aartolahti, LaPiana, Gonzalez-Gonzalez, Colomer, Chung & Ching), self-efficacy (Bell, Metha, LaPiana, Erdogan, Colomer), and usability (Bell, Ringgenberg, Montoya, LaPiana, Epalte, Colomer, Chung & Ching).

In some studies, subjective data collected through questionnaires or interviews were correlated with other measures. In the study by Montoya et al. (2021), the researchers added the perception of fatigue and the electromyographic activity of the upper limbs measured via surface electrodes (sEMG) during interaction with the videogame, observing a decrease in fatigue symptoms after the completion of the rehabilitation program. Similarly, in the study by Erdogan et al. (2018), despite being conducted without patients, qualitative data collection was supplemented with an analysis of psychophysiological signals such as blood volume pulse, SC, and ST-biofeedback sensors to detect subjective emotions. This allowed for the derivation of multiple features related to the training.

Ringgenberg et al. (2022) also included the perspective of secondary-end users (health professionals) and tertiary-end users (health insurance experts or similar) in evaluating the game experience of the participants. From the observations of health professionals, different themes emerged, such as meaningfulness, distraction from functional limitations, safety through protective devices or personalized adaptations, availability, and accessibility of the exergames. Bell et al. (2022) also emphasized that training may include adaptive equipment to facilitate independence. The perspective of tertiary-end users, in addition to the economic aspects that will be discussed later, highlighted the difficulties for the elderly to interact with devices and the need for professionally trained physiotherapists to support these patients.

Outcome assessment tool

Given the difficulty of objectifying the participants' lived experiences, the studies proposed qualitative investigation methods based on specific criteria. In many cases, researchers used existing questionnaires, while in other cases, they created questionnaires specifically for the research. The need to assign a value almost always led to the choice of using the Likert scale, with scores ranging from 1-5 to 1-10.

Validated Questionnaires

The most commonly used questionnaire (Montoya, Colomer, Chung) was the System Usability Scale (SUS), which was used to evaluate whether users consider the system to serve its intended purpose or not (Brooke, 1996). Usability, by definition, refers to the patient's ability to achieve the goal (effectiveness),

the resources they expend to achieve the goal (efficiency), and the users' overall satisfactory experiences. In these studies, scores were investigated using a Likert scale of 1-10.

Montoya et al. (2021) and Erdogan et al. (2018) used the Game Experience Questionnaire (GEQ) to measure the level of engagement during gaming sessions and its correlation with the type of input method (gesture or voice) or the game score obtained. The questionnaire is a tool constructed to rate the overall emotional valence in the game. One part measures the player's feelings during the experience, including immersion, flow, competence, positive and negative affect, tension, and challenge. The second part concerns the emotions experienced after the game and the return to reality (Ijsselsteijn, 2008).

Chung et al. (2015) used the self-efficacy scale to measure an individual's confidence in their ability to perform a specific task or achieve a particular goal. The scale typically consists of multiple items that measure an individual's confidence level, sense of mastery, and level of motivation to achieve their goals.

The Intrinsic Motivation Inventory (IMI), used by van dei Kooij et al. (2019) and Elor et al. (2018), is a psychological tool used to measure an individual's level of intrinsic motivation, which refers to the internal drive to pursue an activity or goal for personal enjoyment or fulfillment. The inventory typically consists of a standardized set of questions or statements that assess various aspects of intrinsic motivation, such as interest, enjoyment, challenge, and effort.

Erdogan et al. (2018) also used the Self-Assessment Manikin (1-9 Likert scale), a pictorial measurement tool used to assess an individual's subjective experience of emotional arousal, valence, and dominance. It consists of a series of three cartoon-like figures (manikins) representing different levels of emotional activation, ranging from low to high arousal. Each figure is also represented on a valence scale, indicating the individual's positive or negative emotional experience, and a dominance scale, indicating their sense of control or influence over the situation.

Fotopoulos et al. (2022) administered the User Experience Questionnaire (1-7) to evaluate the overall user experience by measuring six key dimensions: attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. It typically consists of 26 statements that users rate on a scale from 1 (strongly disagree) to 7 (strongly agree).

Van dei Kooij et al. (2019) developed a Quick Motivation Index for the study to measure an individual's level of motivation at work. It aims to identify what drives participants and what factors can help increase their motivation and engagement.

Hashim et al. (2021) also used the Pain and Fatigue Questionnaire (PFQ) to measure the severity of pain and fatigue symptoms experienced by individuals. It consists of 24 items that ask about the frequency, intensity, and duration of

pain and fatigue, as well as the impact of these symptoms on daily activities, mood, and quality of life.

Ad-hoc Questionnaires

Metha et al. (2020), LaPiana et al. (2020), and Ferreira et al. (2019) proposed a 16-item questionnaire to the patients, specifically created for the study.

In particular, in the study by Ferreira et al. (2019), where diabetic patients were asked to perform self-treatment exercises for the foot, authors created a questionnaire to investigate not only the patients' general opinions regarding the proposed activity but also to determine if the users had truly understood the performance required by the exercises in the application.

Interviews

The most frequently chosen tool for collecting subjective data was the semi-structured interview (Bell, Ringgenberg, Aartolahti, Hashim, Epalte, van dei Kooij, Elor). Some interviews were conducted in person with the participants (Bell, Ringgenberg, Aartolahti, van dei Kooij, Colomer), while others were collected via telephone (Epalte et al., 2020). To facilitate brainstorming and obtain more personal opinions, the interviews followed theoretical models such as personal construct theory (Aartolahti), focus groups (Ringgenberg), and the general inductive approach (Bell), with questions based on the Technology Acceptance Model (TAM) already used in healthcare. The interviews were video- or audio-taped (Bell, Ringgenberg, Aartolahti, Epalte, van dei Kooij, Elor) to allow for qualitative analysis by multiple researchers and overcome the risks of bias. In the study by Hashim et al. (2021), an analysis of the framework was performed on free text comments written by the patients. In the study by Epalte et al. (2020), the interviews were analyzed using deductive thematic analysis: through the analysis of the user responses, the researchers interpreted the answers and categorized them based on domains such as design, usability, flexibility, and emotions.

Qualitative methods

Elor et al. (2018), in addition to the qualitative analysis of the data obtained from the interviews, observed the participants' behaviors during the gaming session. The observations were carried out by two researchers who independently analyzed the participants' behaviors from the video footage.

Preferences, worries and expectations

All studies have received positive feedback from the analyzed groups regarding their overall experience, even when functional results were not significant

(Metha et al., 2020). In addition to finding gamification enjoyable and useful for rehabilitation, many participants expressed their desire for greater personalization of the programs and regular updates (Bell, Ringgenberg,30,43), tailored to the user's context and needs, the aspiration to exceed the goals achieved with traditional rehabilitation, and the wish for independent use (Bell, Ringgenberg), even with family members. Ringgenberg's study (2022) also reported patients' desire for the development of a realistic narrative structure in the game, focusing on activities of daily living to increase possible autonomy in managing everyday life.

Moreover, patients in the study conducted by Elor et al. (2018) though they found the game fun and entertaining, requested "happier music" to improve their experience.

The term "challenging" is often associated with negative feelings (Bell, Montoya) as patients may perceive it as a potential risk. However, it can also serve as an intrinsic source of reward, leading to motivation through the enjoyment of the task itself (van dei Kooij et al., 2019).

In Metha's et al. (2020) partecipants stated that the program made them feel more connected to the care team and more comfortable going home after hospital discharge.

Older adults participating in study 2 worried about feeling physically and technically overhelmed, due to their lack of technological experience. Additionally, concerns about game addiction emerged from interviews with these patients, who cited their limited experience with technology.

Cost-effectiveness

From a cost-effectiveness standpoint, Colomer's study (2016) shows a positive impact on even chronic patients, who consequently require less frequent health-care services.

In study (Riggenberg et al., 2022), TEUs, as stakeholders in health insurance and similar, have requested stronger evidence to support the inclusion of reimbursements for exergame devices in rehabilitation expenses.

Discussion

The aim of this narrative review was to emphasize how aspects related to the individual's experience are crucial in rehabilitative interventions and also in the choice to use gamification. However, the current theoretical context in rehabilitation tends to only emphasize functional outcomes, without realizing the advantage that gamification can have in other aspects, such as adherence, compliance, and mobilization of internal resources.

This view is already outdated in other gaming application fields. The development of new video games constantly seeks to increase player engagement and make video games more attractive even to "non-gamers" in a highly competitive market. Thus, while player engagement is crucial in game programming since the software design phase, in rehabilitation, there is a constant perception of the patient's need to "adapt" to the video game and therefore accept playing in an under-challenging mode just to experience an alternative to traditional exercise. In fact, few have reported possible modifications to the proposed software based on the perceptual deficits that patients may have, always demonstrating a need to adapt the rehabilitation intervention to the level of technology offered rather than vice versa.

Frequently, easily accessible and implementable software has been used to support the cost-effectiveness of the intervention and the possibility of dissemination without requiring specific devices.

One possibility to enhance individual engagement can be represented by the customization options of the avatar in the game (a feature commonly used in commercial video games): the activation of perceptual-motor systems remains even in patients with degenerative diseases such as Parkinson's disease (Mezzarobba et al., 2023). These strategies could increase the chances of engagement even in individuals with pathology.

The final consideration may be that at the moment, rehabilitation with gamification can only be considered for certain types of patients. The challenges that have emerged are related to higher costs, the difficulty of monitoring patients when they perform exergames at home to avoid compensation, and the difficulties some patients face in accessing gaming modes (e.g., due to age). There is also no discussion about the pre-injury experience and the predisposition to using devices even prior to the injury.

Several studies emphasize how gamification represents an alternative approach for rehabilitation pathways that risk becoming repetitive and dull. The literature (examples from this review include Fotopoulos et al., 2022, and Then et al., 2020) suggests that users do not feel highly engaged in this type of intervention. They may simply continue self-efficacy exercises at home, which could be more cost-effective, leaving greater access to physiotherapy for other patients. These different considerations can primarily be attributed to the differences between patient populations, who have different movement problems and are in different moments and phases of life.

The most significant data supporting gamification often come from test studies conducted on healthy individuals who do not perceive the limitations that

patients experience, including understanding or the actual possibility of action within the game.

This increasingly distances the possibility of creating positive associations that lead to effective emotional learning. The results achieved through the game remain confined to the gaming context and are not effectively transferred to real-life actions. This is demonstrated by the studies of Aartolahti et al. (2022), Metha et al. (2020), and Then et al. (2020), which compare data from patients who used gamification to controls. Despite good adherence to the proposed gamified rehabilitation program, patients do not achieve significantly superior functional results compared to controls.

The articles analyzed in this narrative review give little attention to the execution of movements, as if the role of the physiotherapist were more that of a technician who "controls" the correct functioning of the software, rather than that of a rehabilitation professional. However, the crucial role that the physiotherapist maintains within the experimental context is repeatedly emphasized and irreplaceable. In particular, the study by Hashim et al. (2021), involving adolescent patients with atraumatic shoulder instability, highlights the importance of personal contact with the physiotherapist. A new interpretation emerged from the study by Segura et al. (2016), where an increased patient compliance with the therapist was observed because they felt they had the therapist "on their side." The change in the physiotherapist's role to become an ally rather than a controller when the patient interact with a third party, such as the proposed device/software, can stimulate improved performance. This could contribute to overcoming motor deficits, even in patients who may not be able to achieve scores that provide satisfaction through achieving exergame goals (external rewards).

In contrast, in the study by Then et al. (2020), the authors conclude by supporting the use of gamification as an extensive rehabilitation approach to be continued without the presence of a physiotherapist to avoid complications and associated costs, allowing other patients to access specific rehabilitation with the physiotherapist. This enables the physiotherapist to focus more on patients who require greater attention.

Regarding the possibilities of low-cost interventions, it was not possible to identify a unified philosophy among the analyzed studies. In some cases, web channels and simple apps have been utilized, enabling patients to independently access the software from home. In other cases, systems combining visual cameras for motion information collection with motion detection systems, including the use of force plates, have been devised. This has yielded results that may be more scientifically applicable but less significant when considering the main objective of gamification and the potential for dissemination for self-efficacy intervention.

Although this is not a systematic review and does not include all the literature relevant to the field, it aims to provide reflection for professionals and exergame programmers to collaborate while maintaining their diverse expertise and specificities, finding a more productive common ground to create personalized programs for individuals with various pathologies affecting motor behavior, taking into account the patients' lived experiences.

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Abstract

Game-based approaches are emerging in many fields, such as education, social sciences, marketing and government. Most studies debate its role in consolidating learning, guided by both internal and external rewards.

These approaches are also being applied in rehabilitation, where patients must undergo a re-learning process of motor gestures after an injury to a body structure. In physiotherapy, much importance is given to analytical-functional movement aspects, but less to the recovery of the complete experience, including motivation, perception, and emotional experience of the patient during the process.

The aim of this narrative review is to investigate the role of subjective experience in the application of gamification in physiotherapy, considering the added value it provides to recovery by involving neural structures, not just motor functions. By analyzing the most investigated aspects in using gamification in rehabilitation, we will outline the primary methods of investigation into the engagement and emotions involved in the process.

Through a selection of scientific articles found on main databases, we identified articles investigating the patient's experience. The analysis of these articles was based on aspects related to the recovery of movement, the technology used, as well as the methods of investigation and collection of qualitative data regarding the emotions and perceptions of patients during the gamification experience.

The results are divided into two primary topics. Overall, this review supports the idea that gamification could represent a rehabilitation approach integrating physiotherapy, more suitable for the final stages of recovery, such as returning to work or sports.

Keywords: Gamification, rehabilitation, physiotherapy, subjective experience, multisensory .

Zusammenfassung

Spielbasierte Ansätze werden in vielen Bereichen immer wichtiger, wie zum Beispiel in der Bildung, den Sozialwissenschaften, im Marketing und in der Regierung. Die meisten Studien diskutieren ihre Rolle bei der Konsolidierung des Lernens, die sowohl durch interne als auch externe Belohnungen gesteuert wird.

Diese Ansätze werden auch in der Rehabilitation eingesetzt, bei der Patienten nach einer Verletzung einer Körperstruktur einen Wiedererlernungsprozess motorischer Bewegungen durchlaufen müssen. In der Physiotherapie wird viel Wert auf analytisch-funktionelle

Bewegungsaspekte gelegt, weniger jedoch auf die Wiederherstellung des gesamten Erlebnisses, einschließlich Motivation, Wahrnehmung und emotionaler Erfahrung des Patienten während des Prozesses.
Das Ziel dieser Übersichtsarbeit ist es, die Rolle subjektiver Erfahrungen bei der Anwendung von Gamification in der Physiotherapie zu untersuchen und den Mehrwert zu betrachten, den sie für die Genesung bietet, indem sie neuronale Strukturen einbezieht, nicht nur motorische Funktionen. Durch die Analyse der am häufigsten untersuchten Aspekte bei der Verwendung von Gamification in der Rehabilitation werden wir die wichtigsten Untersuchungsmethoden für die Einbindung und die im Prozess auftretenden Emotionen skizzieren.
Durch eine Auswahl wissenschaftlicher Artikel, die in den wichtigsten Datenbanken gefunden wurden, haben wir Artikel identifiziert, die sich mit der Erfahrung des Patienten beschäftigen. Die Analyse dieser Artikel basierte auf Aspekten, die mit der Wiederherstellung der Bewegung, der verwendeten Technologie sowie den Methoden der Untersuchung und Sammlung qualitativer Daten in Bezug auf die Emotionen und Wahrnehmungen der Patienten während der Gamification-Erfahrung zusammenhängen. Die Ergebnisse sind in zwei Hauptthemen unterteilt. Insgesamt unterstützt diese Übersichtsarbeit die Idee, dass Gamification einen Rehabilitationsansatz darstellen könnte, der die Physiotherapie integriert und besser für die letzten Phasen der Genesung geeignet ist, wie zum Beispiel die Rückkehr zur Arbeit oder zum Sport.
Schlüsselwörter: Gamification, Rehabilitation, Physiotherapie, subjektive Erfahrung, multisensorisch.

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